Design, Construction and Performance Determination of a Cowpea Thresher at Various Moisture Content

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Abstract
To eliminate unwanted materials from threshed cowpea (VignaunguiculataL.), make the threshing faster and less difficult, a 150 kg/hr capacity cowpea threshing machine was designed, developed and the performance evaluated at various moisture contents. It has spiked threshing drum which rotates at 735rpm to generate power of 3.75kW. Trials conducted showed that the beans at initial moisture content (mc) of 20.7% after a day of drying, yielded percentage recovery of 42.6% of clean grains; at 18.4% mc after two days of drying, yielded percentage recovery of 48.3%; three days of drying at 15.3% mc yielded 57.6%; five days of drying at 13.5% mc yielded 60.7% recovery andat 12.6% mc after seven days of drying, yielded percentage recovery of 61.4%. Based on the optimum machine parameters, the machine throughput was determined to be 144.29, 110.86, 136.33, 167.81 and 127.39 kg grains/hour upon five trials, giving an average of 137.34 kg/hour. The results of the study as indicated by analysis of variance **(ANOVA)** showed that there were no significant differences ($P > 0.05$)difference between the recoveries. Grain damage reduced to5% after five (5) days of drying which and therefore recommend that the cowpea should be dried for a minimum of five days before threshing for better recovery.

Keywords: Design; Development; Throughput; Evaluation; Threshing; Spiked Threshing Drum

1 INTRODUCTION

Cowpea (VignaunguiculataL.Walp) is an annual legume crop which originated from Africa and is widely grown in Africa, Latin America, South East Asia and the southern United States (Allen and Watts, 1998).Nowadays it is a legume widely adapted and grown throughout the world (Aveling, T. 1999; cited by Gomez, 2004)

Once the crop has been harvested from the farm, the seeds must be dislodged from the panicle, and the process is called threshing. Threshing involves the removal of grains from the pods. Threshing can be done either mechanically or manually (Adekanye and Olaoye. 2013).

1.1 Manual Threshing.
Manual system of threshing is characterized with time wastage, threshing losses, and high drudgery (Olaoye, 2011).
Threshing is traditionally done on hard dry ground or on rock. To reduce the incidence of stone, a tarpaulin or similar materials are spread before threshing. Threshing is done using pestle and mortar or by spreading the dried crop on the floor where it is beaten with a stick (Phillips et al., 2000; cited by Maunde, 2011).Both methods of threshing inflict a lot of breakages to the seeds. The seeds are then separated by winnowing (Fulani et al, 2013).The cereals and legumes are threshed in some places with the threshing board on the threshing floor; in others they are trampled by a train of horses, and in others they are beaten with flails.

1.2 Mechanical Threshing.
Mechanical threshing is the use of machines either steam engine, diesel engine or electric motorin driving the machine,for the threshing of the crop. Mechanical threshing involves high technology which is very expensive but helps to maintain the quality of the final product, eliminatesdrudgery associated with local threshing system and reduces threshing losses (Olaoye, 2011). Somefactors affecting theefficiency of threshing operation are identified as feeding method, cylinder speed, concave-to-cylinderclearance and moisture content (Kepner et al., 1978)

1.3 Problem Statement
From the earliest time that man had used grains as food, the problem of removing the unwanted inedible glumes, straw or husk from the actual

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seed had existed (Sutton, 1974; cited by Irtwange, 2009).

Since the end of the Second World War, considerable amount of money and a great deal of human effort have been expended in introducing mechanization to peasant farmers (Abdoun, 1976; cited by Irtwange, 2009). Improper harvesting and threshing usually results in losses of up to 5% of the crop;Allen and Watt (1998), therefore,better production techniques alone are not sufficient to solve the problem of field losses in production of cowpea, (Bruce et al. 2001; cited by Olaoye, 2011). It is important to note that manual system of threshing of cowpea provides the basis for exploitation ofwomen and children labour and the finished product contains impurities such as chaffand stones. The traditional way of threshing beans is also inefficient, uneconomical, time consuming and slow at the time agriculture is undergoing rapid technological advancement in most developing countries (Olmsted and Rhode, 1988).

The development of mechanical thresher to solve the above mentioned problems clearly has edge over conventional methods and had reduced the drudgery of work to a greater extent (Olmstead and Rhode, 1988).Hence, the need for appropriate technology that will combine both the threshing and cleaning (separation of the grain from the chaff) operations together at considerable efficiency, improve upon the quality for human consumption and at low initial operating cost.

1.4 Main objective
The main objective of this study is to design, construct and determine the performance of an Electric motor powered beans (cowpea) thresher for small and medium scale farmers in Ghana.

1.5 Objective.
The specific objectives of this project are to:
- To design a cowpea thresher.
- To determine the optimal operational parameters
- To determine the yield percentage recovery.
- To determine threshing efficiency, cleaningefficiency, grain damaged and throughput at different moisture contents.

2. METHODOLOGY
2.1 Application of basic design principles (including drawings)
2.2 Constructed through fabrication processes of machining, cutting and welding at the workshop of Mechanical Engineering.

2.3 Evaluation of thresher
2.3.1 Experimental method
The harvested cowpea was separated into five units and labelled **A, B, C, D,** and **E**. The units were dried for a number of days in the open air for **7 hours** from **8³⁰am to 3³⁰ pm** each day as follows: Unit "**A**" was dried for a day, unit "**B**" for two (2) days, unit "**C**" for three (3) days, unit "**D**" for five (5) days and unit "**E**" for seven (7) days. Three samples from each unit were taken after drying to the laboratory to determine the average moisture content as shown in **table 5.** After the moisture content has been determined, **100 kg** of the unit was then taken and threshed to determine the yield percentage recovery. Analysis of variance was performed on the data to determine if there were any significant deference between the treatments and the responses.

3   RESULTS AND DISCUSSION
3.1 Design criteria
The design must meet the following design criteria:
  i.   Cost material must be less than **Gh¢1,500**
  ii.   Expected capacity must be **150kg/hr**
  iii. Require power **3.73 kW**
  iv.   Prevent injury to operator
  v.   Source of power is Electric motor

3.2 Conceptual Design
Consist of E-motor, belt drive transmission, winnower with axial blower, spikes threshing drum with ball bearings, chute and hopper.

3.3 Design Drawings
Drawings were produced by the aid of SolidWorks software
Pictorial and exploded drawings of the thresher are shown in Figures 1 and 2.
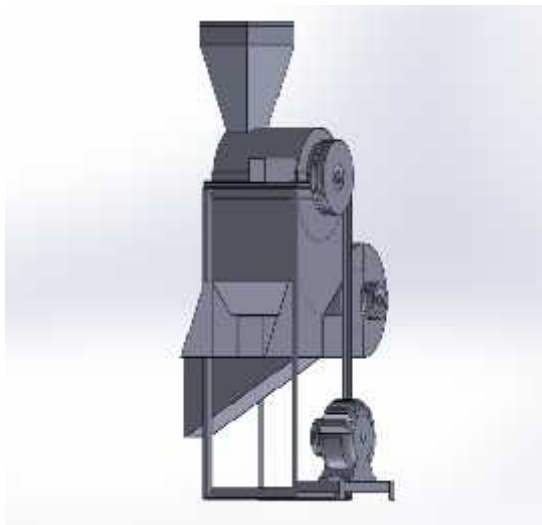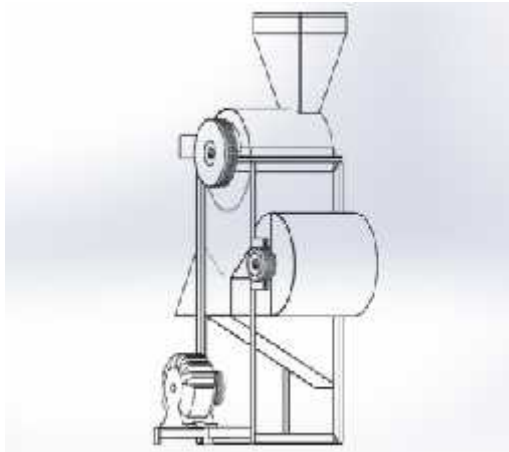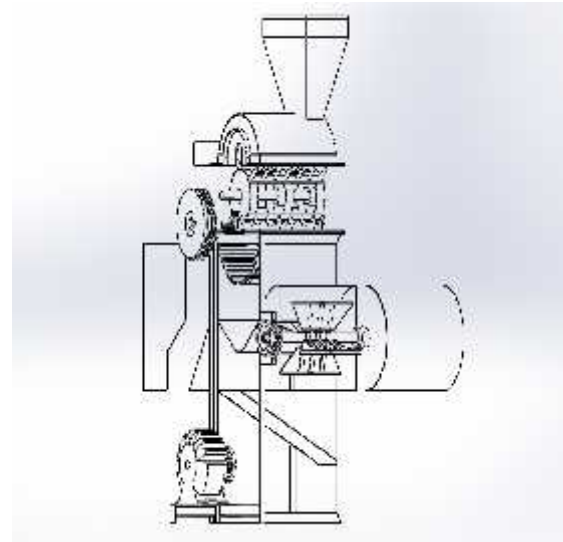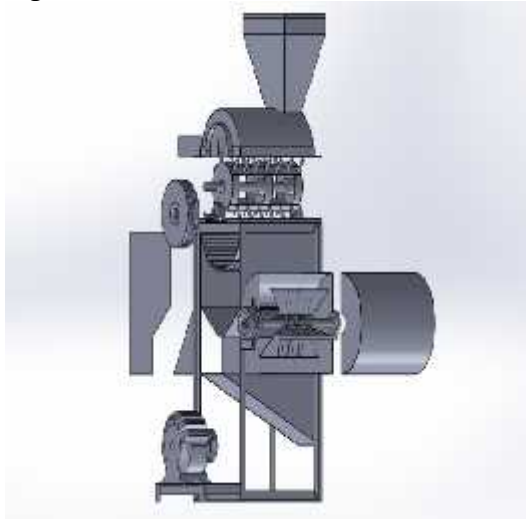
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Fig. 2:Exploded view of the thresher

Fig. 1: Pictorial view of the thresher

3.4   Design Calculations
3.4.1 Prime Mover (Electric Motor).
The purpose of an electric motor is to develop the necessary power required for the task. The most common type of motor used for industrial purpose is; the squirrel cage induction motors, where a continuous supply of power is required. The motor used for this design is three-phase squirrel E-motor of 5 Horse Power (HP), speed of 1470rpm and a voltage of 380 V.

3.4.2Material Selection.
Material must be capable of supporting their own weight and any other applied load without distortion which would reduce the efficiency of the structure being built. According to Alan Everest (5th edition), "when a material is said to be 'strong', it is its strength in tension which is usually referring to.According to Khurmi and Gupta(8th edition)selection of a material for a machine part or structural member is one of the most important decisions the designer has to make to consider the materials and their properties associated with the design, e.g., strength, stiffness, and cost.
Some factors to be considered are;
i.   Availability of the materials.
ii.   Suitability of the materials for working conditions in service.
iii.   The cost of the materials.
The most important property which determines the utility of the material is physical, chemical and mechanical properties.

3.4.3 Shaft of threshing drum

Determining the minimum shaft diameter required to transmit the required torque (power):

$$T = \frac{P}{\text{S}} = \frac{60.P}{2.f.n} = \frac{30.x10^3.P}{f.n}$$

Where $T[Nm]$ is torque

$\qquad$ $P\ [kW]$ is power

$\qquad$ $n\ [rev/min]$ is rotational speed

For P = 5 HP = 5 / 1.341 kW=3.73 kW

$$T = \frac{30.x10^3.P}{f.n} = \frac{30x(3.73)x10^3\,Nm}{f(1470)}$$

$$T = 24.243\,Nm$$

Shaft transmits basically torque:

For mild steel shaft material;
Torsional strength is:

$$\ddagger_{dt} = 170\,N/mm^2$$

$$\ddagger = \frac{T}{\left(f d^3/16\right)} \leq \ddagger_{dt} \quad \Rightarrow \quad d \geq \sqrt[3]{\frac{16T}{f\ddagger_{dt}}}$$

$$d \geq \sqrt[3]{\frac{16T}{f\ddagger_{dt}}} = \sqrt[3]{\frac{16(24.243Nmm)}{f\left(170\,N/mm^2\right)}}$$

$$d \geq \sqrt[3]{726.654} = 8.99 = 9mm$$

3.4.4 BEARING

Fig. 3: Pillow Block Ball Bearing

A **bearing** is a machine element that constrains relative motion between moving parts to only the desired motion. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis.

3.4.5 Bearing selection

The main criteria used for selecting bearings are axial stiffness, load carrying capacity, running accuracy, speed and frictional moment as well as the ability to cope with misalignment between shafts.

A pillow block bearing is used for this design. The pillow block bearing is P2B – pillow block, 2 bolt base. The selection guide is shown in the table below:

Table 1: Selection for stainless housed mounted Ball Bearings – Metric

Series	Shaft Size (mm)	Part No.	Description
205	25	136850	P2B-SCEZ-25M-SHSS

Table 2: Load carrying capacity and lifespan

Dynamic Capacity (kg)	Static Capacity (lbs)	Life Hours	Radial Load (kg)
1212.91	802.40	60,000	99.79

3.4.6 PULLEY.

Fig. 4: V -Belt Pulley.

The type of pulley used for this design is v-belt pulley.

Speed ratio

$N_1D_1 = N_2D_2$, or $\frac{N_1}{N_2} = \frac{D_2}{D_1}$ i.e.

$$\frac{Speed\,of\,driver}{speed\,of\,driven} = \frac{Diameter\,of\,driven}{Diameter\,of\,driver}$$

$$\frac{1470}{N_2} = \frac{203.2}{101.6}$$

$$N_2 = 735\,rpm$$

Driver pulley specification
DIN 2211-SPB-2T 102
Driven pulley specification
DIN 2211-SPB-1T 204

3.4.7 Belt Selection

V belt B-type is used for this design with specifications shown in table three (3).

3.4.8 The effective pull on belt:

T = T_1 – T_2,
Where: T_1 = tension on tight side; T_2 = tension on slack side;

Torque, Ts, on shaft = F x r, and F = Ts/r.
But T = F and T = Ts/r. Also, Ts= T_M, and
T = T_M / r
But P_M= ωT_M, and T_M= P_M/ω. Therefore, T = P_M/ (ωr), and T_M= $(T_1 - T_2)r_1$,
Where: T = effective pull on belt;
F= Force on driver pulley;
T_S= torque on shaft;
T_M= Torque on the motor;
r_1= radius of driver pulley;
T_1 - Tension on the tight side of belt;
T_2 = Tension on the slack side of belt;
MT = Torsion moment.

3.4.9 Centre Distance of Belt
The maximum centre distance of belt in use depends on the size of the two pulleys and is given as:

$$X_{max} = 2(D + d)$$

Where: X_{max} = maximum center distance.
D = diameter of bigger pulley
d = diameter of smaller pulley

$$X = 2(203.2 + 101.6)$$
$$X = 609.6 mm = 610 mm$$

3.4.10 Length of Belt
Belt length can be calculated if the diameters of both the bigger pulley and the smaller pulley and the belt centre distances are known:
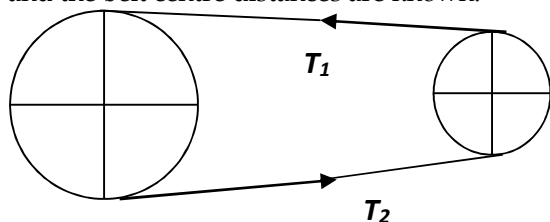

Fig. 7: Schematic diagram of belt drive.

$$L = 2x + \frac{f}{2}(D + d) + \frac{1}{4x}(D - d)^2$$

Where: L = belt length
D = diameter of driven pulley;
d = diameter of driver pulley; X= distance between pulleys.

$$L = \{2(610) + \frac{f}{2}(610) + \frac{1}{4(610)}(101.6)^2 \} mm$$

L = 1,220 + 958.31 + 4.23 = **2,183mm**

Table 3: Belt specifications

Section	SPB
Belt top width,b_o(mm)	16.3
Belt height, h (mm)	13
Belt weight,W_b(kg/m)	0.195

Max. belt speed, V_{max} (m/s)	42
Max. flexing rate,f_{Bmax} (s^{-1})	100

3.4.11 Material Cost Analysis
Table 4: shows the cost of the respective materials and parts

Unit Code	Qty	Material	Unitcost Gh ¢	Total Gh ¢
PCS	3	30mm x 30mm Angle iron	30.00	90.00
PCS	2	2mm, mild steel plate	130.00	260.00
PCS	1	25mm x 5mm, Flat bar	20.00	20.00
PCS	2	12.5mm, Iron rod	15.00	30.00
FT	3	25mm, Shaft	30.00	90.00
PCS	4	205 Pillow block bearing	60.00	240.00
PCS	3	V- Pulley	30.00	90.00
PCS	3	V- Belt	10.00	30.00
PCS	30	M10 x 40mm, Bolt & nut	1.00	30.00
PCS	1	Motor	400.00	400.00
BOX	1	Electrodes	25.00	25.00
GAL	1	Anti – rust paint	35.00	35.00
GAL	1	Oil Paint	30.00	30.00
		SUB - TOTAL		**1370.00**
Contingency cost		**5% of sub-total**		**68.5**
Grand total				**1,438.50**

Modelling in solid works 2012
The software used for the Finite element analysis calculations is Solid Works,which comprises of pre-processing, solution and post-processing, and Solid Analysis Guide. For the analysis of the threshing machine, the angle bar element (30 x 30 x 3 of the stand is used. The stand of the machine has a length of 600mm, height of 820mm and width of 350mm. The angle element has six degrees of freedom at two nodes: (i.e. three translations in the x, y. and z directions and three rotations about the x, y. and z-axes. SolidWorks 2012 generates the meshed diagram from the modelled angle bar and the degrees of freedom and conditions of loading are imposed on the meshed diagram. Various diagrams are generated by SolidWorks 2012and analysed

meshed figures of the stand are shown in Figure 3.

The equivalent stress obtained by Von Mises equation is 221×10^6 N/m^2.

Fig. 3: Load acting on the stand

The graphical output of the deflection in the structure is also seen and it can be simulated to see the motion of the deflection in the structure.

3.6Table 5: Experimental design results

Units	Number of drying days	Average MC %	Percentage Recovery (%)
A	1	20.7	42.6
B	2	18.4	48.3
C	3	15.3	57.5
D	5	13.5	60.7
E	7	12.6	61.4

One variety, popularly called white beans **(Vignaunguiculata)**was used to test the machine. Trials conducted showed that the beans at initial moisture content (MC) of 20.7% after a day of drying yielded percentage recovery of 42.6% of clean grains; two (2) days of drying at 18.4% mc yielded percentage recovery of 48.3%; three (3) days of drying at 15.3% mc yielded percentage recovery of 57.5% of clean grains; five (5) days of drying at 13.5% mc yielded percentage recovery of 60.7% of clean grains and after seven (7) days of drying, yielded percentage recovery of 61.4%. Based on the optimum machine parameters, the machine throughput was determined to be 144.29,110.86, 136.33, 167.81 and 127.39 kg grains/hour upon five trials, giving an average of 137.34 kg/hour.

3.7 Machine Description
This cowpea threshing machine comprised of ten main parts namely Main frame (stand), Hopper, Cover, Threshing drum, Threshing chamber, and Chaff discharge chute.Cowpea exit spot, Blower, Motor seat and Key

3.8Operation
3.8.1 Starting and Running the Thresher
1) Ensure that all bolt and nuts on the thresher are tightened down.
2) Rotate the threshing drum by hand to make sure that there are no restrictions to rotation.
3) Ensure that the beltsare well tensioned, and the belt guidesare in position.
4) Switch on the motor from the mains.
5) Before threshing, you need to partially dry the crop in the field for a couple of days to lower the moisture content which will make threshing easier.
6) As the crops are loaded in the hopper they Slidethrough a small opening between the hopper and the cover and come into contact with the threshing drum. Never reach your hand into the threshing area or attempt to throw crop into the threshing area.
7) The threshing drum rotates in a counter Clockwisedirection at approximately 735rpm. The crop is then threshed against the threshingbars of the threshing drum.
Notice: Threshing wetor moist crop is not recommended.
7) Collect threshed grain in container at the end of the exit spot.(Plant, 2010)

4.0 CONCLUSIONS AND RECOMMENDATION

4.1. Conclusion
Performance evaluation of the Electric powered cowpea thresher was conducted. Based on the optimum machine parameters, the machine throughput was determined to be 144.29, 110.86, 136.33, 167.81 and 127.39 kg grains/hour upon five trials, giving an average of 137.34 kg/hour. Hence, the thresher wasfound to meet the design objectives. Based on the throughput capacity of the thresher, the total cost was One thousand four hundred and thirty-eight Ghana cedis, fifty pesewasonly **(Gh¢ 1,438.50).**

Bases on the recovery at the various moisture contents, there were difference but the analysis of variance (ANOVA) showed that there were no significant differences ($P > 0.05$) between the treatments and their yields.

4.2. Recommendation

The cowpea threshing machine is mainly recommended for the threshing of cowpea.
The cowpea should be dried for a minimum of five (5) days before threshing for high and effective performance.
The threshing of soya beans should be tried using the machine to maximize its field use.

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APPENDICES

Appendix 1: Moist. Content determination

Units	A(1 day drying)		
Sample	**1**	**2**	**3**
Wt. of container, W_1 **(g)**	46.2	44.7	41.3
Wt. of cont. + wet beans, W_2 **(g)**	111.2	101.1	108.6
Wt. of cont. + dry beans, W_3 **(g)**	99.6	91.4	97.6
Wt. of wet beans, $W_{wb} = (W_2 – W_1)$ **g**	65.0	56.4	67.3
Wt. of dry beans, $W_{db} = (W_3 – W_1)$ **g**	53.4	46.7	56.3
Moisture removed, $M_w = (W_{wb} – W_{db})$ **g**	11.6	9.7	11.0
Moist. Cont. MC % $= (Mw/W_{db}) \times 100$	21.7	20.8	19.5
Average MC%	**20.7**		

Units	B(2 days drying)		
Sample	**1**	**2**	**3**
Wt. of container, W_1 **(g)**	46.2	44.7	41.3
Wt. of cont. + wet beans, W_2 **(g)**	101.1	110.2	117.8
Wt. of cont. + dry beans, W_3 **(g)**	92.5	99.8	106.2
Wt. of wet beans, $W_{wb} = (W_2 – W_1)$ **g**	54.9	65.5	76.5
Wt. of dry beans, $W_{db} = (W_3 – W_1)$ **g**	46.3	55.1	64.9
Moisture removed, $M_w = (W_{wb} – W_{db})$ **g**	8.6	10.4	11.6
Moist. Cont. MC % $= (Mw/W_{db}) \times 100$	18.6	18.9	17.9
Average MC%	18.4		

Units	C(3 days drying)		
Sample	**1**	**2**	**3**
Wt. of container, W_1 **(g)**	46.2	44.7	41.3
Wt. of cont. + wet beans, W_2 **(g)**	98.8	114.1	107.3
Wt. of cont. + dry beans, W_3 **(g)**	91.6	105.9	97.6
Wt. of wet beans, $W_{wb} = (W_2 – W_1)$ **g**	52.6	69.4	66.0
Wt. of dry beans, $W_{db} = (W_3 – W_1)$ **g**	45.4	61.2	56.3
Moisture removed, $M_w = (W_{wb} – W_{db})$ **g**	7.2	8.2	9.7
Moist. Cont. MC % $= (Mw/W_{db}) \times 100$	15.9	13.4	17.2
Average MC%	**15.5**		

Units	D(5 days drying)		
Sample	**1**	**2**	**3**
Wt. of container, W_1 **(g)**	46.2	44.7	41.3
Wt. of cont. + wet beans, W_2 **(g)**	105.2	112.8	106.9
Wt. of cont. + dry beans, W_3 **(g)**	97.9	105.1	99.1
Wt. of wet beans, $W_{wb} = (W_2 – W_1)$ **g**	59.0	68.1	65.6
Wt. of dry beans, $W_{db} = (W_3 – W_1)$ **g**	51.7	60.4	57.8
Moisture removed, $M_w = (W_{wb} – W_{db})$ **g**	7.3	7.7	7.8
Moist. Cont. MC % $= (Mw/W_{db}) \times 100$	14.1	12.6	13.5
Average MC%	**13.5**		

Units	E(7 days drying)		
Sample	**1**	**2**	**3**
Wt. of container, W_1 **(g)**	43.6	48.7	41.2
Wt. of cont. + wet beans, W_2 **(g)**	101.2	103.8	110.3
Wt. of cont. + dry beans, W_3 **(g)**	94.7	97.7	102.5
Wt. of wet beans, $W_{wb} = (W_2 – W_1)$ **g**	57.6	55.1	69.1
Wt. of dry beans, $W_{db} = (W_3 – W_1)$ **g**	51.1	49.0	61.3
Moisture removed, $M_w = (W_{wb} – W_{db})$ **g**	6.5	6.1	7.8
Moist. Cont. MC % $= (Mw/W_{db}) \times 100$	12.7	12.5	12.7
Average MC%	**12.6**		

Appendix 2: Analysis of variance for units A, B and C

Summary	Count	Sum	Average	variance
Row 1	2	63.3	31.65	239.805
Row 2	2	66.7	33.35	447.005
Row 3	2	72.8	36.4	890.42
Column 1	3	54.4	18.133	7.3433
Column 2	3	148.4	49.467	56.523

ANOVA

Source of variation	Rows	Columns	Error	Total
SS	23.17	1472.67	104.56	**1600.4**

Df	2	1	2	**5**
MS	11.585	1472.67	52.28	
F	0.222	28.17		
P-value	0.8186	0.03372		
Fcrt.	19	18.51		

ANOVA

Source of variation	Rows	Columns	Error	Total
SS	0.01	2304	0.64	**2304.65**
Df	1	1	1	**3**
MS	0.01	2304	0.64	
F	0.0156	3600		
P-value	0.9208	0.0106		
Fcrt.	161.45	161.45		

Summary	Count	Sum	Average	Variance
Row 1	2	74.2	37.1	1111.92
Row 2	2	74	37	1190.72
Column 1	2	26.1	13.05	0.405
Column 2	2	122.1	61.05	0.245

Challenges of Environmental Sanitation and Plastic Waste Management in the Dormaa Municipality of Ghana

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Abstract
The study assessed the general problems associated with environmental sanitation and plastic waste management challenges in the Dormaa Muncipality in the Brong-Ahafo Region of Ghana. Qualitative and quantitative approaches to data collection were used to obtain information relevant for the study. The qualitative methods included the use of interviews and observation, and the quantitative part involved the use of questionnaires. The study established that inadequate of litter bins, lack of public education on environmental sanitation, lack of sanitary by-laws on littering and poor public attitude are the major factors contributing to the plastic waste management problems in the Dormaa Municipality. To alleviate the problems associated with plastic waste management in the study area, the study recommends that enough litter bins should be provided, an effective public education on sanitation should be undertaken and frequent organization of clean- up exercises should be encouraged, as well by-laws against littering of plastic waste in the municipality should be enacted and strictly enforced.

Keywords: Plastic Waste; Environment; Sanitation, DormaaMunicipality

1. INTRODUCTION

Management of waste is probably the most significant environmental issue facing rural and urban areas in Ghana. Indiscriminate disposal of plastic waste, particularly sachet water bags and polythene bags, results in the littering of streets, markets, lorry stations, households and drains, among other places. This makes the surrounding the of such places offensive to the eye, thereby posing danger to health and tourism development.

Participants in a National Stakeholders Workshop on plastic waste management in Accra, organized in December, 2003, under the auspices of the Ministry of Environment and Science in collaboration with the Environmental Protection Agency (EPA), the Ministry of Tourism, the Association of Ghana Industries (AGI) and the National Association of Sachet Water Producers cautioned that burning plastic waste materials emit certain toxic gasses which can cause damage to the brain, spinal cord as well as the reproductive system of those who inhale the fumes (Boah-Mensah & Chantel, 2003). Also, the participants noted that post mortem results conducted on livestock, especially cattle, had indicated that plastic materials had killed several of these animals by obstructing their intestines. Again, small ruminants and fish were known to have been choked or suffocated by flying plastics and eventually died in the process. These happen when fishes and other animals, during their feeding processes, ingest pieces of plastic or even get their heads covered by these plastics.

Plastic waste is believed to clog the drainage system which increases flooding problems during the rainy season, and also creates a breeding ground for mosquitoes. Plastic waste, such as toothbrushes, and containers for talcum powder, body/hair cream, detergents, cooking oil, machine oil, as well as broken toys, and plastic chairs, buckets, and utensils end up in the refuse dump and find their way into the soil. They stay there forever because they cannot decompose and, therefore, reduce the soil's fertility and/or impede plant growth (Ghana Science Association, 2004).

An alarming feature of the plastic waste menace in the study area, Dormaa Municipality, is the indiscriminate manner in which polythene bags and sachets water bags are disposed by individuals. Also, the content of household litter bins is deposited on heaped waste dumps leaving plastic film to the mercy of the wind.

Generally, the act of ensuring that the environment is free from the adverse effects of waste materials is termed waste management. Lardinois (1996) referred to Waste

Management as encompassing the full range of activities of the waste streams, from the generation of used materials to their disposal. Similarly, Gilpin (1996) has defined waste management as "purposeful, systematic control of the generation, storage, collection, transportation, separation, processing, recycling, recovery and disposal of solid waste in a sanitary, aesthetically acceptable and economical manner" Again, a definition adopted by the European Council (1991) saw waste management to mean the collection, transport, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites. While Schubeller, Wehrle and Christen (1996) focused on municipal solid waste management, which they defined as "the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste in urban areas." One can infer from these definitions that waste management is the act of protecting the environment from the negative impacts of waste materials in order to maintain the natural environment and protect public health. Hence, Cooper (1999) suggests that the priority of a waste management system must always involve the provision of a cleansing service, which helps to maintain the health and safety of citizens and their environment. Gilpin (1996) sees the work of waste management as a professional practice involving preparing policies, determining the environmental standards, fixing emission rates, enforcing regulations, monitoring air, water and soil quality and offering advice to government, industry and land developers, planners and the public.

Waste management, therefore, involves a wide range of stakeholders who perform various functions to aid maintain a clean, safe and pleasant physical environment in human settlements in order to protect the health and well-being of the population. However, the existing waste management practices that emphasize collection, transportation, and final disposal by the Plastic Waste Management Department of the Municipal Assembly and private waste collectors in the Dormaa Municipality have been ineffective (Asomani-Boateng, 2007). As a result, high rise refuse dumps, littered streets, choked gutters, stagnant waters, and indiscriminate defecation in public and open spaces have become common features in our cities (Issah, 2006).

Environmental sanitation is an essential factor contributing to the health, productivity and welfare of the people of Ghana. It is identified in Ghana's programme of economic and social development set out in "Vision 2020" as a key element underlying health and human development. The programme also identifies environmental protection and the improved management of human settlements as key factors in rural and urban development (Ministry of Local Government and Rural Development, 2001).

According to the Ghana Statistical Service (2002), many urban areas in Ghana, including the Dormaa Municipality, have not been able to manage the quantity of waste generated as their population keep on increasing. For instance, the urban areas of Accra, the national capital, produce about 760,000 tons of Municipal Solid Waste (MSW) per year or approximately 2000 metric tons per day. This figure is expected to increase to 4000 metric tons per day by 2025 (Ghana Environmental Protection Agency, 2002).

Mensah (2005) noted that throughout Ghana the disposal of solid waste has always been an intractable problem.Flooding has become a more common and devastating phenomenon in Accra due to the accumulation of garbage and silt in local drains and water bodies. The recent rains in Accra exposed the havoc being caused by plastic waste. According to Fobil, Armah, Hogarh, and Carboo (2008), just an average of one or two hours of rain in Accra on March 15, 2005 led to flooding in certain parts of the city. The same intensity and duration of rain a decade ago would not have resulted in flooding. Such floods cost the city lives and property. Choked drains and gutters also lead to stagnant waters that act as a breeding ground for malaria-carrying mosquitoes (EPA, 2002 in Anomanyo, 2004).

The present crisis in waste management bears significant negative impacts on public health, the environment, and the economy. Of the top ten diseases present in Ghana, six are related to poor environmental sanitation. These are malaria, diarrhea, diseases of the skin/ulcers, intestinal worms, acute eye infections, and typhoid fever. Together, they constitute about 70-85% of out-patient cases at health facilities (MLGRD 2010). The most prevalent

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communicable disease in Accra is Malaria, which registered nearly 300,000 cases in 2005 alone (Accra Metropolitan Assembly, 2009).

Several studies have identified factors that contribute to waste management problems in developing countries (Onibokun & Kumuyi, 1999; Ogawa, 2002; Lohse, 2003; and Kironde, 1999). Some of the factors are lack of waste management personnel, weak enforcement of the law, inadequate finance, lack of appropriate technology and equipment, weak political support.

Available today in many shapes and forms, plastics have become part of our everyday life. According to the Bureau of International Recycling (2011), we now use about 20 times more plastic than we did 50 years ago, and certain post-consumer products contain as many as 20 different types of plastic materials. Generally, the study examined the challenges of environmental sanitation and plastic waste management in the Dormaa Municipality of Ghana. Specifically, the study sought to answer the following research questions: what are the common plastic wastes in the Dormaa Muncipality? What are the major factors contributing to indiscriminate plastic waste disposal in the Dormaa Muncipality? What are the adverse environmental impacts associated with plastic waste management? What is the effectiveness of waste management by-laws in the Dormaa Muncipality? What are the initiatives undertaken by stakeholders to arrest the challenges associated with plastic waste management in the Dormaa Muncipality?

2.   METHODOLOGY
2.1 Study Area
The study was conducted within the Dormaa Municipality which has a population of 22,913 (Ghana Statistical Service, 2000). The Dormaa Municipality is located at the western part of the Brong-Ahafo Region. It is bordered to the north by the Jaman District and Berekum Municipality; to the south and south-east by Asunafo and Asutifi Districts; to the east by the Sunyani Municipality; to the west and north-west by La Cote d'voire and to the south-west by the Bia District in the Western Region. The Municipality has a total land area of 917 square kilometers, which is about 3.4 percent of the total land area of Brong Ahafo Region and about 0.52 percent of that of the country. It has 296 settlements, one traditional authority and

one constituency, namely Dormaa West (Ghana Statistical Service, 2000).

2.2 Research Approach and Design
The study used both qualitative and quantitative methods as described by Preece (1998). The qualitative methods included the use of interviews and observation, and the quantitative part involved the use of questionnaires.

2.3 Population and Sample Size Determination for Households
The Dormaa Municipal Assembly statistics show that the total number of households in Dormaa is 11,863. The 11,863 households, therefore, represented the sample frame for the study. Using the formula provided by deVaus (2002) with a confidence level of 90% and margin of error of 10%, the sample size n was determined.

$$n = N \div [1 + N (\alpha)^2]; \tag{1}$$

Where N which is the sample frame = 11,863 and α which is the margin of error = 10%. The sample size was estimated to be 100 households. The choice of the margin of error of 10% was influenced by resource constraints in terms of money and time.

2.4 Sample and Sampling Procedure
One hundred (100) respondents were sampled for the household survey. As a result, 100 questionnaires were distributed equally among five (5) communities (Yeboah Afari, Atoase, Dormaa Central, Ankokodee and Pamuu) in the study area. In addition, one (1) key informant interview each was conducted with the heads of the Municipal Environmental Health and Sanitation Department, EPA and Zoomlion Ghana Limited.

The study employed non-probability method of sampling. The specific non-probability sampling method applied in this study included the purposive and convenience sampling methods. Purposive sampling technique was used to select Yeboah Afari, Atoase, Dormaa Central, Ankokodee and Pamuu communities for the study. These communities were chosen because of the fact that they were the areas hard hit with the problems of plastic waste. The purposive sampling procedure was also applied in selecting relevant institutions and interviewing key officials who could provide relevant information required for the study. The key

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institutions identified and visited included the Environmental Health and Sanitation Department of the Dormaa Municipal Assembly and Zoomlion Ghana Limited. The officials selected and interviewed were the head of departments responsible for solid waste management in the institutions.

The convenience sampling procedure under the non probability sampling method was applied in selecting 100 households for the study. The criteria for selection of households were based on readiness and willingness of households to be interviewed. The researchers visited and administered twenty (20) household questionnaires within each of the five selected communities. Household heads who were readily available and willing to answer the questionnaire took part in the study. This procedure was followed until the required number of households targeted for the study was achieved.

The choices for the above non probability sampling methods were influenced by the kind of data required and the subject matter of the study. Additionally, the use of theconvenience sampling procedure for the selection of the households for the study wasinfluenced by the homogenous nature of plastic waste management and the local conditions in the Dormaa Municipality.

The study used both secondary and primary sources of data.

2.5 Secondary Sources

Substantial relevant data from secondary sources on plastic waste management and environmental sanitation had been collected and reviewed thoroughly to understand what had already been done in this field by other authors. The researchers obtained secondary data from textbooks, articles, journals, magazines, newspapers, internet, atlas and other relevant publications on waste management and environmental sanitation.

2.6 Primary Source

The researchers collected primary data through questionnaires, direct observations and key informant interviews. The household questionnaire used was semi-structured, and contained both open-ended and closed-ended questions. The closed-ended questions required the respondents to make choices from alternative responses while the open-ended

questions provided space for the respondents to give their own responses to questions.

Direct observations were used to gather information on plastic waste management activities and infrastructure for managing plastic waste in the study area. Observations included waste scenes like street litter, choked drains, waste containers and waste disposal sites. Photographs of plastic waste scenes were taken as they occurred in the natural setting. The direct observations were used to compare the actual waste situations in the study area with the information gathered through key informant interviews and household questionnaire survey.

Key informant interviews were undertaken from the Environmental Health and Sanitation Department of the Dormaa Municipal Assembly, EPA, and Zoomlion Ghana Ltd to generate information regarding plastic waste management. This involved a face-to-face guided question and answer interaction between the researchers and key officers of the institutions involved in waste management in the study area.

2.7 Pre-Testing/ Pilot Study of Data Collection Methods

To ascertain the validity and reliability of the findings of the study, the data collection tools were pilot studied, using ten (10) people. The items that were found not to be understood or misunderstood were modified to make them suitable for the study. The 10 involved in the pilot study were excluded in the real study.

2.8 Data Handling

After cleaning up the data from the household questionnaire survey and correcting the few mistakes that were detected in the filling of the questionnaires, the data were coded and fed into Statistical Package for Social Sciences (SPSS) software for windows. Analysis was undertaken to generate a descriptive picture of the data gathered on plastic waste management and sanitation. Simple percentages were used to present the quantitative data obtained from the household questionnaire.The qualitative data from direct observation and key informant interviews conducted with key persons in waste management organisation were analysed manually by making summaries of their views and supporting these with relevant quotations that captured these views.

2.9 Ethical Consideration

In administering the questionnaire, the researchers ensured that, as much as possible, each respondent's privacy was protected. Respondents were assured that the information they were providing would only be used for academic purposes, and that their views would be treated with all the confidentiality required. Questions asked did not go beyond what was needed for the study.

3. RESULTS AND DISCUSSION

The study analyzed the demographic characteristics of respondents. This is reported in Table 1.

Out of the 100 respondents, 78% were males and 22% females. Majority of respondents were males because they happened to be the heads of the households interviewed.

Age is known to be an important variable that correlates with many other variables, particularly knowledge, attitudes and practice. Of the 100 respondents, majority of them (42%) were within the 25−34 age group while only 1% were in the 65+ year group, as shown in Table 1.

In respect with the marital status of respondents, most of them (62%) were married, whilst 5% were divorced. This is depicted in Table 1.

Table 1:Demographic Characteristics of Respondents

	Frequency	Percent
Gender of Respondents		
Males	78	78
Females	22	22
Total	100	100
Age of Respondents		
15-24	5	5
25-34	22	22
35-44	42	42
45-54	19	19
55-64	11	11
65+	1	1
Total	100	100
Marital status of Respondents		
Single	25	25
Married	62	62
Divorced	5	5
Widowed	8	8
Total	100	100
Occupation		
Agriculture	63	63
Service	24	24
Commerce	3	3
Industry	10	10
Total	100	100
Educational level of Respondents		
Primary	13	13
JHS/Middle School	25	25
SHS	28	28
Post-Secondary	15	15
Tertiary	19	19
Total	100	100
Religion		
Christians	75	75
Moslems	22	22
Traditionalists	3	3
Total	**100**	**100**

Source: Fieldwork, March 2012

All the respondents had acquired some level of education. Majority of them (28%) had up to Senior High School (SHS).   Fifteen percent (15%) and 19% had up to Post-Secondary level and tertiary level respectively, as shown in Table 1. The literacy rate of respondents who had attained basic education, that is, Junior High School/ Middle School education and above, was 93% as compared to the national average of 49% (Boateng, 1997). The study area had valuable human resource and this potential could make it easier for the people to be better educated on the menace of plastic waste and the problems associated with its indiscriminate disposal.

With reference to religious background, most of the respondents (75%) were Christians, followed by Moslems (22%) and Traditionalists (3%). Since 97% of respondents belonged to organized religious institutions, this platform could be very useful in the mass education on plastic waste management.

The predominant occupation in the study area was agriculture and employs about 63% of the respondents, the service sector also employed 24% and commerce and industry, between 3-10%.

3.1 Plastic Waste Management and Environmental Sanitation

Common Plastic Waste Identified

Various plastic materials or products were used in the study area. The common plastic

waste materials observed in the study area were sachet water bags and polythene bags. Others included plastic bottles, plates, and cups.

Daily Average of Plastic Film Disposed By Households
On the average, each household was found to generate and dispose off 5.35% polythene bags and 14.15% sachet water bags every day. This total of 19.5% plastic waste from each household per day was high and explains the level of littering within the study community. This is depicted in Table 2

Table 2: Daily Average of Plastic Film Disposed

	Number Disposed Daily		
Plastic Waste	Absolute	Respondents	Average
Polythene bags	535	100	5.35
Iced water rubber	1415	100	14.15
Total	**1950**	**100**	**19.5**

Source: Field Survey (March, 2012)

Number of Times Polythene Bag is Used Before Disposal
In Ghana, polythene bags are used in serving and wrapping of food. They are also used as shopping and travelling bags. However, 91% of the respondents indicated that these plastic bags were not reused. That is, they were used only once. Nine percent (9%) of respondents, however, said that these bags were used, at least, twice before being disposed off in order to save money. Thirty-three percent (33%) of the respondents gave the reason that it was less expensive, 60% said it was less durable and 7% said it was both less expensive and less durable. The habit of using polythene bags only once or twice has the tendency to increase the plastic waste menace in the study area.

Disposal Sites for Plastic Waste
All the respondents (100%) had a litter bin in which they kept their household waste, including plastic waste prior to disposal. As shown in Table 3.

Table 3: Plastic Waste Disposal Site

Disposal Site	Frequency	Percent (%)
waste dump	84	84.0
Surrounding near compound	16	16.0
Total	**100**	**100.0**

Source: Field Survey (March, 2012)

84% disposed their household waste on the waste dumps, whilst 16% of them disposed waste near their homes. The reason given was that the waste dumps were far from their homes. Disposing of waste near one's home is a bad practice and should be discouraged.

Views about Work of Sanitary Labourers/Riders
According to the Environmental Health Department of the Dormaa Municipal Assembly, there were 31 sanitary labourers employed by the Assembly and 92 labourers/ riders employed by the Zoomlion Ghana Ltd who were charged with the sweeping of streets, markets and other public places of the study area. Most of the waste they swept were plastic in nature.

Forty-six percent (46%) of the respondents were of the view that sanitary labourers were on a regular basis seen sweeping their communities, although the work done was sometimes below the expectation of the community. Three percent (3%) of the respondents were of the view that sanitary labourers/riders did their work properly but not regularly, 26% indicated the riders did their work regularly and properly and 25% said the rider/labourers did not do their work regularly and properly. This is portrayed in Table 4.

Table 4: Views about Sweepers' Work

Responses	Frequency	Percent
Regularly but not Properly	46	46.0
Properly but not Regularly	3	3.0
Regularly and Properly	26	26.0
Not Regularly and not Properly	25	25.0
Total	**100**	**100.0**

Source: Field Survey (March, 2012)

In a related question, respondents were asked how sweepers disposed plastic waste after they swept and gathered them. Ninety-one percent (91%) of the respondents said they carted them to the nearest waste dump whilst 9% of them said they burnt them, as indicated in Table 5 below.

Table 5: Mode of Disposal of Plastic film by Sweepers

| Response	Frequency	Percent
Cart to Refuse Dump	91	91.0
Burn	9	9.0
Total	**100**	**100.0**

Source: Field Survey (March, 2012)

Maintenance of Waste Dump

Twenty-six percent (26%) of the respondents said the labourers or riders maintained the surroundings of waste dumps in the municipality while 74% said the surrounding of waste dumps were not maintained.

Description of waste Dumps

Out of the hundred (100) respondents, 2% said it was very satisfactory, 24% said it was satisfactory, 55% said it was poor and 19% said
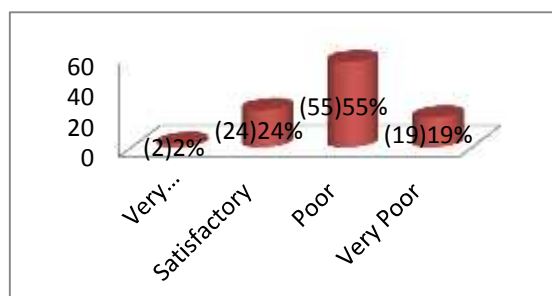
it was very poor. Figure 1 below illustrates this.

Figure 1: Description of waste dumps
Source: Field Survey (March, 2012)

Major Plastic Waste Disposal Method

In the study area, 100% of the respondents agreed to the fact that burning was the major method of getting rid of plastic waste by sanitary labourers and those who undertook clean-up exercises or communal labour. This was also confirmed by the Municipal Environmental Health Directorate, as this was the only feasible method of getting rid of plastic waste since there was no recycling plant in the municipality. Burning of plastic waste is harmful to humans as it releases toxic and corrosive gases into the environment. According to Montgomery (1992), Nyambok and Davies (1993), plastics when burned can release chlorine gas and hydrochloric acid fumes both of which are toxic and corrosive.

Plates at Appendix illustrate the burning of plastic waste.

Factors Contributing to Littering or Indiscriminate Plastic Waste Disposal

From the study, factors that contributed to the indiscriminate waste disposal in the community included lack of litter bins at strategic positions (32.5% of respondents), lack of public education on plastic waste and sanitation (35.3%), poor public attitude/indiscipline (18.7%), lack of by-laws on littering or indiscriminate plastic waste disposal (5.2%), and punitive measures (8.3%). Table 6 illustrates this.

Table 6: Factors Contributing to Indiscriminate Plastic Waste Disposal.

Factors	Response	
	Frequency	Percent (%)
Lack of litter bins	82	32.5
Lack of Public Education	89	35.3
Poor public attitude	47	18.7
Lack of bye-laws	13	5.2
Lack of punitive measures	21	8.3
Total	**252**	**100.0**

Source: Field Survey (March, 2012)

The Dormaa Municipal Assembly (DMA) has the primary responsibility of managing plastic waste and other solid waste generated in the municipality. The Assembly undertakes a range of services in waste management, including collection, transportation and disposal. However, as a result of logistics and financial constraints, Zoomlion Ghana Limited (a private company) has been contracted by the central government to manage the waste in the municipality. The payment for services carried out by Zoomlion is done by the central government. The Municipal Assembly is expected to supervise Zoomlion Ghana Limited at the municipal level. However, Zoomlion Ghana Limited in the Municipality reports directly to its regional office at Sunyani and, when the situation demands, copies of their reports are made available to the Municipal Assembly. The study revealed that there were inadequate litter bins placed at vantage points in the Municipality for public use. However, Zoomlion Ghana Ltd was willing to make available litter bins to households and corporate agencies upon

application and willingness to pay a monthly fee for collection. According to the management of Zoomlion Ghana Limited, the litter bins were not sufficient so the strategy was to distribute them to households and corporate agencies, so that they would be responsible for their safekeeping.

Indiscipline within the community is a contributing factor to indiscriminate plastic waste disposal. Making his contribution on indiscipline, Aklorbortu (2011) stated that Ghanaians have failed themselves through negative attitudes towards their immediate and larger environment. He further emphasized that, until Ghanaians changed their attitudes, preventable diseases such as cholera would continue to claim lives, as well as keep the productive workforce on hospital beds.

Adverse Impacts of Plastic Waste

Table 7: Adverse Impacts

Impact	Responses	
	Frequency	Percent (%)
Make the environment dirty and unsightly	96	38.1
Chokes drains and gutters	38	15.1
Air pollution and outbreak of diseases	47	18.7
Soil infertility	41	16.3
Suffocates and kills animals	17	6.6
Causes accident when it rains on it	13	5.2
Total	**252**	**100**

Source: field Survey (March, 2012)

As indicated in most of the respondents (38.1%) in the community agreed to the fact that plastic waste made the environment dirty and unsightly. Chartey and Boah-Mensah (2003) indicated that plastic waste poses danger to tourism development, because it destroys tourist attraction sites by making them unsightly. It further creates waste management problems due to its non-degradable nature. Secondly, the Integrated Regional Information Networks (2004) observed that plastic waste had had a terrible impact on tourism, particularly on the beaches, east of Accra.

Furthermore, 15.1% of respondents indicated that plastic waste led to the blocking of drains

and gutters, resulting in drainage problems. According to Tambil (2000), a look around Accra and any urban town in Ghana reveals plastic materials being strewn or flowing about.

Also, 18.7% of the respondents asserted that plastic waste led to air pollution and outbreak of diseases, such as malaria and cholera. According to the respondents, plastic bags and containers collect water after rainfall, and this served as breeding places for mosquitoes. Moreover, 16.3% of the respondents said that plastic waste led to soil infertility because they are non-biodegradable.

In addition to the above adverse impacts, 6.6% of the respondents attested to the fact that plastic waste could suffocate and kill animals, especially cattle and pigs, when they eat food mixed with plastic waste.

Responsibility in Solving the Problem of Plastic Waste Management
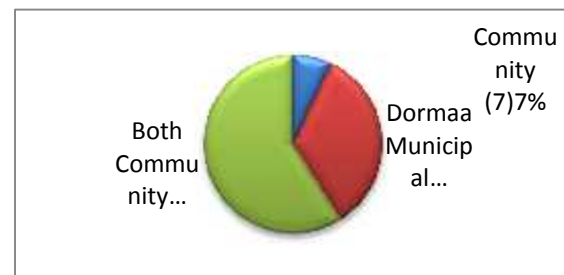

Figure 2: Responsibility in Solving the Plastic Waste Menace

Source: Field Survey (March, 2012)

As represented in Figure 2, fifty-nine percent (59%) of the respondents opined that the challenge of managing plastic waste in the communities was the responsibility of both the community and the Municipal Assembly, 7% indicated this to be the responsibility of the community and 34% said it was the responsibility of the Dormaa Municipal Assembly. According to the Ghana Science Association (2006), it is the responsibility of every Ghanaian to efforts aimed at properly managing plastic waste in the country. It continued that it was erroneous and unhelpful to blame the plastic waste menace on any group of people.

Ninety-two percent 92% of the respondents confirmed that stakeholders such as churches, keep fit clubs, youth groups, traditional councils, local radio stations had been working

towards the plastic waste scare, including clean-up exercises. However, the respondents were quick to add that organizations or institutions usually organize most of the clean-up exercises to climax their annual celebrations. Therefore, these clean-up exercises are not regularly organized.

Personal Effort towards Solving the Plastic Waste Menace

86 percent (86%) of the respondents said they had made an effort towards helping to nib the plastic waste menace in the bud, whilst fourteen(14) respondents representing 14 percent said they had done nothing about the plastic waste situation in the town. The response by majority of the respondents (86%) is good omen for waste management, since the people are already making some contributions.

Waste Management Bye-Laws and Enforcement

In Ghana, the Metropolitan, Municipal and District Assemblies (MMDAs) are responsible for the management of waste through their Waste Management Departments (WMDs) and their Environmental Health and Sanitation Departments. The Local Government Act of 1993 (Act 462) mandates MMDAs to formulate and adopt bye-laws for waste management.

All the respondents (100%) said they knew of the existence of sanitary bye-laws in the study area but did not know of any bye-law specifically for littering or indiscriminate plastic waste disposal. According to 45% of the respondents the enforcement of the waste management bye-laws were Very Weak, 31% said it was Weak, 15% indicated that it was Average, 18% said it was Good, whilst only 1% indicated that it was Very Good.

4.   CONCLUSION

This study has shown that the issue of plastic waste management has become a big problem in Dormaa Municipality as a result of inadequate resources, indiscipline on the part of the people and weak enforcement. As a result there has been indiscriminate littering, leading to the blocking of drains and gutters, flooding and subsequently, flooding. This has led to the creation of fertile ground for the breeding of mosquitoes leading to higher incidence of malaria cases and occasional outbreak of cholera in the study area. The Dormaa Municipal Assembly appears not to

have the capacity to deal with the challenges of plastic waste management and environmental sanitation.

5.   RECOMMENDATIONS

Education is said to be the key to the maintenance of good sanitary conditions in any society. Public education on sanitation in the community should not be limited to the Municipal Environmental Health and Sanitation Department alone. The two radio stations, Dorma FM and Gift FM, and other stakeholders should provide the necessary platform through its health and sanitation programmes. It is imperative on the part of the Dormaa Municipal Assembly to sensitize the community members on the negative effects of indiscriminate littering of plastic waste. The Assembly should establish partnership between local government and institutions like the media, schools, religious bodies and clubs in order to educate the populace on effective waste management.

The Dormaa Municipal Assembly should provide enough litter bins that should be placed at strategic locations in the communities. The Assembly should slowly introduce a policy of 'pay as you litter' to augment the efforts of Zoomlion Ghana Ltd.

Manufacturers should be encouraged to produce durable polythene bags that can be used several times before disposal.
The Dormaa Municipal Assembly should make bold efforts to enforce sanitation bye-laws in the Municipality and the institution of punitive measures to offenders.
The Dormaa Municipal Assembly should provide adequate litter bins at vantage points in the municipality to minimize indiscriminate waste disposal.

The Assembly should recruit sanitary guards to parade the streets to check on indiscriminate littering.
The Assembly should engage all stakeholders (such as churches, keep fit clubs, youth groups, traditional councils, local radio stations) in frequent clean-up exercises.

The assembly should institute award schemes to reward persons/groups in recognition of efforts toward plastic waste management and environmental cleanliness.

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Biogas Generation Potential of Sewage: A Case Study of the Getfund Hall of Koforidua Polytechnic

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Abstract

Anaerobic digestion is an effective way of sewage treatment and fuel gas production from organic substances. The digested effluent can be used as fertilizer to enhance the fertility of the soil. The paper assesses the biogas potential of sewage generated in the Getfund Hall of Koforidua Polytechnic. In the estimation of the amount of sewage generated in the Hall, the student'spopulation in the hall was used. The population of students in the hall varies throughout the year due to vacation periods hence the sewage generated varied accordingly. The estimated population for the 2012/2013 academic year was 516 when the Polytechnic is in session and 162 when the Polytechnic is on recess with a correspondingestimated daily sewage generation of 8.9 m^3 and 2.7 m^3 respectively. The study revealed that an annual biogas potential of 3,916m^{3}could be obtained from the sewage which could offset some 1.77 tonnes of LPG used in the Hall. The production of biogas from sewage will not only lead to clean energy generation but also promote environmentally sustainable development of the country.

Keywords: Treatment; Fertilizer; Sustainable; Clean; Production

1. INTRODUCTION

The problems arising from non-sustainable use of fossil fuels have led to increased awareness and widespread research on the accessibility of new and renewable energy resources (Shinghet al, 1998; Taleghani and Kia, 2005). The renewable sources which are of interest are the ones that are less expensive, environmentally friendly, clean and readily available. Each year some 590-880 million tons of methane are released worldwide into the atmosphere through microbial activities.About 90% of the emitted methane is derived from biogenic sources, i.e. from the decomposition of biomass. The remainder being fossil origin (GATE and GTZ, 2007).

Biogas, a methane rich gas produced by anaerobic fermentation of organic material, is distinct from other renewable energy sources such as solar, wind, thermal and hydro because of its importance in controlling and collecting organic waste materials that, if untreated, could cause severe public-health and **Table 1: Gas yield and methane content for some kinds of substrates (GTZ and GATE, 2007)**

Human excreta based biogas contains 65-66% CH_4, 32-34% CO_2 by volume and the rest is H_2S and other gases in traces whiles the biogas composition for a municipal solid waste is composed of 68-72% CH_4, 18-20% CO_2, and 8% H_2S (Barelli, 2007).

environmental pollution problems (Amigun and Blottnitz, 2007).Theoretically every organic material can be digested. The feedstockfor anaerobic digestion include cattledung and manure, goat dung, chicken droppings, abattoir by-products, kitchen waste, food processingfactory wastes and human excreta. The choice of a feedstock for anaerobic digestion depends on anumber of factors such as substrate temperature and feedstock availability, but the most vital reason for a choice is the feedstock availability (Arthur, 2009). The biogas potential of feedstock also depends on the gas yield per kg of Total Volatile Solids (TVS) present as shown in Table 1.

Substrate	Gas yield (Litres/kg TVS)
Pig manure	340-550
Vegetable residue	330-360
Sewage sludge	310-740
Cow dung	90-310

The Getfund Hall of Koforidua Polytechnic generates a colossal amount of waste (solid and liquid). The solid waste is dumped at a crude site far away from the inhabited part of campus and the liquid waste is transported to a septic tank which is owned and operated by the Polytechnic and desludged periodically.The biogas potential of the solid waste is very difficult to determine because of its method of collection. However, sewage is of a kind hence its biogas potential is relatively easily

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determined. The researchers set out to determine the biogas potential of the sewage at the Getfund Hall of the Polytechnic.

2. Research Approach andMethodology
Estimation of sewage availability

In the determination of the flowrate of sewage generated in the hall, information on the population of students in the hall for the 2012/2013 academic year was used. It was assumed that the academic year is made up of eight months when the polytechnic is in session and the population of the hall is at the maximum. In the remaining four months when the polytechnic is on recess, it was assumed that there is about 30% of the maximum

In the estimation of the sewage flowrate generated in the hall, 20% of the population was added to the actual number to account for non-resident student(visitors) from outside the hall during periods when the Polytechnic is in session and out of session. For the purpose of this study, the population in the hall was categorized into; a) Resident students during Polytechnic in session (SS) b) Resident students when the Polytechnic is out of session (SOS). The volume of sewage generated was estimated for each category of population and with the frequency of usage of the Water Closet (WC) toilet facility in the hall. Using the Volume of the Water Closet (VWC) cistern of 9 L, the daily volumes of sewage (VS) generated by the two category was estimated as; VS = Population× VWC × frequency of usage/person/day.

Estimation of Biogas Potential

The biogas potential generation was based on an optimistic assumption that each person can generate about 30 L of biogas per day (Jha, 2006). The total daily biogas production (DBP) for each of the categories in thePolytechnic was estimated using; DBP = 30 L/person × population. In this expression, the biogas generation was estimated for the two periods in the 2012/2013 academic year. The first period being the vacation lasted for 4 months where each month consists of 30days. The Biogas production Potential of the facilityduringvacation, $BP_V = DBP_V \times 4$ months × 30 days. Similarly, theBiogas production Potential when the polytechnic is in session, $BP_S = DBP_S \times 8$months × 30 days. The Annual Biogas production Potential, $ABP = BP_V + BP_S$

population of students in the hall. The sewage flowrate was estimated for the periods when the polytechnic is in sessionand out of session. In the estimation of the volume of the sewage generated in the hall, the following assumptions were made.

1. The capacity of each water closet bowl is 9liters;
2. Each student in the hall on the average use the toilet facility twice a day;
3. Visitors use the toilet facilities averagely once daily;
4. The students are in the hall eight (8) months in a year from normal session and four (4) months when the Polytechnic is on recess.
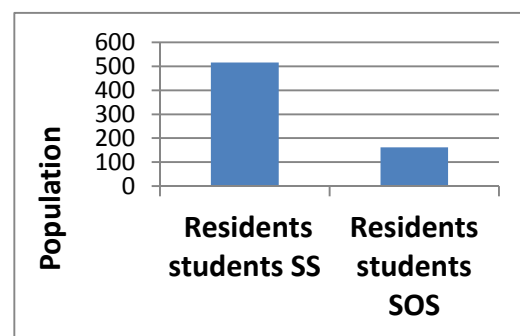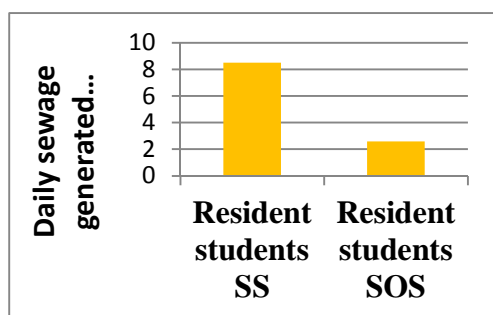

Population of the Hall

The population of the hall was categorized into; a) Resident students when school is in session (SS);(b) Resident students when the school c is out of session (SOS). Figure 1 shows the categories of population of students in the hall contributing to the sewage generated. These figures were the official population provided by the Development Office of the Polytechnic.

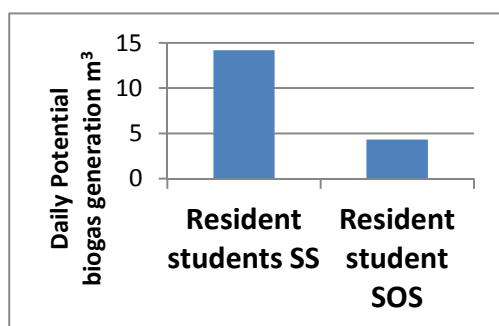**Figure 1: Categories of population in the Hall**

3 RESULTS AND DISCUSSION

It is noted that students' population is maximum when the polytechnic is in session and minimum during vacations.The daily sewage generated in the hall duringpolytechnic sessions and when the polytechnic is on recess is presented in figure 2. From figure 2, it is quite evident that sewage generation during normal polytechnic session is higher than when the polytechnic is on recess.The maximum number of resident students during normal Polytechnic session in the 2012/2013 academic year was 430. To cater for visitors who visit the hall during normal polytechnic sessions, an additional 20% of the maximum population

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was added to the resident populationto make up for the sewage generated by visitors**.**During vacations however, about 30% of the maximum population was assumed to be available in the hall. Similarly to cater for visitors during vacations, about 20% of the vacationresident who were available during vacation was also added and eventually used in the estimation of the daily sewage flows which is presented in figure 2.

Figure 2: Daily sewage generated by the two categories of population in the Hall

The daily biogas generation potential of the hall is estimated and presented in Figure 3.From figure 3, the annual potential biogas generation estimated for the two categories of students in the hall was 3,916m³.This amountis capable of generating about 97,900MJ or 23.5MWh of gross thermal energy per year when it is assumed that 1m³ of biogas is equivalent to 25MJ or 6kWh (Poliafico, 2009). If the biogas is harnessed, it can serve as an alternative source of fuel in the hall where LPG and Electricity are the main sources of fuel for cooking and heating hot water.

Figure 3: Daily Potential biogas generation for the two categories of population in the Hall

Also, the biogas generated can be fed to a biogas generator or lamps to light streets at night. In terms of thermal energy, 1m³of biogas

is equivalent to 5.5kg of firewood (Sasse, 1998) and therefore the estimated biogas can replace as much as 21 tonnes of firewood. Using calorific values of biogas (C_{Biogas}) of 25MJ/m³(Poliafico, 2009) and LPG (C_{LPG}) of 46.1MJ/m³(Poliafico, 2009) and using cooking stove efficiency running on biogas (Eff_{Biogas}) and LPG (Eff_{LPG}) ; 55% (Sasse, 1998) and 66% (Sasse, 1998) respectively, the amount of LPG, the estimated biogas can replace, is obtained using the expression. $M_{LPG} = (C_{Biogas}/C_{LPG}) \times (Eff_{Biogas}/Eff_{LPG}) \times V_{BP.}$ From the expression a total of about 1.7 tonnes of LPG can be offset from the estimated biogas.

4 CONCLUSION

The foregoing shows that the use of anaerobic digesters has a key potential for treating sewage generated in the hall and has additional benefits such as clean energy generation and organic fertilizer production with little or no adverse effect on the environment. To implement this study however, it is imperative that the Polytechnic employs a three-pronged approach; energyproduction, waste treatment and fertilizer production.To further treat the sewage before final discharge into the environment,secondary treatment units should be attached to the installed digester to further treat the effluent to meet Ghana EPA standards for wastewater discharges into the environment or receiving water bodies and improve public health of riparian communities near the receiving water bodies. Also, the effluent can be used as an organic fertilizer to improve soil fertility.The management of the Polytechnic should adapt this approach and help create a sustainable environment.

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Capital Structure and Firm Performance: Evidence from Ghana Stock Exchange

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Abstract

The study examined the relationship between capital structure and firm performance, using secondary data. It covered all the 35 listed companies in accordance with the Ghana Stock Exchange (GSE) Fact Book 2009 over the period 2004 to 2008. Return on equity (ROE), return on assets (ROA) and return on total capital (ROTC) were used as explanatory variables. Capital structure was represented as short term debt (STD), long term debt (LTD) and total equity (TE). Three multiple regression models were utilized; hence series of regression analysis were executed for each model. Observations were that; STD, LTD, and TE respectively account for 8.6% of the variations of return on equity, 0.5% of the variations of return on assets and 3.2% of the variation of return on total capital. Important observed patterns in financing structure were: STD 52%, LTD 9% and EQUITY financing 39%. This has reemphasized the fact that listed companies are highly levered, and also highlights the importance of short-term debts over long-term debts in the financing of companies in Ghana. For every cedi of company financing in Ghana, listed companies employed 0.52pesewas of STD in financing their operations and for every cedi of company financing, listed companies during the study period employed 0.09 pesewas of LTD in their operations, but 0.39 pesewas of equity in financing their operations. This is so because the market for long term debt is not well developed in Ghana. The study observed that STD and TE have a significant positively relationship with ROE, ROA and ROTC but LTD has a significant negative relationship with ROE, ROA and TE.

Keywords: Capital Structure; Performance; Long Term Debt; Short Term Debt; Ghana Stock Exchange.

1 INTRODUCTION

The term **capital structure**refers to the various means of financing a company. It is the mix of long term sources of funds such as debenture, long term debt, and preference and equity share capitals. It is therefore used to represent the appropriate relationship between debt and equity. One crucial issue confronting managers today is how to choose the combination of debt and equity to achieve optimum capital structure that would minimize the firm's cost of capital and improves return to owners of the business (Dadson et al 2012). The appropriate combination of debt and equity that will minimize the firm's cost of capital and maximize the firm's performance and market value is the optimum capital structure. Finance manager do not have a clear cut guideline to be consulted when taking decisions regarding optimal capital structure. This optimum capital structure combination in practice rest on the availability and cost.

One of the earliest comprehensive researches into capital structure of business firms was conducted by the Nobel Prize winners Modigliani and Miller (M&M) in 1958. They argued in their proposition 1 that, (given their ideal world, where there are no bankruptcy cost and frictionless capital market and a world without taxes) the value of a firm do not depend on the mix of debt and equity. Accordingly debt policy of a firm does not matter, butthe cash flows generated by the operating assets of the firm concerned.

This conclusion in M&M proposition 1is inconsistent with what pertains in the real world of business, where capital structure matters, so firms continue to borrow.As a result, M&M in 1963 (proposition 11) reviewed their earlier proposition to include taxes and other market imperfections such as costs associated with trading in securities and contend that capital structure matters and firms can really maximize value by using more debt in their operations so as to take advantage of tax shield benefits of leverage.Contributing to M&M (1958 & 1963) study on capital structure, other theories of capital structure have emerged.

One of such contributors is the tax shield school of thought. Capital structure of the firm is

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explained in terms of the tax shield or benefit associated with the use of debt. Green et al (2002) espouse the idea that tax policy has an important effect on the capital structure decisions of firms. Normally the basic tax laws allow firms to deduct interest on debt in computing taxable profits. Tax advantages derived from debt often lead firms to be completely financed through debt. However, this proposition should not entice managers to borrow to the hilt. It is the trade-off that ultimately determines the net effect of taxes on debt usage (Miller, 1977; Myers, 2001). Thus firm that can derive maximum benefit from debt usage are those whose managers can accurately determine the point where the advantages of interest tax shield ends and where the cost of financial distress starts.

Myers (1984) and Myers and Majluf (1984) in pecking order theory, contend that firms will always resort to the cheapest source of funding to stimulate their operations. Myers (1984) argues that companies will only issue equity as a last resort when their debt capacity has been exhausted. They agreed that, there is a certain hierarchy of firm preferences regarding financing of their investments. Undoubtedly, firms would prefer internal sources of funding to expensive external finance (Myers and Majluf, 1984). They concluded that companies with few investment opportunities and substantial free cash flow will have low (or even negative) debt ratios because the cash will be used to pay down the debt. It also suggests that high-growth firms with lower operating cash flows will have high debt ratios because of their unwillingness to raise new equity.

Following closelyare the bankruptcy cost school of thought. Bankruptcy costs refer to the cost that occurs when a firm fails to honor its debt obligations and stand the possibility of being closed down (Titman et al 1984). The potential costs of bankruptcy may be direct and indirect, Abor (2008). Firms that have high distress cost would have incentives to decrease outside financing so as to lower these costs. Hence, the optimal capital structure represents a level of leverage that balances bankruptcy costs and benefits of debt finance.

In Ghana, few studies have been conducted to examine the determinants of capital structure and profitability, Dadson et al (2012). None of them have fully been directed at listed

companies on the GSE. Abor (2007) compared the capital structure of quoted firms, large unquoted firms, and small and medium enterprises (SMEs) in Ghana using panel data regression. The study observed that quoted and large unquoted firms exhibit significant higher debt ratios than do SMEs.

Abor (2008) studied the link between corporate governance and the capital structure decision of SMEs in Ghana. The study sought to assess how the adoption of corporate governance structures among SMEs influences their financing decisions by examining the relationship between corporate governance characteristics and capital structure using regression model. The results suggested that SMEs pursue lower debt policy with larger board size. However, SMEs with higher percentage of outside directors, highly qualified board members and one-tier board system were observed to employ more debt. His study made it that corporate governance structures influence the financing decisions of Ghanaian SMEs.

Amidu (2007) devised a study to investigate the determinants of capital structure of banks in Ghana and found a significantly negative relation between total debt and profitability

Dadson and Badu (2012) investigated the relationship between capital structure and performance of listed banks in Ghana, using panel data, the result revealed that banks listed on the Ghana Stock Exchange are highly geared and this is negatively related to the banks performance in terms of return on equity and Tobin's q. From the foregoing discussions based on the available empirical literature, none of the studies conducted in Ghana employed all the listed firms for empirical analysis, to the extent that results from investigations into the relationship between capital structure and performance are also inconclusive, and requires more empirical work, given the fact that research, technology and innovation are the bedrock for sustainable development, this study aimed at contributing to the debate on capital structure and performance of listed firms in an era where the private sector has been earmarked as the engine of growth.

It is expected that the findings of this study will have important policy implications for Ghanaian listed firms.

2 METHODOLOGY

The study analyzed companies from the six different dominant sectors of Ghana's capital market including: Finance and Insurance, paper converters and information Technology, Manufacturing and Trading, Agriculture and Agro processing, Metal and oil, and Pharmaceuticals and Beverages spanning from 2004 to 2008. Secondary data was used and were collected from audited financial statements as well as the fact book of Ghana stock Exchange. The study used time series data. Time series analysis identifies the nature of phenomenon represented by the sequence of observation and forecast the future and observes a trend. The time series data were analyzed using both qualitative and quantitative approach. Using qualitative approach, a pattern in the data set were ascertained. According to (Gujarati, 2004)every statistics to describe a data usually summarizes the content and display the mean indicators of the variables used in the study. For quantitative analysis, the study therefore conceptualized capital structure as a three dimensional construct and for empirical purposes; the linear regression model in estimating relationship between variables was used.Linear regression is the least squares estimator with explanatory variable(s). The basic regression equation was as shown below:

$$Y_{it} = \alpha_i + \beta_1 X_{it} + u_{it} \qquad (1)$$

Where:

- Ñ **Y_{it}** is the value of the dependent variable (Y is what is being predicted or explained i.e. the performance variables)
- Ñ α_i or alpha, a constant (equals the value of Y when the value of X=0), that is time invariant–specific effects
- Ñ β_1 or Beta, the coefficient of X (the slope of the regression line; how much Y changes for each one-unit change in X).
- Ñ **X_{it}** is the value of the independent variable (X) (what is predicting or explaining the value of Y, that is capital structure variables)
- Ñ u_{it} is the error term; the error in predicting the value of Y, given the value of X, or it's a random disturbance (it is not displayed in most regression equations).

The Modigliani and Miller (MM) model was adopted to serve as framework for the model development.They argued that capital structure was irrelevant in determining the firm's value and its future performance. Modigliani and Miller (1963) showed that their model is no more effective if tax was taken into consideration since tax subsidies on debt interest payments will cause a rise in firm value when equity is traded for debt.Modigliani and Miller (1963) argued that the capital structure of a firm should compose entirely of debt due to tax deductions on interest payments. To this end the market value of a firm is given by: Equity + Debt = Value (i.e. E + D = V). The objective of the managers is the maximization of the firm's value i.e. of its share price. Debt finance is cheaper than equity finance ($r_d < r_e$), because equity is more risky than debt.Traditional theory postulated that if a firm substitute's debt for equity, it will reduce its cost of capital so increasing the firm's value is given by equation 2.

$$r_a = r_d \frac{D}{D+E} + r_e \frac{E}{D+E} = r_e - (r_e - r_d) \frac{D}{D+E} (2) \qquad (2)$$

Where: r_a = value of the firm, r_d = cost of debt; r_e = cost of equity

  D = total debt;   E = total equity

But, when the D/E ratio is considered too high, both equity-holders and debt-holders will start demanding higher returns so that the cost of capital of the firm will rise. Hence, there exists an optimal, cost minimizing value of the D/E ratio.Modigliani- Miller (M-M) proposed that the value of a firm is the same regardless of whether it finances itself with debt or equity. The weighted average cost of capital: r_a is constant.In the light of this, M-M assumed perfect and frictionless markets, no transaction costs, no default risk, no taxation; both firms and investors can borrow at the same r_d interest rate.Base on M-M proposition 2, the rate of return on equity grows linearly with the debt ratio. This given by equation 3.

From: $r_a = \frac{x}{E+D}$ and $r_e = \frac{x - r_d D}{E}$ (3)

It follows that: $r_e E = r_a (E + D) - r_d D \qquad (4)$

Hence: $r_e = r_a + (r_a - r_d) \frac{D}{E} (5)$

M-M indicated thatthe distribution of dividends does not change the firm's market value; it only changes the mix of E and D in the financing of the firm. To this end, for a firm todecide aninvestment, a firm should expect a rate of return at least equal tor_a, no matter where the financewould come from. This means that the marginal cost of capital should

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be equal to the average one. The constant r_a is sometimes called the "hurdle rate" (the rate required for capital investment).

It can be infused that the M-M propositions are benchmarks, not end results; in this respect financing does not matter exceptfor market imperfections or for costs (i.e. taxes) not explicitly consider. A hint that financing can matter comes from the continuous introduction of financial innovations. If the new financial products never increased the firms' value, then there would be no incentive to innovate.Non-uniquenessof r_a: perhaps it is not very important.Since interests are considered as costs, a leveraged firm has a fiscal benefit. Its operating earnings net of taxes are given by equation 6:

$X_n=(1-t_c)(X-r_dD+rdD=(1-t_c)X+t_cr_dD$(6)

While for an unleveraged firm they are: $X_n = (1-t_c)X=$ net profits.

The difference: t_cr_dD, once capitalized at r_a, makes the value of the leveraged firm greater than that of the unleveraged by the amount:$\frac{tc\,rdD}{ra}$ At the limit: "the optimal capital structure might be all debt" (Miller). But it is necessary to consider the personal taxation of capital gains, dividends and interests that can (partially) offset the firms' tax advantages. In the absence of offsetting, nothing would stop firms from increasing debt in order to decrease taxation. There must be some costs to prevent aggressive borrowing.

The single explanatory variable linear equation was modified and transformed into multiple regressions to analyze the study. The full model used for testing firm's performance in relations to its capital structure is as follows:

$Y_{(1,2,3),i,t}=\alpha_i+\beta_1X_{1,i,t}+\beta_2X_{2,i,t}+\beta_3X_{3,i,t}+u_i$(7)

Gujarati (2004) argued that the main strength of using multiple regression is its ability to measure the joint effect of any number of independent variables upon one dependent variable. Multiple regression model is a model in which a dependent variable depends on two or more variables. For empirical purposes, the following operationalization of Equation 7 is used.

$ROTC_{1,,i,t}=\alpha_i+\beta_1STD_{i,t}+\beta_2LTD_{i,t}+\beta_3TE_{i,t}+u_i$ (8)

Where: ROTC = return on total capital; STD = short term debt;

LTD = long term debt; TE = Total equity; u_i = error term

$ROE_{2,i,t}=\alpha_i+\beta_1STD_{i,t}+\beta_2LTD_{i,t}+\beta_3TE_{i,}+u_i$ (9)

In equation 9 and 10 the same independent variables are maintained except the dependent variable which are ROE (return on equity) and ROA (return on asset).

$ROA_{3,i,t}=\alpha_i+\beta_1LTD_{i,t}+\beta_2LTD_{i,t}+\beta_3TE_{i,t} \quad +u_i$ (10)

2.1 Research Questions and Hypotheses

This study addressed two research questions. The first describes the irrelevancy of capital structure and firm performance, i.e. do capital structure decisions matters in firm's performances in Ghana? A descriptive method was used to answer this first research question. The second research question determines the extent to which the increase or decrease in capital structure affect firm's performance, i.e. to what extent does the increase or decrease in capital structure affect firm's performance? To answer this second research question, two hypotheses were tested.

Thus, Hypothesis 1 is stated in the null and alternative forms as follows:

H_0: There is no significant relationship between a firm's performance and capital structure as measured by return on assets, return on equity and return on total capital.

H_a: There is a significant relationship between a firm's performance and capital structure as measured by return on assets, return on equity and return on total capital.

To investigate whether there has been significant change in firm's performance as a result of decrease or increase in capital structure. Hypothesis 2 is stated in the null and alternative forms as follows:

H_2: There is no significant change in firm's performance as a result of increase or decrease in capital structure.

H_{2a}: There is a significant change in firm's performance as a result of increase or decrease in capital structure.

3.   RESULTS AND DISCUSSIONS
3.1 Descriptive Statistics

Table 4.1 and 4.2, shows the mean value and standard deviations of the variables under study, return on equity was averaged 18% (Std dev = 0.33) as compared to ROA which is 6% (std dev =0.14) and ROTC of 5% (std dev = 0.11). This was the average profitability in respect of ROE, ROA and ROTC measures. The high standard deviations means that

profitability was not stable and companies operated under severe risky business environment. The performance indicators also means that as listed firms employ debt into its capital structure the return to equity will increase. The higher performance level of ROE might have been contributed by tax shield of interest and disciplinary role imposed by high short term debts. This implies that management of firms can use short term debt decisions to increase the return on the firm.This study has observed that companies that employ short term debt into their capital structure maximized their equity shareholders wealth, but will be operating under severe unstable condition depicted by the standard deviations of the various profitability measures.

Furtherance to the above, from table 4.1 listed companies' use of STD averaged 52% in financing their operations. However, some variations in the levels of STD were eminent as indicated by the high Standard deviation of 0.26. This shows the level of reliance listed entities place on short term debt finance. However, the use of LTD averaged 9% which was not astronomically deviated as in STD (i.e. 0.12. An important point that was also noted is that 39% of the capital structure of listed firms was equity with a standard deviation of 0.23. In the choice of their capital structure, the study also noted some instability as shown by the high standard deviations.This study has shown that listed entities do not rely much on LTD, but on STD. This is so because the market for long term debt is not well developed in Ghana, but it is easy to raise money in the money market in the short term because of the unstable nature of the macroeconomic environment. Why ROA is not performing well is probably due to the fact that, listed companies are hugely financed by STD, it will be very difficult for them to invest in viable long term projects using STD, therefore listed firms will be unable to invest in profitable long term projects that would increase their net assets with the resultant multiplier effect on ROA, hence listed firms which rely on STD will always be under investing. This confirms Myers (1977) argument. This observed trend in capital structure presents some interesting results and will direct the extent at which listed companies can take opportunities as they are presented by the environment, given the fact that most of them are finance by short term debts.

Table 4.1: Descri. Stats. Summary

	STD	LTD	TE	ROE	ROA	ROTC
Mean	0.52	0.09	0.39	0.18	0.06	0.05
Max	0.92	0.57	0.94	1.14	1.2	0.38
Min	0.00	0.00	0.00	-.95	-0.54	-0.43

Source: Constructed from GSE Fact book 2009

Table 4.2: Descriptive Statistics for Models 1, 2 & 3

Model	Variable	Mean	Std. Dev.
1	ROE	0.1776	0.32866
	STD	0.5207	0.26268
	LTD	0.0891	0.12358
	TE	0.3871	0.23854
2	ROA	0.0547	0.14257
	STD	0.5207	0.26268
	LTD	0.0891	0.12358
	TE	0.3871	0.23854
3	ROTC	0.0515	0.10538
	STD	0.5207	0.26268
	LTD	0.0891	0.12358
	TE	0.3871	0.23854

Source: Constructed from GSE Fact book 2009

4.3 CorrelationAnalysis
Pearson correlation analysis showed the results as in Table 4.2. Correlation is a single number that described the degree of relationship between two variables. A Pearson correlation indicates the direction, strength and significance of the relationships for all variables in the study, however, it does not imply causality. Theoretically, there could be a perfect positive correlation between two variables, which is represented by 1.0 or a perfect negative correlation, which is represented by -1.0.The dependent variables, ROE, ROA and ROTC are significant and positively correlated with each other, as highlighted in Table 4.3 below.

The correlation analysis provide early sign that STD, LTD and TE are significantly related to ROE (corr. = 0.307, p-value 0.000, corr. = -0.207, p-value= 0.006, corr.= -0.222, p-value= 0.003), and to ROA (corr.= -0.025, p-value= 0.746, corr.-0.119, p-value= 0.115, corr.= 0.094, p-value = 0.216) and to ROTC (corr.=-0.090, p-value=0.237, corr.= -0.138 p-value=0.069, and

corr. 0.177, p-value= 0.019).As evident here, the dependent variables exhibited a weak correlation with the explanatory variables. Noticeably, low values are reported in comparing to +1 or -1. These therefore suggests the possibility of finding close to zero or a non-significant relationships in the next step of the analysis devoted to the estimation of the econometrics models l to 3 presented in table 4.4.

Table 4.3: Pearson Correlation Matrix

	ROE	ROA	ROTC
STD	0.307	-0.025	-0.090
LTD	-0.207	-0.119	-0.138
TE	-0.222	0.094	0.177

Source: Constructed from GSE Fact book 2009

4.4 Regression Results

A series of regression analyses were executed and the results are filed at the appendix 1,2 and 3. The finding of which are summarized and presented in table 4.4 below.

Variance Inflation factor (VIF) of the variables in the regression models were examined to check for the presence of multi-co-linearity problem.The Durbin Watson statistics that is shown in appendix 1, 2 and 3 indicates that no serious serial correlation problem exists.

F-test is used to test the hypothesis that the variation in the independent variable explained a significant proportion of the variation in the dependent variable in the model. The F-test as shown in table 4.4 indicates that all the models are significant in explaining the firms' performance. However, the explanatory power of the models as shown by the adjusted R^2 is very low comprising of 8.6%, 0.5% and 3.2%. R-square measures the proportion of the total variation or dispersion in the dependent variable that is explained by the variation of the independent variable. Therefore R^2 informs us how good the line is best fit and also measures the percentage of change in the independent variable that is caused by the change in the independent variable.

It follows therefore from Table 4.4 that; the results indicate that the explanatory variables (the capital structure ratios in this case) partially explain 8.6% of the variations in ROE of listed companies in Ghana. The reported coefficient for STD to ROE was 0.337 and significant at the 0.28, LTD to ROE was -0.256 and significant 0.469, and TE to ROE was 0.004

and significant 0.990. The sign agreed with the direction hypothesized except for LTD. The implication to the capital structure coefficient for example, that of STD is that, the STD is significant in varying ROE by a change of 0.337 per cedi of STD, and LTD (-0.256) and TE (0.004).

On the other hand 0.5% of the variations in capital structure, explains the variations in ROA.

The reported coefficient for STD to ROA was 0.023 and significant at the 0.871, LTD to ROA was -0.112 and significant 0.484, and TE to ROA was 0.075 and significant 0.596. The sign do agree with the direction hypothesized except with LTD. The implication to the capital structure coefficient for example, that of LTD is that, LTD is significant in varying ROA by a change of negative 0.256 per cedi of LTD, and STD (0.023) and TE (0.075).

Similarly, 3.2% of the variations in capital structure accounted for the variations in ROTC. Furthermore, the reported coefficient for STD to ROTC was 0.011 and significant at the 0.912, LTD to ROTC was -0.101 and significant 0.387, and TE to ROA was 0.087 and significant 0.403. The sign do agree with the direction hypothesized except with LTD. The implication to the capital structure coefficient for example, that of LTD is that, LTD is significant in varying ROTC by a change of negative 0.101 per cedi of LTD, and STD (0.011) and TE (0.087).

From Table 4.4 below, it can be concluded that STD and TE have a significant positively relationship with ROE, ROA and ROTC but LTD has a significant negative relationship with ROE, ROA and TE. In the case of STD the result is consistent with the findings of Abor (2007) which concluded in the case of South Africa; "the result exhibited a statistically significant positive relationship between STD and ROA".Based on the above findings, I do not reject the null hypothesis. This finding is also supported by Grossman and Hart (1982) who argued that higher levels of debt in the firm's capital structure will be directly associated with higher performance. In the case of LTD, it is consistent with Mesquita and Lara (2003) who found that LTD is not significant with ROE, which agrees with Fama and French (1998) and Miller (1997) but this has further been extended by this study to ROA and ROTC.

The above results means that returns to a company must be well planned in line with capital structure.

Table 4.4   Regression results

Dependent Var.	ROE	ROA	ROTC
Independent Var.	Model 1 Coefficient (P-Value)	Model 2 Coefficient (P-Value)	Model 3 Coefficient (P-Value)
Constant	0.023	0.023	0.21
STD	0.337 (0.281)	0.023 (0.871)	0.011 (0.912)
LTD	-0.256 (0.469)	-0.112 (0.484)	-0.101 (0.387)
TE	0.004 (0.990)	0.075 (0.596)	0.087 (0.403)
R²	0.086	0.005	0.032
DW STATS	1.838	1.940	1.855
F-STATS	6.472 (0.01)	1.306 (0.274)	2.913 (0.036)
N	175	175	175

Significant at 0.05 level.Source: Constructed from GSE Fact book 2009.

5 CONCLUSION

An important observation from the study was that 61% of the total capital of listed companies is made up of debt. Of this, 52% constitute short-term debts while 9% is made up of long-term debts with equity accounting for 39%.This means that listed companies are highly levered and showed over reliance on short term debts.

The next observation was that STD and TE have a significant positive relationship with ROE,

ROA and ROTC but LTD has a significant negative relationship with ROE, ROA and TE.

It follows therefore that, the explanatory variables (the capital structure ratios in this case) partially explain 8.6% of the variations in ROE of listed companies in Ghana. On the other hand 0.5% of the variations in capital structure, explains the variations in ROA. Similarly, 3.2% of the variations in capital structure accounted for the variations in ROTC.

The result from the descriptive statistics also showed that over the period under study, the performance of listed companies measured by ROE, ROA and ROTC were 18%, 6% and 5% respectively.The higher performance levels of ROE might have been contributed by tax shield of interest and disciplinary role imposed by high short term debts. This implies that management of firms can use short term debt decisions to increase the return on the firm. The study therefore shows that all the models tested have a very low explanatory power on firm performance. The models were all free of multicollinearity problem based on Variance Inflation Factor, and serial correlation based on Durbin-Watson statistics.

It should therefore be the burning desire of top management of every firm to make prudent financing decision in order to remain profitable and competitive in sustaining development, in this new economic paradigm. The government of Ghana must assist to develop the debt market so that companies can raise a lot of debt which they need to meet their short to medium term loan obligations as a bedrock for sustainable development in Ghana.

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Comparison of Logistic Regression and Linear Discriminant Analyses of the Determinants offinancial Sustainability of Microfinance Institutions

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Abstract

Profitability and sustainability are primary issues for successful micro finance services. Establishing a system of sustained provision of modern financial services has, however, been challenging and most controversial. Several studies have been conducted on the determinants of sustainability of microfinance institutions using large and well developed Microfinance Institutions (MFIs) in various countries. However, the levels of significance of the factors that influence financial sustainability of MFIs vary with studies. In addition, the results are mixed and empirical evidence regarding the determinants of MFIs' financial sustainability is also missing. The objective of this study therefore is to develop a model which could be used to identify likely future MFIs that are non-sustainable. This study examined the determinants of financial sustainability of microfinance institutions using discriminant analysis (DA) and logistic regression (LR) models.

Keywords: Microfinance Institutions; Linear Discriminant Analysis; Logistic Regression; Financial Sustainability

1. INTRODUCTION

Microfinance as we know it today can be defined as "the provision of a broad range of financial services such as deposits, loans, payment services, money transfers, and insurance to poor and low-income households and, their micro enterprises. Microfinance institutions have been defined by different scholars in different ways. However, the essence of the definition, of microfinance refers to the provision of financial services generally saving and credit to low income clients (Legerwood, 1999). Robinson (2001) defined microfinance as small scale financial services – primarily credit and saving provided to people who farm or fish or herd; who operate small enterprises or micro enterprises where goods are produced, recycled, repaired, or sold, who provide services, who work for wages or commissions; who gain income from renting out small amounts of land, vehicles, draft animals, or machinery and tools; and to other individuals and groups at the local levels of developing countries, both rural and urban.

The concept of microfinance is not new in Ghana. Traditionally, people have saved with and taken small loans from individuals and groups within the context of self-help to start businesses or farming ventures. Available evidence also suggests that the first Credit Union in Africa was established in Northern Ghana in 1955 by Canadian Catholic Missionaries. Susu, which is one of the current microfinance methodologies, is thought to have originated in Nigeria and spread to Ghana in the early 1990s (Dowling, 2011).

Since more than three-fourth (75%) of the population of Ghana earn under two dollars a day, micro finance is probably the most appropriate way to provide financial services to majority of Ghana's population. It is, therefore, not surprising that governments perceive microfinance to be central to achieving the greater goal of poverty alleviation. Through microfinance, governments aim to provide poor entrepreneurs, especially those in the informal sector, with greater access to customized financial services. The first systematic effort to restructure the rural banking sector was with initiation of the International Development Association (IDA) from 1989 to 1995. This project, which was implemented by the Bank of Ghana, initiated institutional reforms in the rural banking sector and provided a lot of credit to the eligible rural banks.

The microfinance sector, apart from being a critical component of the financial system, is also regarded as a poverty reduction strategy for developing countries (Kyereboah-Coleman, 2007).It is in this regard that microfinance is very crucial. The financial sustainability of MFIs is a necessary condition for institutional sustainability (Hollis and Sweetman, 1998). For sustainable poverty alleviation, the MFIs

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themselves should be financially sustainable to continuously provide services to their customers. It has been argued that unsustainable MFIs will not help the poor in the future because the MFIs would not be around for long (Schreiner, 2000). According to Nyamsogoro (2010), it is better not to have MFIs than having unsustainable ones. This indicates how important the sustainability of MFIs is. Interventions through the delivery of microfinance services are considered to be one of the policy instruments of the governments to eradicate poverty.

Several studies have been conducted on the determinants of sustainability of microfinance institutions using large and well developed MFIs in various countries. However, the levels of significance of the factors that influence financial sustainability of MFIs vary with studies (Cull et al, 2007 and Christen et al, 1995; cited in Kinder, 2012). In addition, the results are mixed and empirical evidence regarding the determinants of MFIs' financial sustainability is also missing. Therefore, by using discrimanant analysis(DA) and logistic regression(LR) models, this study examined the determinants of microfinance institutions' financial sustainability. The models were also used to classify MFIs which are sustainable and those that are not.

Related works

The goal of LR is to find the best fitting and most parsimonious model to describe the relationship between the outcome (dependent or response variable) and a set of independent (predictor or explanatory) variables. The method is relatively robust, flexible and easily used, and it lends itself to a meaningful interpretation. In LR, unlike in the case of DA, no assumptions are made regarding the distribution of the explanatory variables.

Contrary to the popular beliefs, both methods can be applied to more than two categories (Hosmer and Lemeshow, 1989). To simplify, we only focus on the case of a dichotomous outcome variable (Y). The LR model can be expressed as the case of a dichotomous outcome variable (Y). The LR model can be expressed as:

$$P\left(Y_i = 1 \mid X_i\right) = \frac{e^{s^T X_i}}{1 + e^{s^T X_i}} \qquad \dots \qquad (1)$$

where the Y_i are independent Bernoulli random variables. The coefficients of this model are estimated using the maximum likelihood method.

Discriminant analysis can be used to determine which variable discriminates between two or more classes, and to derive a classification model for predicting the group membership of new observations (Worth and Cronin, 2003). For each of the groups, DA assumes the explanatory variables to be normally distributed with equal covariance matrices. The simplest LDA has two groups. To discriminate between them, a linear discriminant function that passes through the centroids of the two groups can be used. LDA is discussed further by Kachigan (1991). The standard DA model assumes that the conditional distribution of $X \mid y$ is multivariate normal with mean vector μy and common covariance matrix S. With some algebra we can show that we assign x to group 1 as:

$$P\left(1 \mid x\right) = \frac{1}{1 + \left(e^{\Gamma + \mathsf{S} x}\right)^{-1}} \qquad \dots \qquad (2)$$

where Γ and S coefficients are

$$\Gamma = -\log \frac{f_1}{f_0} + \frac{1}{2}\left(\sim_1 + \sim_0\right)^T \Sigma^{-1}\left(\sim_1 - \sim_0\right)$$

and $\mathsf{S} = \left(\sim_1 - \sim_0\right)^T \Sigma^{-1}$.

f_1 and f_0 are prior probabilities of belonging to group 1 and group 0. In practice the parameters $f_1, f_0, \sim_1, \sim_0$ and Σ will be unknown, so we replace them by their sample estimates, i. e.:

$$f_1 = \frac{n_1}{n}, f_0 = \frac{n_0}{n}$$

$$\hat{\sim}_1 = \bar{x}_1 = \frac{1}{n_1}\sum_{y_i=1} x_i , \qquad \hat{\sim}_0 = \bar{x}_0 = \frac{1}{n_0}\sum_{y_0=1} x_i$$

$$\dots \qquad \dots \qquad \dots \qquad \dots \qquad (3)$$

$$\hat{\Sigma} = \frac{1}{n}\left[\sum_{y_i=1}\left(x_i - \bar{x}_1\right)\left(x_i - \bar{x}_1\right)^T + \sum_{y_i=0}\left(x_i - \bar{x}_0\right)\left(x_i - \bar{x}_{10}\right)^T\right]$$

$$\dots \qquad \dots \qquad \dots \qquad \dots \qquad (4)$$

(2) is equal in form to LR. Hence, the two methods do not differ in functional form, they only differ in the estimation of coefficients.

Since more information is needed regarding the predictive accuracy of the methods than just a binary classification rule, Harrell and Lee

(1985) proposed four different measures of comparing predictive accuracy of the two methods. These measures are indexes A, B, C and Q. They are better and more efficient criteria for comparisons and they tell us how well the models discriminate between the groups and/or how good the prediction is. Theoretical insight and experiences with simulations revealed that some indexes are more and some less appropriate atdifferent assumptions. In this work, we focus on three measures of predictive accuracy, the B, C and Q indexes. Because of its intuitive clearness we sometimes add the classification error (CE) as well. The C index is purely a measure of discrimination (discrimination refers to the ability of a model to discriminate or separate values of Y). It is written as follows

$$C = \frac{1}{n_0 n_1} \sum_{\substack{i=0 \\ Y_i=0}}^{n} \sum_{\substack{j=1 \\ Y_j=1}}^{n} \left[I\left(P_j > P_i\right) + \frac{1}{2} I\left(P_j = P_i\right) \right]$$

...   .   (5)

where P_k denotes an estimate of $P(Y_k=1 \mid X_k)$ from (1) and I is an indicator function. We can see that the value of the C index is independent of the actual group membership (Y), and as such it is only a measure of discrimination between the groups, and not a measure of accuracy of prediction. A C index of I indicates perfect discrimination; a C index of 0.5 indicates random prediction.

The B and Q indexes can be used to assess the accuracy of the outcome prediction. The B index measures an average of squared difference between an estimated and actual value:

$$B = 1 - \frac{1}{n} \sum_{i=1}^{n} \left(P_{i\_} Y_j\right)^2 \quad \text{...} \quad \text{...} \quad \text{...} \quad (6)$$

where P_i is a probability of classification into group i, Y_i is the actual group membership (1 or 0), and n is the sample size of both populations. The values of the B index are on the interval [0, 1], where 1 indicates perfect prediction. In the case of random prediction in two equally sized groups, the value of the B index is 0.75. The Q index is similar to the B index and is also a measure of predictive accuracy:

$$Q = \frac{1}{n} \sum_{i=1}^{n} \left[1 + \log_2 \left(P_i^{Y_j} \left(1-P\right)^{1-Y_i} \right) \right]$$

...   .   (7)

A score of 1 of the Q index indicates perfect prediction. A Q index of 0 indicates random predictions, and values less than 0

indicate worse than random predictions. When predicted probabilities of 0 or 1 exist, the Q index is undefined. While the C index is purely a measure of discrimination, the B and Q indexes (besides discrimination) also consider accuracy of prediction.

Discriminant Analysis (DA) is a statistical tool that can predict the group membership of a newly sampled observation (Toshiyuki Sueyoshi and Shiuh-San Hwang, 2004). Sueyoshi and Kirihara (1998, 1999) have recently proposed a new type of nonparametric DA approach that provides a set of weights of a linear discriminant function, consequently yielding an evaluation score for the determination of group membership. The nonparametric DA is referred to as "Data Envelopment Analysis-Discriminant Analysis (DEA-DA)," because it maintains its discriminant capabilities by incorporating the nonparametric feature of DEA into DA. In this study, a use of two statistical tests is proposed for DEA-DA and its discriminant capability is compared with DEA from a perspective of financial analysis.

Discriminant analysis in this study by Kevin Keasey and Robert Watson (1986) is used to examine empirically whether current cost accounting (CCA) information may be useful for predicting the performance of small companies. A matched sample of failed and non-failed firms is chosen and historic cost accounts are adjusted in line with the requirements of Statement of Standard Accounting Practices (SSAP) 16. The companies are all single-plant independently owned firms in the Northeast of England; all the failed firms had ceased to trade during 1974-1980.

Altman (2000) mentioned that the MDA technique has the advantage of considering an entire profile of characteristics common to the relevant firms and another advantage of MDA in dealing with classification problems is the potential of analyzing the entire variable profile of the object simultaneously rather than sequentially examining its individual characteristics. Most recent research on the use of discriminant analysis on evaluating company performance in Malaysia is by Muhammad Rubini Kertapati and Nuradli Ridzwan Shah Bin Mohd Dali (2004). This research is using 11 ratios as independent

variable to determine the performance of finance company in financial industry in Malaysia.

Logistic regression is a form of regression which is used when the dependent is a dichotomy and the independents are of any type (Alan Agresti, 1996). Continuous variables are not used as dependents in logistic regression. Unlike logit regression, there can be only one dependent variable. Logistic regression can be used to predict a dependent variable on the basis of continuous and/or categorical independents and to determine the percent of variance in the dependent variable explained by the independents; to rank the relative importance of independents; to assess interaction effects; and to understand the impact of covariate control variables.

Logistic regression applies maximum likelihood estimation after transforming the dependent into a logit variable (the natural log of the odds of the dependent occurring or not). In this way, logistic regression estimates the probability of a certain event occurring (Imam Ghozali, 2006). Logistic regression has many analogies to OLS regression: logit coefficients correspond to b coefficients in the logistic regression equation, the standardized logit coefficients correspond to beta weights, and a pseudo R statistic is available to summarize the strength of the relationship. Unlike OLS regression, however, logistic regression does not assume linearity of relationship between the independent variables and the dependent, does not require normally distributed variables.

Logistic regression also does not assume homoscedasticity, and in general has less stringent requirements. It does, however, require that observations are independent and that the independent variables be linearly related to the logit of the dependent. The success of the logistic regression can be assessed by looking at the classification table, showing correct and incorrect classifications of the dichotomous, ordinal, or polytomous dependent. Also, goodness-of-fit tests such as model chi-square are available as indicators of model appropriateness as is the Wald statistic to test the significance of individual independent variables.

Because both DA and LR can be used for predicting or classifying individuals into different groups based on a set of measurements, a logical question often asked is: How do the two techniques compare with each other? In the literature, there has been considerable discussion about the relative merits of the two different techniques (e.g., Dattalo, 1994; Fraser, Jensen, Kiefer, & Popuang, 1994; Wilson & Hardgrave, 1995).

Theoretically, DA is considered as having more stringent data assumptions. Two prominent assumptions for DA are multivariate normality of data and homogeneity of the covariance matrices of the groups (R. A. Johnson & Wichern, 1988; Stevens, 1996). However, it is not entirely clear what consequences the violation of those assumptions has on DA analysis results. LR, on the other hand, is considered relatively free of those stringent data assumptions (Cox & Snell, 1989; Neter et al., 1989; Tabachnick & Fidell, 1996). Although there is no strong logical reason to expect the superiority of one technique over the other in classification accuracy when the assumptions for DA hold, it would be reasonable to expect that LR should have the upper hand when some of those assumptions for DA are not tenable (Neter et al., 1989; Tabachnick & Fidell, 1996).

Research findings about the relative performance of the two methods appear to be inconsistent. With regard to data normality, Efron (1975) showed that under the optimal data condition of multivariate normality and equal covariance matrices for the groups, DA is more economical and more efficient than LR. When the data are not multivariate normal, results from some simulation studies (e.g., Baron, 1991; Bayne, Beauchamp, Kane, & McCabe, 1984) indicated that LR performed better than DA. That finding, however, has not been unequivocally supported by the studies in which researchers compared the two techniques by using extant data sets; in quite a few studies involving actual nonnormal data sets, very little practical difference has been found between the two techniques (e.g., Cleary & Angel, 1984; Dey & Astin, 1993; Meshbane & Morris, 1996).

With regard to the condition of equal covariance matrices for DA, there are few empirical studies comparing the relative

performance of PDA and LR for unequal covariance matrices. Researchers seem to assume that LR should be the method of choice when the two groups do not have equal covariance matrices (Harrell & Lee, 1985; Press & Wilson, 1978). Several studies that involved extant data sets did not suggest that DA's performance would suffer appreciably because the assumption was violated (Knoke, 1982; Meshbane & Morris, 1996). No one seems to have specifically manipulated that condition in simulation studies to examine its effect on the performance of DA and LR.

The relative performance of DA and LR under different sample-size conditions is also an issue of interest. Viewed from the perspective of statistical estimation in general, maximum likelihood estimators (as in LR) tend to require larger samples to achieve stable results than ordinary least square estimators (as in DA). Inconsistent results have been reported about the relative performance of the two techniques with regard to sample-size conditions. For example, in a simulation study, Harrell and Lee (1985) implied that PDA performed better under small sample-size conditions. B. Johnson and Seshia (1992) showed that when the techniques were applied to real data sets, the findings did not clearly confirm that conclusion.

There are several reasons for the limited internal and external validity of those studies. First, using extant data sets gives researchers no control of data characteristics, thus making it impossible to systematically investigate the impact of each individual factor, because in extant data sets the effects of those relevant factors are often hopelessly confounded. Second, most of those studies did not provide enough information about the data characteristics, making it very difficult to synthesize the results across studies. For those reasons, simulation studies with strong experimental control are useful in assessing the effects of those relevant factors.

2.   METHODOLOGY

To identify the factors that influence the financial sustainability of MFIs, we utilized panel data on MFIs in Ghana for the years 2005 through 2012. This yielded unbalanced panel data for 173 MFIs. The MFIs' data is collected from individual institutions as reported to MIX market. In this study financial self sufficiency is used as dependent variable since the study seeks to identify determinants of financial sustainability of MFIs. These variables are: Inflation rate(x_1), Interest rate (x_2), Portfolio at risk(x_3), Operating expense /asset ratio (x_4), Debt/equity ratio (x_5), and Deposits to total assets(x_6).

The independent variables that were associated at a significance level a = 0.05 with the dependent variable "financial sustainability" were entered in a principal components analysis (PCA). Sixteen variables satisfied the above criterion, so 16 principal components were extracted from the analysis. Applying Kaiser's criterion (eigenvalue >1), we retained 6 mutually independent factors. The assumptions for the two models were all fulfilled and the components due to their extraction methods followed the multivariate normal distribution and were mutually independent. The variance - covariance matrices of the groups were equivalent. We used the standardized canonical discriminant function coefficients and the unstandardized function coefficients for discriminant analysis and Z statistic (squared Wald statistic) for logistic regression, to evaluate how much each one of the variables contributes to the discrimination between two groups.

The contribution of the respective variables to the discrimination depends on how large the coefficients are. We also compared the sign and magnitude of coefficients. Box's M test was used to check the equality of the covariance matrices, and it was revealed that they were equal (P>.05), thus this assumption for discriminant analysis was met. For each model, we plotted the corresponding response operating characteristics (ROC) curve.

An ROC curve graphically displays sensitivity and 100% minus specificity (false positive rate) at several cutoff points. By plotting the ROC curves for two models on the same axes, one is able to determine which test is better for classification, namely, that test whose curve encloses the larger area beneath it. All analyses were performed using the SPSS version 17.0 software.

3.   EMPIRICAL RESULTS

In this section, a discussion of the determinants of financial sustainability of MFIs which are

measured by using DA and LR is presented. Using PCA and applying Kaiser's criterion, 6 variables of our original data were extracted. These variables were used in both discriminant and logistic regression analyses, and both techniques revealed the same results. We observe that the direction of the relationships was the same, and there were not extreme differences in the magnitude of the coefficients. The overall correct classification rate was 81.3% for discriminant analysis and 83.1% for logistic regression analysis.

Approximately 66 %(115) of the sampled MFIs was used as training set to create the model. The remaining MFIs, 34 %(58) was used to validate the model results. The classification function was used to assign cases to groups.The binary grouping variable was defined to be 0 if the MFI is not sustainable and 1 if MFI is sustainable. After the appropriate functions were calculated, the individual MFIs in both the training and validation sets were classified from the estimate functions, that is, the functions estimated from the training sets).

The logistic regression classified 82 (65 + 17) of the 115 MFIs in the training set correctly for a 71.30% classification rate (see Table 1). In the validation set, 36 (25 + 11) of the 58 MFIs were correctly classified, for a 62.07% correct classification rate.

Table 1: Summary of Classifications of MFIs by Logistic Regression and Discriminant Function Methods

Cases	Discriminant Analysis		Classification Rate (%)	Logistic Regression Analysis		Classification Rate (%)
	Actual Group			Actual Group		
Training Set	0	1		0	1	
Default Group(0)	71	5		65	11	
Non-Default Group(1)	33	6		22	17	
Total	104	11	67	87	28	71
Validation Set						
Default Group(0)	31	0		25	6	
Non-Default Group(1)	24	3		16	11	
Total	55	3	59	11	17	62

The discriminant analysis correctly classified 77 of the 115 MFIs in the training set, for a 66.96 percent correct classification rate. The prior probabilities used were 0.66 of   non sustainability, and 0.34 of sustainability. In the validation set only 34 of the 58 MFIs were correctly classified, for a 58.62 percent correct classification rate of particular interest is the pattern of errors. When the cases that were misclassified in the validation set by each procedure are examined critically, it is found that some overlap. Sixteen cases were misclassified the same by both procedures. All the 16 were positive that were classified as negative. In addition, logistic regression misclassified six negatives as positive that the discriminant analysis classified properly. Discriminant analysis classified 8 positives as negatives that the logistic regression correctly classified. Thus there is a clear difference in the types of cases misclassified by the two procedures. The discriminant functions consistently misclassify many more MFIs into the 0 group than the logistic function. These associations may be studied by inspection of the equations estimated. The estimated functions are for logistic regression:

$$LR(X) = 0.547 - 8.61X_1 - 4.32X_2 - 1.98X_3 - 5.23X_4 - 8.82X_5 + 6.13X_6$$

$$\ldots \quad \ldots \quad (8)$$

and for discriminant analysis:

$$r = 0 \quad \ldots \quad \ldots \quad (9)$$

where X_1 is Inflation rate, X_2 is Interest rate, X_3 is Portfolio at risk, X_4 is Operating expense /asset ratio, X_5 is Debt/equity ratio and X_6 is Deposits to total assets.

As we might have expected from the earlier analyses, the two functions are quite similar.

Table 2 presents sensitivity and specificity of both approaches at various cutoffs of the probability of having any record of financially sustainable.

Table 2: Sensitivity and specificity of logistic regression and discriminant analysis models, at various cutoff points for the probability of sustainability.

*Cutoff Values	Discriminant Analysis		Logistic Regression Analysis	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
0.05	94.9	8.3	100	25.1
0.10	92.3	23.3	100	25.8
0.25	69	69.2	92.3	37.1
0.50	28.2	95.8	71.8	70.4
0.75	5.1	100	25.6	78
0.90	0	100	5.1	76.8

P*(default)=values less than or equal to the cut-off value indicate that the MFI is not sustainable; those greater than the cut-off value indicate that a customer is MFI is sustainable.

Although some differences are observed between the methods, as we can see in Figure 1, the ROC curves of the aforementioned models clearly indicate that the logistic model is similar to the discriminant analysis model (i.e., no difference in the area under the curve (AUC), 74.6% versus 74.4%, P= .9).
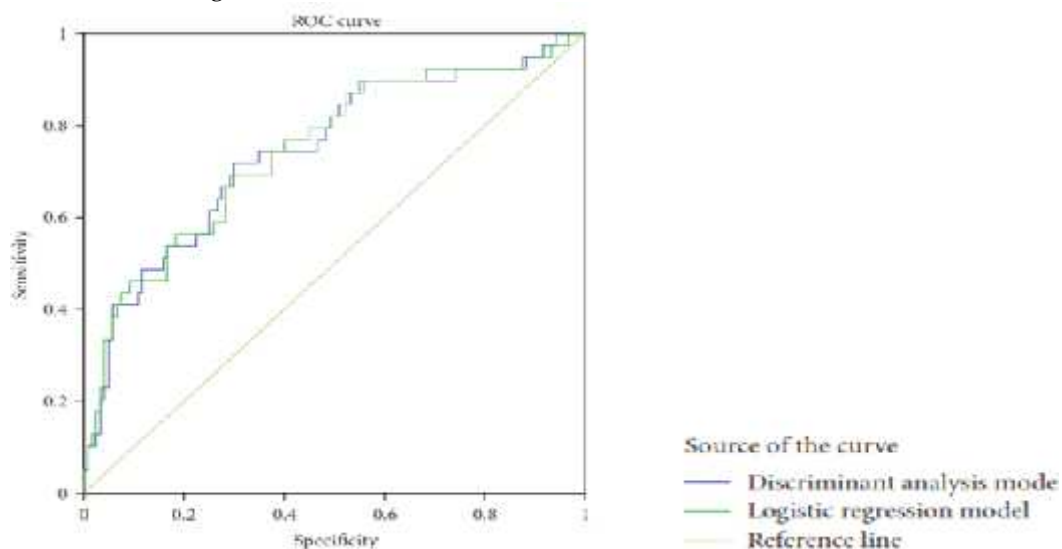
Figure 1: Receiver operating characteristics (ROC) curves for the discriminant analysis and logistic regression models.

Tables 3 and 4 present the results of the Discriminant Analysis and the Logistic Regression model

Tables 3: Discriminant Analysis of the determinants of Financial Sustainability of MFIs

Variable	Parameter Estimate	Standard Error	t- Value	Pr > |t|
Intercept	0.547	0.03811	13.77	<.0001
Inflation rate(x_1)	-8.61	0.00073668	-9.96	<.0001
Interest rate (x_2)	-4.32	0.00083207	-3.87	< .0001
Portfolio at risk(x_3)	-1.98	0.03314	-6.89	<.0001
Operating expense /asset ratio (x_4)	-5.23	0.02389	8.11	<.0001
Debt/equity ratio (x_5),	-8.82	0.02474	18.76	<.0001
Deposits to total assets(x_6)	6.13	0.08431	-6.6	<.0001

Tables 4: Logistic Regression Analysis of the determinants of Financial Sustainability of MFIs Logistic Regression

Variable	Parameter Estimate	Standard Error	t- Value	Pr > |t|
Intercept	0.683	0.03811	13.77	<.0001
Inflation rate(x_1)	-6.92	0.00073668	-9.96	<.0001
Interest rate (x_2)	-3.02	0.00083207	-3.87	< .0001
Portfolio at risk (x_3)	-2.07	0.03314	-6.89	<.0001
Operating expense /asset ratio (x_4)	-4.87	0.02389	8.11	<.0001
Debt/equity ratio (x_5),	-8.09	0.02474	18.76	<.0001
Deposits to total assets (x_6)	6.91	0.08431	-6.6	<.0001

Inflation rate(x_1) is included in the macroeconomic variables to show how the economic situation might affect the sustainability of MFIs. In this study inflation rate has a value of -8. 61 from LR model and -6.92 from DA model which are all statistically significant at a 5% level. This is highly expected because the inflation rate is used to calculate the MFIs cost of capital that lowers the financial sustainability. Therefore it is clear that MFIs operating in a low inflation country are more successful in becoming self-sustainable whilst MFIs in high inflated countries find it more difficult. The main reason is the erosion of MFI equities due to inflation as higher rates of inflation results in large part of equities being loses.

The coefficient of interest rate (x_2), (-4.32 and -3.02 from LR and DA models respectively), is highly significant at 5% level. The relationship between the interest rate (x_2) and repayment rate is of particular interest. Interest rates are related to the price of capital. The lower the interest rate, the higher the repayment rates of borrowers. The implication is that a higher interest rate increases cost function, which affects their level of markup and thereby reduces the ability to repay borrowed fund. It also implies that that the high interest rate in a country negatively affects the sustainability of the local MFIs.

The coefficient of Portfolio at risk(x_3) is -1.98 and -2.07 from LR and DA models respectively. This variable is significant at a 5% level. As the portfolio at risk (PAR) indicates the portion of portfolio which is at risk of defaulting is clear that a low value will enhance the possibility for a MFI to be sustainable in the long run. The high debt ratio or leverage allows the MFI to be more profitable, thus sustainable and to reach a greater clientele base (Coleman 2007)

The coefficient of operating expense /asset ratio (x_4) is -5.23 and -4.87 from LR and DA models respectively. The result is statistically significant at the 5% level and implies that a decrease (an increase) in this variable increases (reduces) the financial sustainability of MFIs. This result collaborates the finding of Pasiouras and Kosmidou (2007), Bourke (1989) and Kosmidou (2008) that poor expenses management to be among the main contributors to poor financial institutions' profitability.

The coefficient of debt/equity ratio (x_5), (-8.82 and -8.09 from LR and DA models respectively), is statistically significant at 5% level. This may be due to the fact that MFIs in Ghana do not pay dividends and this makes equity a relatively cheap source of finance compared to debt financing. A number of studies provide empirical evidence supporting this negative relationship between debt level and firm's performance or profitability (Rajan and Zingales, 1995; Wald, 1999; Booth et al, 2001; Fama and French, 2002).

The variable, Deposits to total assets(x_6) has a positive coefficient of 6.13 from the LR model and 6.91 from the DA model. This value is significant at a 5% level. This positive value is associated with the benefit that institutions such banks have from having lots of deposits from the public. The financial benefit comes from the fact that the interest rate paid on deposits is always cheaper than borrowing from other institutions and at the same time deposits mobilization can release MFIs from their dependence on donor funds, government

subsidies and external credit. Let us remember that below market rates in the study are taking out from consideration with the calculation of the cost of capital. The debt obtained below

4.   CONCLUSION

The   objective of this paper was to use discriminant analysis (DA)   and   logistic regression(LR)   models   to   examine   the determinants of microfinance institutions' financial sustainability. The models were also used to classify MFIs as sustainable and not sustainable. In general, both models produced similar results. Both methods estimated the same statistical significant coefficients, with similar effect size and direction, although logistic regression estimated larger coefficients.

The overall classification rate for both models was good, and either can be helpful in predicting the possibility of the sustainability of MFIs. Logistic regression slightly exceeds discriminant   function   in   the   correct classification rate but the differences in the AUC were negligible, thus indicating no discriminating difference between the models.

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The Use of a Model Sand Filtration System for Greywater Treatment: A Case Study of Getfund Hall of Koforidua Polytechnic, Ghana

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Abstract
The research aimed at assessing the performance of a model sand filtration system for the treatment of greywater generated at the Getfund Hall of Koforidua Polytechnic. Fifteen (15) water quality parameters were analyzed by collecting influent and effluent wastewater samples of the model sand filtration system and their average values compared with EPA (Ghana) guidelines for wastewater discharges into the environment. Most of the effluent wastewater pollutant met the set guidelines, while others were unacceptable. The ability of the model sand filtration system to effectively deal with key pollutants such as Colour 81%, BOD 74%, COD 70%, Turbidity 65% suggest that the model sand filter is efficient. The use of the model sand filter will not only lead to wastewater treatment before final discharge into the environment but also promote environmentally sustainable development of the country.

Keywords: Greywater; EPA (Ghana); Sand; Treatment; Parameters

1.   INTRODUCTION

The importance of water in all facets of life cannot be over emphasized. It is vital for human wellbeing and is a fundamental resource for development, especially residential area location. As a result, the development of any city has practically taken place near some source of water supply (Rangwalaet al., 2007). The growing concern on environmental issues in relation to wastewater (greywater and sewage) released into the environment, lead many countries and water utilities to explore alternatives such as water treatment and conservation to manage municipal wastewater systems (Griggs, 1999).

The ever increasing levels of pollutants and complexity of effluents from municipality and industry, demand effective technologies to reduce pollutants to the desired levels. The use of current wastewater treatment technologies for such reclamation is progressively failing to meet required treatment levels. Advanced wastewater treatment technologies are essential for the treatment of industrial wastewater to protect public health and to meet water quality criteria for the aquatic environment and for water recycling and reuse (Tchobanologouset al., 2003).

The protection of receiving waters is essential to prevent eutrophication and oxygen depletion in order to sustain fish and other aquatic life. Discharge of untreated effluent wastewaters into water bodies may put at risk

Greywater is generally defined as household wastewater that does not come from a toilet, meaning that it is wastewater that does not contain urine or feces (Morel &Diener, 2006). It makes about 50-80% of residential "waste" water in Pakistan and Vietnam and Ghana (Van Zyl, 1999). The quantity of greywater produced by a household depends above all on practices of the household in question. A household's practices are directly influenced by the amount of freshwater available and the cost and supply route of that freshwater, as well as the number of people living in the household, their ages and gender and the living conditions in the nearby area (Murphy, 2006; Mungai, 2008).

riparian communities that depend on these waters for domestic and personal use. Though treatedgreywater may not comply with drinking water standards, contacts with water carrying high pathogenic loads may potentially lead to the transmission of enteric infections (Kamala and KanthRao, 2002).

The Getfund hall of Koforidua Polytechnic generates about 400m^3/day of greywater which end up in the environment without any form of treatment. To treat the greywater before final discharge into the environment, the researchers conducted andassessment on a model sand filter designed to treatgreywater before final discharge into the environment. The objective was achieved through physical, chemical and biological analysis of the effluent

and results compared with EPA (Ghana) guidelines.

2. RESEARCH APPROACH AND METHODOLOGY

Greywater Sources

Greywater generated in the hall is diverted into a central drain that empties its contents directly into the environment. Sources of greywater generated in the hall include wastewater generated from cleaning the floors, hand basin, kitchen, bath and laundry.

The Model Sand filtration System

Plate 1: Plate showing layers of the filtration mode

The filtration model is shown in Plate 1. The model is a slow sand filter and consists of a bucket having an inlet which is open to the atmosphere at the top, an outlet or underdrain system for the exit of the effluent/treated greywater and layers of gravel and sand materials. The gravel was graded and was laid in layers of 0.05m for the topmost, intermediate and lowest layers having sizes varying from 0.03m to 0.65m. The total depth of the sand layers was 0.25m and the effective size of sand varied from 0.0002m to 0.0003m. The uniformity coefficient of sand is about 2 to 3, enhancing the removal of bacteria.

Sampling was done weekly starting from March to April 2013. Sixteen (16) samples representing eight (8) influent and eight (8) effluent samples of the model filter were analysed. Temperature and pH were measured in-situ. Parameters that were analyzed for include conductivity, turbidity, colour, temperature, pH, total suspended solids, total dissolved solids, BOD, COD, coliforms, nutrients and trace metals. Table 1 presents the methods and instruments used for the greywater quality analysis.

Wastewater Sampling and Analysis

Table 1: Methods and instruments used for greywater quality analysis

Parameter	Method Used	Instrument Used
Temperature	-	Laboratory scale thermometer
Colour	-	Nesselerizer
pH	-	Cyberscan PC 300 series pH meter
Turbidity	APHA Standard method (USEPA)	HACH model 2001P TurbidimeterCyberscan PC 300 Series
Total dissolved solids	Cyberscan PC 300 Series	Cyberscan PC 300 Series
Total suspended solids	Gravimetric method	-
BOD	Winkler modification	-
COD	Closed tube method	-
DO	-	Oximeter
Ammonia-nitrogen	Titrimetric method	Micro Kjeldhal Method
Trace metals	-	A.A.S 220 model
Coliforms	Membrane filtration method	Membrane filter

3. RESULTS AND DISCUSSION

Wastewater characteristics

The mean value of each water quality parameter considered for both influent and effluent wastewater samples have been computed and tabulated (Table 2) as well as the standard deviation and standard errors of 95% confidence interval

Table 2: Greywater characteristics

Parameter	Average Influent	Average Effluent	EPA Ghana (2000)
Temp °C	29.11±0.34	28.02±0.3	<3 above amb
pH	7.84±0.09	7.55±0.2	6-9
Conductivity µS/cm	628.43±57.46	312.60±34.32	750
Turbidity NTU	90.14±3.47	32.3±6.58	75
TDS mg/l	488.85±23.01	467±21.9	<1000
Colour TCU	84.64±13.73	16.25±5.45	100
TSS mg/l	92.39±26.48	39.0±17.36	<50
BOD mg/l	89.79±26.49	23.45±5.51	50
COD mg/l	612.99±66.35	179.23±31.44	<250
NH_3-N mg/l	2.88±0.48	2.04±0.05	1
DO mg/l	1.6±0.30	1.0±0.20	<1
Cadmium mg/l	0.0±0.0	0.0±0	<0.02
Lead mg/l	0.003±0.0	0.0025±0.0	<1
Copper mg/l	0.001±0.0	0.0005±0.0	1
Coliforms FC/100ml	889±171	583±97	400

Temperature

The temperature of the influent greywater was in all cases higher than the effluent greywater for all the sampling times. The temperature of the influent wastewater to the model slow sand filter ranged from 28.77 to 29.45°C and with a mean of 29.11°C. The effluent temperature ranged from 27.72 to 28.52°C. The drop in the effluent temperature could be due to heat losses by convection to the atmosphere and conduction to the walls of the model filter. A drop in temperature is paramount to aiding bacterial activities in the treatment tanks. The health of human beings and plants. The decrease in the pH value of the effluent wastewater indicates that some form of treatment had been achieved.
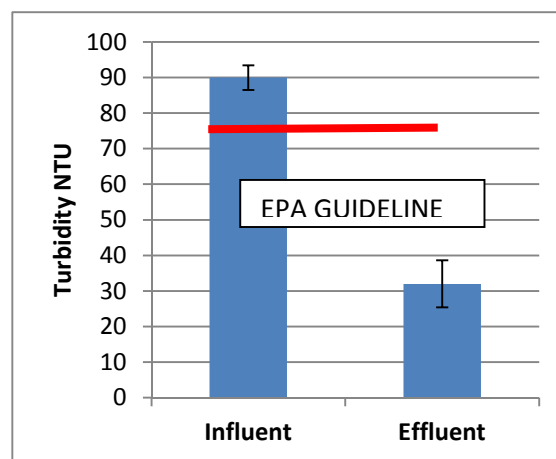
Turbidity

Turbidity, a measure of the light transmitting properties of wastewater, is a test used to indicate the quality of wastewater discharges with respect to colloidal and residual suspended matter. High levels of turbidity in industrial effluents contribute large amounts of suspended solids to receiving waters. The mean influent turbidity value was in the range of 86.67 and 93.61 NTU and was 90.14 NTU. The final effluent turbidity value was in the range of 25.72 and 38.88 NTU. The mean effluent turbidity value of 32.3 NTU was above the EPA Ghana guideline value of 75 NTU. Figure 1 is a plot of the mean influent and effluent turbidity results and the EPA Ghana guideline.

mean effluent temperature of 28.02°C was below the EPA Ghana guideline of 30°C.

pH

The acidity or alkalinity of water is measured in terms of its pH value or H-ion concentration. All the influent wastewater samples analyzed were alkaline. The mean pH value was 7.8 and was in the range of 7.75 to 7.8. The mean pH values of the effluent wastewater ranged from 7.35 to 7.75 and were all within EPA Ghana guideline range of 6 to 9, indicating no direct effect on the colour.

Figure 1: Influent and effluent turbidity and EPA guideline

Various domestic activities such as cleaning of floors, laundry, cooking and others impart considerable amount of colour to greywater. Mean colour value for the influent greywater ranged from 70.91 to 98.37 TCU respectively with the mean of 84.64 TCU. The mean final effluent colour was 16.25 TCU and ranged

between 10.8to 21.7 TCU. Both the mean influent
and effluent colour results were below the EPA Ghana guideline value of 100 TCU.

Conductivity
Generally conductivity of water is determined to ascertain the ability of the waters to conduct electrical current. The mean influent conductivity value ranged between 560.97 and 685.89µS/cm and was 628 µS/cm. The high influentconductivity values may be attributed

Dissolved Oxygen
Dissolved oxygen is required for the respiration of aerobic microorganism as well as all other aerobic life forms. Mean influent DO ranged from 1.3 to 1.9 mg/l and was 1.6 mg/l. Mean effluent DO was 1.0 mg/l and ranged from 0.8 to 1.2 mg/l. The decrease in the effluent DO may be attributed to the use of the dissolved oxygen by microorganisms to degrade organic matter during the greywater treatment period. Both the influent and effluent DO values were consistent with the EPA Ghana guideline value of 1 mg/l.

Total dissolved solids
Total dissolved solids consist of both the organic and inorganic molecules and ions present in the true solution of the greywater. Mean influent TDS value ranged from 465 to 511 mg/l and was 488 mg/l. Mean effluent TDS value was 467 mg/l and ranged from 445 to 488 mg/l. It was noted that both average influent and effluent TDS results were consistent with the EPA Ghana guideline for discharges into the environment.

Total suspended solids
The mean influent TSS value ranged from 65 to 118 mg/l and was 92 mg/l. The mean effluent TSS value ranged from 17 to 56 mg/l and was 39 mg/l. The mean effluent value of 39 mg/l met the EPA Ghana guideline value of 50 mg/l.

Biochemical Oxygen Demand
The influent BOD concentration of the treatment plant ranged from 63 to 116 mg/l, with a mean of 89 mg/l. The high values of BOD in the influent greywater may be attributed to the high concentration of the organic matter content in the wastewater. The mean effluent BOD concentration was 22 mg/l and in the range of 17 to 28mg/l. Figure 2 is a plot of the average influent and effluent BOD

to the highconcentration of dissolved ions present in the greywater. Mean effluent conductivity was 312 µS/cm in arange from 346.92 to 278.28 µS/cm. The drop in effluent conductivity value shows some amount of ion removal. The conductivity levels of the effluents wastewater were satisfactory compared to EPA (Ghana) guideline value of 750 µS/cm.

results and the EPA Ghana guideline. The result of the average effluent signifies that the biological method is able to treat the wastewater by means of biodegradation of organic matter. It is noted that the release of excess amounts of organic matter into the environment could result in a significant depletion of oxygen and subsequent mortality of fishes and other oxygen dependent aquatic or marine organism. The percentage removal achieved was 74%.
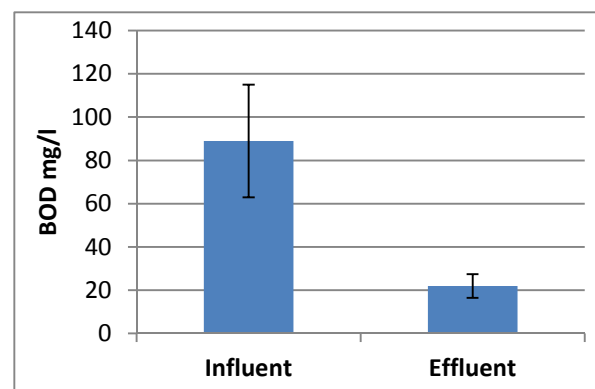

Figure 2: Influent and EffluentBODandEPA Guideline

Chemical Oxygen Demand
The mean influent COD value ranged between 679 mg/l to 546 mg/l and was 612 mg/l. The mean effluent COD was between 147 mg/l and 210 mg/l respectively with a value of 179 mg/l. All the effluent COD values were low as compared to the influent values and met the EPA Ghana guideline value of 250 mg/l. The effluent values could be attributed to the presence of sulphides, sulphites, thiosulphate and chlorides that cause interferences to COD. The removal efficiency was 70%. Figure 3 is the plot of the influent and effluent COD results and EPA Ghana guideline.
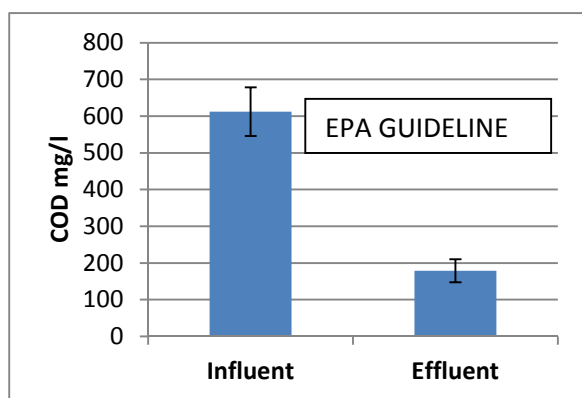
Figure 3: Influent and Effluent COD and EPA guideline

nitrification processes. The average effluent result was above EPA Ghana set guideline.

Cadmium

The mean influent cadmium concentration was 0.0 mg/l and the effluent cadmium concentration 0.0 mg/l. The effluent quality is acceptable according to EPA Ghana guideline of <0.02 mg/l.

The mean influent lead concentration was 0.003 mg/l and the mean effluent was 0.0025 mg/l. Both influent and effluent lead concentrations results obtained were below the EPA Ghana guideline of 1 mg/l.

Coliforms

The mean influent coliforms count ranged from 718to 1060 C/100 ml and registered an average of 889 C/100 ml. The effluent coliforms count ranged from 486 to 680C/100 ml with an

Ammonia- Nitrogen (NH$_2$-N)

The mean influent ammonia value ranged from 1.9 mg/l to 3.3 mg/l and was 2.88 mg/l. The mean effluent value was 2.0 mg/l and ranged from 1.99 mg/l to 2.09 mg/l. The initial rise in ammonia of the influent quality could be due to the presence of ammonia as a by-product of anaerobic digestion whilst the fall in the effluent values could be due to nitrification and deand de-nitrification processes. The average effluent result was above EPA Ghana set guideline.

Copper

The mean influent copper concentration was 0.001 mg/l and the mean effluent was 0.0005 mg/l. Both influent and effluent copper concentration were within the EPA Ghana guideline of <1 mg/l and was satisfactory.

Lead

average of 583 C/100 ml. Even though some form of treatment was achieved, both the influent and effluent coliform concentration is unacceptable in comparison to EPA Ghana guideline. Figure 4 is a plot of the average influent and effluent coliform results and the EPA Ghana guideline.
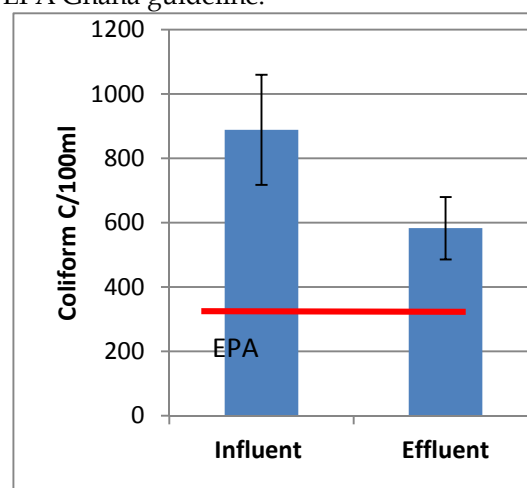

Fig 4. Influent and Effuent Coliform results and EPA guideline

4.   CONCLUSION AND RECOMMENDATION

The model slow sand filtration system has a high potential of removing key pollutants and could be used for better treatment of greywater if managed properly. The removal efficiencies of key parameters such as Colour, Turbidity,

BOD, COD and TSS were between 50 and 100%. The wastewater treatment plant is efficient; however parameters such as coliforms and ammonia were unsatisfactory. Consequently disinfection of the effluent greywatermay be carried out before final discharge into the environment. Further research may be conducted to determine the potential suitability of the treated greywater for irrigating lawns and flowers and gardens.

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Public-Private Partnership in Waste Management: The Way Forward for Ghana.

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Abstract
Waste Management (WM) has become a major issue in most cities of the developing world where provision of the service has been the obligation of local authorities. In Ghana the enormousness of the waste generated coupled with huge financial burden on government for disposal of the generated waste necessitated the introduction of Public-Private Partnership (PPP) in WM in the mid-1990s. This paper presents findings from a study on the impact of PPP in WM since its adoption in Winneba in the Effutu Municipality. The study adopted both qualitative and quantitative research methodologies. Findings from the study show that the introduction of PPP in WM in Winneba has led to a 20% increase in volume of waste collected and over 70% increase in the coverage of communal containers. In addition, there has been a 100% increase in WM equipment and a 50% upward adjustment of communal container lifting frequency as well as the complete elimination of dumping in gutters/sea. Contrary to the author's expectation, the mean travelling distance for waste disposal by households has increased by over 10 meters.

Keywords: Waste Management; Public-Private Partnership; Ghana; Privatisation

1. INTRODUCTION

Privatisation, because of its perceived advantages by policy makers, has been a major phenomenon in both the political and economic landscape of Ghana and Waste Management (WM) has not been left out of the private sector participation endemic. As urbanisation is on the ascendancy in emerging cities, viable WM systems have increasingly become crucial for the proper functioning of these cities (Owusu, 2010). However, local governments of these emerging cities have been unable to effectively provide the sort-after viable WM systems. In view of this, a partnership between public and private entities has been widely advocated as a means to address the WM menace. In line with these, this paper seeks to gain insights into the contributions of PPP to the improvement of WM in Ghana.

Today, municipal waste collection and disposal are particularly problematic in developing country cities, but many Western cities have also grappled with this problem in the past and some still do. In his book "Rubbish", Girling (2005) observed that before the twentieth century, many cities in Europe "drowned in a sea of garbage" with most of their municipal waste being dumped into rivers and open sewers. The current situation in most developed countries is a different story altogether. WM is done with great efficiency and the most modern technologies. Studies such as that of Muneera (2012) and Oteng-Ababio (2010) have attributed such remarkable achievement to privatisation.

The Word Bank (2014) asserts that

> It is common for municipalities in developing countries to spend 20-50% of their available recurrent budget on WM. Yet, it is also common to find that 30-60% of all the urban waste in developing countries remains uncollected and less than 50% of the population is served. In some cases, as much as 80% of the collection and transport equipment is in need of repair or maintenance.

Depicting a similar picture of the problem, Cointreau, (2014), has estimated that in some cases, up to 60% of solid waste generated within urban centers in poor countries remains uncollected and such refuse accumulates on waste lands and streets, sometimes to the point of blocking roads.

The problem is further compounded with local authorities' inability to meet the financial burden caused by waste disposal (Durand, 2013; Pacione, 2005).

In the face of local governments (public) unsuccessful attempt to address urban WM, a

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partnership with private entities has been widely advocated as a means to address the WM menace. As a result, local governments in Ghana since the mid-1990s have partnered with private WM companies with the hope of improving WM systems. However attention has been on the private sector's involvement in WM in the bigger cities of Accra and Kumasi to the neglect of emerging cities. In the news on television and radio, as well as the dailies, every waste problem addressed, is often in relation to the big cities. Meanwhile emerging cities like Winneba are experiencing serious urbanisation, which will, according to Owusu (2010), be associated with large volumes of waste generation. This paper therefore, seeks to gain insights into the extent to which PPP has improved WM in emerging cities in Ghana. every waste problem addressed, is often in relation to the big cities. Meanwhile emerging cities like Winneba are experiencing serious urbanisation, which will, according to Owusu (2010), be associated with large volumes of waste generation. This paper therefore, seeks to gain insights into the extent to which PPP has improved WM in emerging cities in Ghana.

1.1 Objectives and Research Questions
The purpose of this paper is to assess the extent to which PPP has improved WM by looking at the impact of PPP on waste collection and disposal as well as the extent of support for the partnership. To this end the paper answers the following questions.
a. How has PPP improved waste collection in Winneba?
b. To what extent has PPP affected disposal of waste in Winneba?
c. What is the extent of support for PPP in managing waste?

1.2 Theoretical Framework
The theoretical framework underpinning this study is rooted in two theories of economic development, the neo classical free market fundamentalism and the coordination failure approach.

The neo-classical free market fundamentalism emphasises the important role free market, open economy and privatisation of inefficient public enterprises play in development. Leading writers of the theory, like Lord Peter Bauer, Deepak Lal, Ian Little, Harry Johnson, Jagdish Bhaguah and Anno Krueger argue that,

it is state intervention in economic activities that slows the pace of economic development (Todaro & Smith, 2009). The neo-classical free market has three different approaches - free market, public-choice and market friendly approaches. The last approach, market friendly approach, the focus of this paper, propounds that imperfections exist in developing countries markets and that, it is imperative government partner with the private sector to ensure the smooth running of markets (Todaro & Smith, 2009). Thus privatising WM and getting rid of the plethora of government regulations and price distortions in waste collection and disposal will result in an improvement in WM.

The Coordination failure approachcontends that, institutions inability to harmonise their actions and decisions leads to a state where all agents are made worse off (Todaro & Smith, 2009). It states that many agents must come together to undertake investments in order to produce profitable results. Consequently the approach gives an insight into the fact that coordination between public and private WM institutions will see both of them gaining with improvement in WM. A study by Oteng-Ababio (2010) showed that indeed coordination failure results in breakdown of partnership and eventually poor WM. In his work in the Greater Accra Metropolitan Area (GAMA), Oteng-Ababio (2010) revealed that PPP will fail if one stakeholder fails to deliver.

1.3 The Concept of Privatisation
Privatisation has been widely thought to be synonymous with denationalisation. Denationalisation is only a form of privatisation and it refers to the sale of assets or shares of a publicly owned enterprise to the private sector. (Perihan & Ozlem, n.d.) Privatisation refers to the transfer of functions previously performed exclusively by the public sector to the private sector. In other words, privatisation is an umbrella term, which encompasses all methods or policies implemented to increase the role of market forces within the national economy. Its objective is to achieve greater efficiency and improvement in technology. Methods of privatisation include PPP, decentralization etc. (Perihan & Ozlem, n.d.)

The term Public Private Partnership (PPP, P3s or P³) is believed to have its antecedents in

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Britain in the early 1990s. The term has been used by many people to mean different things hence an elusive universally agreed definition. According to Nyachhyon (2006, p.28), PPP refers to a

> …tripartite form of contractual agreement between the public sector (government and municipality) and the private sector (formal and informal enterprises) for provision of basic Services based on combination of commercial viability, sustainability, environmental awareness, social responsibility, public accountability (fairness, Competitiveness and Transparency) with effective involvement of civil societies (communities, NGOs, research groups) as beneficiary target groups.

1.4 The Concept of Waste Management
The business of keeping the environment free from the contaminating effects of waste materials is generally termed WM. Gbekor (2003, p. 18) also explains WM as involving "the collection, transport, treatment and disposal of waste including after care of disposal sites". Schubeller, Wehrle and Christen (1996, p. 7) focus on municipal solid WM which they define as "the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste in urban areas" It can be deduced from these definitions that WM is the practice of protecting the environment from the polluting effects of waste materials in order to protect public health and the natural environment through collection, transportation, processing, recycling or disposal, and monitoring of waste materials.

1.4.1 Goals of waste management
The 1976 United States Resource Conservation and Recovery Act (RCRA) capture the following as the goals of WM.
a. The protection of human health and the environment from the hazards posed by waste disposal.
b. The conservation of energy and natural resources through waste recycling and recovery.
c. Reducing or eliminating the amount of waste generated.
d. Ensuring that waste is managed in an environmentally safe manner.

Other writers agree with these objectives of WM. For example, Schubeller et al. (1996) have stated the goals of municipal solid WM as protecting environmental health, protecting the quality of the environment, supporting the efficiency and productivity of the economy and the generation of employment and income for people.

On her part, Cointreau (2014) argued that the overall goal of WM is to collect, treat and dispose solid waste generated by all residents of urban areas in an environmentally and socially acceptable way, using the most economical means available.

Similarly, the Ghana Environmental Protection Agency (1996) has noted that WM is essential in the present day context for the following reasons:
a. To protect human health against waste-related hazards and risks
b. To prevent pollution of the environment and its natural resources like air, water and land
c. To produce energy which could be an alternative for the fast depleting fossil fuels and other conventional sources of energy
d. To make optimum use of the waste generated

For a better and sustainable future

2. METHODOLOGY
The population for this study consisted of all residents of Winneba. However, the sample for the study was drawn from two localities and a list of registered members of house to house (HtH) waste collection service. The choice for the localities was because, both did not enjoy HtH services but disposed waste through a Communal Container (CC). This prevented interviewing the same respondent twice as a respondent selected from the HtH registered members list could not be reselected from the listed structures sampling frame.

2.1 Sampling Procedures
The purposive sampling was used to choose two of the 36 localities making up the study area. A listing of all the structures in both localities was then embarked upon to create a sampling frame from which 60 households were selected to respond to self-administered questionnaires. The selection from each locality

was based on the number of structures listed i.e. 69 and 137 structures for the two localities, Class 1B and Zongo, respectively. While the selection of HtH respondents was based on the total number of clients of the service, which stood at 100. To find the percentage of the sample size that would come from each sampling frame, the sampling frame population was expressed as a percentage of the total sampling frame population of the two localities and HtH registered members list to get 22%, 45% and 33% for Class 1B, Zongo and HtH registered members correspondingly. The percentage calculated was also expressed as a percentage of the sample size to get 13, 27 and 20 households from Class 1B, Zongo and HtH registered members in that order.   The systematic random sampling was then used to guide the sequence of selecting respondents from the sampling frame.

3. RESULTS

This section presents results based on 60 responses in an area where PPP in WM was introduced in 2006. The findings is also based on in-depth interview with the Environmental Health and Sanitation Department of the Effutu Municipal Assembly

3.1 Background of Respondents

Out of the total number of households interviewed 55% of respondents were females. The study showed an average age of respondents to be 36 years with the minimum and maximum ages being 19 and 61 years respectively (Table 1). Is was also discovered that households that patronised CC service, had average age of those who transport waste to dumpsite to be 20 years with minimum and maximum ages of 9 and 39 years respectively. Average household size in the study was 6 with a minimum and maximum household size being 1 and 13 respectively.

Table 1. Age and Household Size of Respondents

	Minimum	Maximum	Mean
Age of respondents in completed year	19	61	36
Age of CCC Disposers	9	39	20
Number of household members	1	13	6

The study further revealed 55% of respondents to be married with 37% never married. The rest are 3% for divorced and 5% for widowed (Table 2). Most respondents (63%) migrated to the study area with the remaining 37% being indigenes.

3.2 How has PPP improved waste collection in Winneba?

Table 2. Demographics of Study Participants

Demographic Factors	Respondent Subgroups	Percentage
Gender	Males	45
	Females	55
Birth Place	Migrant	63
	Indigene	37
Marital Status	Married	55
	Divorced	3
	Widowed	5
		37
	Never Married	
Education Level	Basic	25
	Secondary	25
	Commercial/Vocational	17
	Tertiary	22
	None	11

Based on the market friendly theory (Todaro & Smith 2009), it is anticipated the private sector's involvement in WM would improve the collection of waste in the study area. In line with this, some variables were tested to measure the extent to which the results of this study conforms to the assertions of the market friendly approach.

3.2.1 Disposal frequency and volume of waste collected

Interview at the Environmental Health and Sanitation Department revealed that prior to the partnership in WM, CCs were emptied twice a week while the current frequency shows a 50% improvement over the 2006 rate. This trend is due to the increase in number of vehicles for waste collection from one skip loader and a tractor in 2006 to two skip loaders and one tractor presently. The improvement is also a result of the introduction of waste tricycles by ZGL for collection of waste, particularly that on the streets of the Municipality.

Table 3: Reason for Respondents Satisfaction or Otherwise

	Breeds flies	Frequent disposal	Poor Location	Unfrequented disposal	Timely Disposal	Afford-ability	Total
Yes	0%	42%	0%	0%	23%	10%	75%
No	3%	0%	12%	10%	0%	0%	25%

The study further revealed that, with current per capita waste generation at 0.05 tonnes per day, total waste collection had shot up by 20% owing to PPP. Eighty percent of the 2.7 tonnes (2721.4kg) daily waste generated is collected as against 60% of 2.2 tonnes of waste generated in 2006.

3.2.2 CC coverage and distance to CC disposal site
Figure 1a displays the position of CC in sampled localities before 2006 while Figure 1b shows the situation presently. The green dots represent household location taken with the Garmin GPS device. The blue diamonds indicate the position of CC in the locality. From Figures 1a and 1b, it would be realised that CC coverage has risen since 2006. The study also revealed that out of 36 localities in Winneba, only 18 were served with CC in 2006. However, 31 localities are served with CC presently. This represents an increase in coverage of CC by
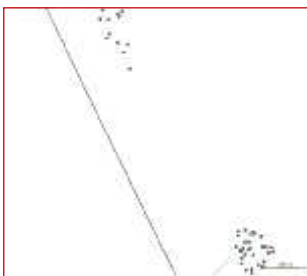
Figure 1a: Pre 2006   **Figure 1b: Post 2006**

over 70%.

3.2.3 Travelling distance to disposal site

Contrary to expectations, average travelling distance to CC disposal site has risen from 83.17 meters before 2006 to 97.11 metres currently.

3.3 To what extent has PPP affected disposal of waste in Winneba?
Proper disposal of waste is critical for good health and protection of the environment

(Cointreau 2014; Schubeller et al., 1996 & RCRA, 1976). This section therefore presents some variables to measure the extent to which PPP has affected waste disposal.

3.3.1 Final disposal type
The study showed that a landfill site was used as a place of final disposal. The site is located about 2km from the township of the study area. It was also revealed that there was no means of recycling, instead waste dumped at the site were burnt. When the site is full, it is covered and another part of the site is excavated and used.

3.6 Method of household waste disposal
Results showed that the most common method of household waste disposal prior to 2006 was burning (Figure 2a). CC accounted for 25% of means of disposal with 23%, 5%, and 12% for dugouts, bush dumping and gutter/sea dumping respectively. A different picture is, however, painted in Figure 2b. It is observed that an improved method of disposal and a more environmentally friendly means of disposal dominate in the methods of waste disposal. Dumping in the sea/gutter has completely been eliminated.
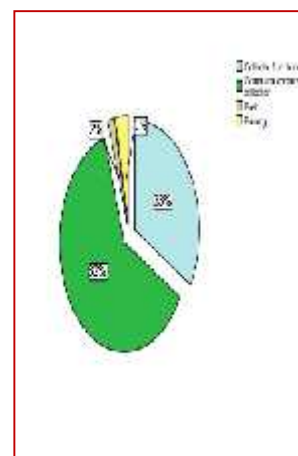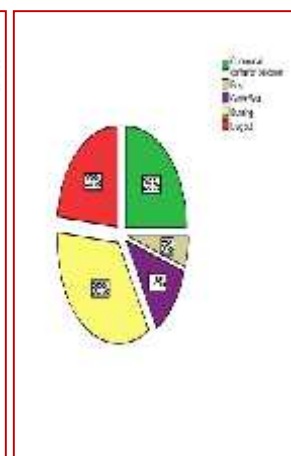
Figure 2a: Pre 2006 Method of Disposal   **Figure 2b: Method of Waste Disposal**

3.4 What is the extent of support for PPP in managing waste

Most (75%) of respondents expressed satisfaction with WM with varying reason (see Table 3). Those who expressed dissatisfaction were mainly in areas served by the CC lifted solely by the municipal assembly. Figures 3a

Figure 3a CC owned   Figure 3b CC owned
by Assembly   by ZGL

and 3b affirm these results.

4 DISCUSSIONS

Based on the works reviewed, it is anticipated the private sector's involvement in WM, will produce a positive impact on WM. This section discusses findings of the study based on the set objectives of the study

4.1 Extent to which PPP has improved Waste Collection

Though waste generation has risen to a daily tonnage of 2.7 at present, percentage collected has risen due to resource capacity increment brought in by PPP. The introduction of HtH service has also contributed to the increase in volume of waste collected. This was summarised in the words of the Environmental Health Officer interviewed, "Zoomlion is able to manage waste effectively due to the type of facilities and experience they have". This concurs with the study by Oteng-Ababio (2010) which revealed an impressive 25% improvement in waste collection in the Greater Accra Metropolitan Area with the participation of the private sector. This is in agreement with the neo-classical free market argument that partnership of the public sector with the private sector will lead to development

Travelling distance to disposal site has shot up with the introduction PPP in WM due to improved disposal methods. Many households prior to 2006 were using dug out and burning

within household premises as means of disposal. However, after 2006, with the inception of PPP in WM, most households resorted to improved form of disposal which is outside their compound.

4.1 Extent to which PPP has improved Waste Disposal

The likely negative health effects of waste disposal on residents have been reduced to the barest minimum due to PPP. Final disposal site has been moved several kilometres away from the township of the study area. This means the site will not have any direct health effects on residents. This is in tandem with the objectives of WM put forward by Cointreau (2014), Schubeller et al. (1996), Ghana EPA (1996) & RCRA (1976). However, pollution of the air by the burning of waste at the site contributes to global warming. Thus, though the WM goal of avoiding health risk associated with final disposal has been achieved by PPP, the effects of disposal on the environment have seen a rather negative increase.

4.3 Extent of support for the partnership to manage waste

The success of an organisation is dependent on the level of support received from its clients. Indeed the Coordination failure approach buttresses this through the assertion that many agents must come together to undertake investments in order to produce profitable results. Thus if clients come together in support of an organisation there would be a very high likelihood of success. There extent of support that an organisation will enjoy is dependent to large extent on the satisfaction of clients. If clients of an organisation are dissatisfied cooperation and coordination will equal zero hence the demise of such an organisation due to coordination failure. Despite the fact that some respondents expressed dissatisfaction of the state of WM in Winneba, it is clear from the findings that, there is a considerable support for PPP in WM indicated by the 75% satisfied with WM. Thus PPP in WM management will thrive in the study area and so, must be continued.

5 CONCLUSION

This paper sought to determine how the application of PPP in WM has impacted on WM. It utilised only collection and disposal

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aspects of WM to measure impact of PPP on WM.

The study, in line with the third goal of WM by the RCRA (1976), showed a tremendous improvement in WM since the commencement of the partnership between the public and private sector to manage waste in Winneba based on the fact that total waste collected has increased by over 20% since the inclusion of the private sector in WM in Winneba with CC counts, shooting up in the various localities in Winneba by over 70%. In addition, number of skip loaders has increased by 100%, leading to an increase in CC lifting frequency by 50%. There has been improvement in method of disposal with more people changing from predominantly burning of waste before 2006 to a more environmentally friendly CC and HtH collection.

Though there has been a significant improvement in WM in Winneba due to PPP, average travelling distance for waste disposal has increased by over 10 meters since the adoption of PPP in WM. This resulted because most residents used burning within household premises as method of disposal. Thus, the introduction of more CC after the partnership to manage waste meant residents had to travel a slightly longer distance to dispose waste.

There was also an indication of tremendous support for PPP in WM by residents, seen through the expression of satisfaction by over 70% of respondents. This also shows some amount of cooperation between residents of Winneba and WM institutions. It is also in support of the coordination failure approach, which argues that if there is no support, hence no coordination among organisations, in a partnership, such partnership will fail.

These findings buttress the neo classical market fundamentalist assertion that privatisation does ensure efficiency. Thus, private sector partnership with the public sector comes with it a lot of positives to bear on WM.

Based on these conclusions, it is recommended that all MMDAs should partner with private WM companies to ensure efficiency through the maximum use of resources and technology. In addition HtH service ought to be the ultimate for all MMDAs in the long run so that

time for disposal purposes could be channelled to other productive ventures.

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Energy Consumption, Economic Development and the Environment in Ghana

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Abstract
This paper examined the relationship existing between energy consumption, economic development and the environment (carbon dioxide emissions) in Ghana for the period 1971 and 2010 with data from the World Bank's World Development Indicators. The Augmented Dickey-Fuller (ADF) and the Phillips Perron (PP) unit root testing approaches found all the variables to be integrated of order one. By employing the Fully Modified Ordinary Least Squares (FMOLS) methodology, the paper found CO_2 emissions to have a statistically significant positive relationship with energy consumption and real GDP per capita, and a negative relationship with real GDP per capita squared. Considering the high possibility of Ghana to emit CO_2, the paper proposes the intensive use of energy sources like solar which is less CO_2 emitting. It is also proposed that the nation embarks on a massive tree planting exercise to help absorb some of the emitted CO_2so as to reduce the harmful effects of climate change on the environment and development.

Keywords: CO_2 Emissions; Energy Consumption; Environmental Kuznets Curve (EKC)

1. INTRODUCTION

The environmental Kuznets curve (EKC) has been the fundamental hypothesis (model) underlying the relationship between the environment and economic development. Most studies on the EKC have concentrated on the emissions of greenhouse gasses (GHGs), chiefly carbon dioxide (CO_2) (see Hossain, 2012, Farhani and Rejeb, 2012) as a legit proxy for environmental degradation due to their direct impact on climate change and global warming (Iwata et al., 2010; Olivier et al., 2012, and Farhani and Rejeb, 2012).The escalating dangers of climate change on the economy have lured governments, non-governmental organizations, environmentalists and economists alike into expanding investments andstudies on GHGs and climate change mitigation issues.

Initial studies on environmental degradation (GHGs emissions) were focused mainly on trade and economic growth/development nexuses as ways of testing the efficacies of the EKC and the pollution haven hypothesis (PHH).However, in recent times the intense contribution of energy consumption to GHGs emissions has attracted the attention of many researchers (seeMenyah and Wolde-Rufael, 2010; Tiwari, 2011;Hossain, 2012; Hamit-Haggar, 2012; Farhani and Rejeb, 2012). The consumption of energy has been identified as the major contributor to CO_2 emissions (Halicioglu, 2009; Akpan and Akpan, 2012, Olivier et al., 2012, Farhani and Rejeb2012). It accounts for as high as about 80% of CO_2 emissions (Akpan and Akpan, 2012). The emissions of CO_2 from energy consumption are mainly seen in the combustion of fossil fuels in transportation (Michaelis, 1993; Sagar, 1995) and industrial activeities (Poon et al., 2006 and Hossain, 2012).

The pursuit of development and industrialization require massiveutilization of energy and natural resources that could have harmful effect on the environment (Hossain, 2012).Considering the strive of developing countries (especially Sub-Saharan Africa) to development and its associated massive energy consumption, emissions of GHGs are likely to be high.The consequence of this is the increase in the harmful effects of climate change.

Successive governments in Ghana have embarked on plethora measures to increase energy consumption,in a way of electrifying every town in the countryto boost economic growth. Though full electrification has not been achieved due to some governance and financial constraints, about 67% of the population have access to electricity (UNEP, 2013). The main sources of energy in the country are biomass, electricity and petroleum. Energy from biomass (the use of firewood, charcoal and crop residue) amounts to as much as 60% of the entire energy consumed. This is followed by petroleum and electricity, accounting for 29% and 11%

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respectively (UNEP, 2013).Biomass energy remains the main source of cooking fuel for about 85% of Ghanaian households (Edjekumhene and Cobson-Cobbold, 2011). The massive use of biomass energy (especially firewood and charcoal) makes the country more susceptible to GHGs emissions and less resistant to climate change.

With increased in economic activities and energy consumption, CO_2remains the most abundant GHG emitted in Ghana (EPA, 2011). Theemissions showed a consistent increase from the year 1989 to 2007 with the exceptions of years 2000 and 2005 (see World Development Indicators, 2013).Ghana is noted to be the 108themitter of CO_2in the world. The Energy sector is the largest contributor of CO_2 emissions, contributing about 41% of the country's emissions (EPA, 2011) with residential and transport sub-sectors as major contributors (UNEP, 2013).

With the exception of studies such as (Menyah and Wolde-Rufael, 2010, and Akpan and Akpan, 2012), there exist very limited studies showing the relationship betweenCO_2emissions, energy consumption and economic development in Sub-Saharan Africa. To the best of author's knowledge there is no particular study in Ghana showing this relationship. This paper therefore aims to fill this gap by examining the relationship between CO_2 emissions (as a proxy for environmental degradation), energy consumption and economic development in Ghana by employing advanced econometric techniques.

Studies of this sort are very relevant due to the devastating effect of CO_2 emissions (major cause of climate change) to the health of people, agriculture and the environment as a whole. Despite the fact that the poorest (developing) countries contribute the least to GHGs emissions, they are the hardest hit victims of the consequences of climate change (Tiwari, 2011). Azomahou et al., (2006) assert that the study of $CO_2$is imperative because; it is the most problematic and difficult GHG to manage and also has massive threaton the environment.

Empirically, the Fully Modified Least Squares (FMOLS) estimator postulated by Phillips and Hansen (1990) was used to find the possible relationship among the variables. The rest of the paper is structured as follows; the second section presents a brief theoretical and empirical literature on the topic. Section 3 describes the methodology. Sections 4 and 5 discuss the results and conclusion respectively. The paper divides the literature explaining the nexus among the environment, energy consumption and economic development into two. The first establishes a relationship between growth and environmentaldegradation. This is mainly to test the efficacy of the EKC hypothesis as initiated by Grossman and Krueger (1991).The EKC asserts that there exists an inverted U shaped relationship between income (growth) and environmental degradation (Kijima et al. 2010). As per capita income increases, environmental degradation (emissions) also increases but tends to fall after a certain level. It can also be viewed as:pollution increases initially as a country develops its industries and then declines after reaching a certain level of economic progress (Jayanthakumaran et al., 2012). At the initial stages of growth, there exists a positive relationship between economic growth and environmental degradation but as higher levels of incomes are achieved, the relationship between growth and environmental degradation turns negative. Studies on the EKC have produced mixed findings, with some affirming the assertion (see Roberts and Grimes, 1997;Schmalensee et al., 1998;Heil and Selden, 2001;Fosten et al., 2012) and others defying it (see Roca and Alcantara, 2001; Akbostanci et al., 2009; Franklin and Ruth, 2012).

The second aspect of the literature which is more recent tries to establish the relationship between energy consumption and environmental degradation (GHGs emissions). The escalating contribution of energy consumption to the emissions of GHGs has called for this examination. Menyah and Wolde-Rufael (2010) in examining the causality between energy consumption, CO_2 emissions and economic growth in South Africa between 1965 and 2006 found that there exists a unidirectional causality running from energy consumption to economic growth and from energy consumption to CO_2 emissions without a feedback effect.In the USA, a study by Soytas et al. (2007) for the period 1960 to 2004 found that energy consumption granger cause carbon emissions in the long run.Over the period 1970

to 2008,Akpan and Akpan (2012) show empirically that increase in electricity consumption leads to an increase in carbon emissions in the long run in Nigeria. In examining the relationship between CO_2emissions, energy consumption, and real GDP for 12 Middle East and North African Countries (MENA) over the period 1981–2005, Arouri et al., (2012) found that in the long run energy consumption has a positive significant impact on CO_2 emissions. Hossain (2012) shows that higher energy consumption in Japan leads to more CO_2 emissions in a study over the period 1960 to 2009.In examining the determinants of CO_2 for a global panel of 69 countries for the period 1985–2005, Sharma (2011) found out that trade openness, per capita GDP, and energy consumptionhave positive impact on CO_2 emissions.

2. METHODOLOGY

This section describes the empirical framework of the study, data used and the time series features of the variables.

2.1 Econometric Model and Data Description

Following the assertion of the EKC hypothesis and the works of Halicioglu, (2009); Hossain, (2012); Jayanthakumaran, (2012) and Hamit-Haggar, (2012), the paper is modeled as;

$$ED = f(ENCONS, GDP, GDP^2) \dots\dots\dots\dots (1)$$

where ED represents environmental degradation, ENCONSisenergy consumption, GDP is real GDP per capita and $GDP^2$is real GDP per capita squared. The paper uses CO_2 emissions as a measure for environmental degradation and real GDP per capita for economic development. CO_2 emissions are the most appropriate proxy for the environment variable since it is the largest GHG emitted globally and in Ghana. They are also the most environmental degrading element causing climate change. The squared variable depicts the inverted U-shaped nature of the EKC (see Halicioglu, 2009; Arouriet al., 2012; Wang, 2012; Jayanthakumaran et al., 2012). Nevertheless the major focus of this paper is not on the establishment of the EKC instead energy consumption.

Equation (1) can be rewritten in its explicit estimable econometric model as;

$$(CO_2)_t = \alpha_0 + \alpha_1 ENCONS_t + \alpha_2 GDP_t + \alpha_3 GDP_t^2 + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots (2)$$

Equation (2) can be expressed in its logarithm form as;

$$\ln(CO_2)_t = \alpha_0 + \alpha_1 \ln ENCONS_t + \alpha_2 \ln GDP_t + \alpha_3 \ln GDP_t^2 + \varepsilon_t \dots\dots\dots\dots\dots\dots (3)$$

All variables are as defined afore. ε_t represents the error term, t time and ln natural logarithm. All the variables are expressed in logarithm form so as to have them assessed in the same unit of measurement.With energy consumption being the largest contributor of GHGs emissions, α_1 is expected to be positive. For the EKC hypothesis to hold, $\alpha_2$and α_3 are expected to be positive and negative respectively.

The paper employed the use of annual time series data sourced from the World Bank's World Development Indicators between the period 1971 and 2010. CO_2 emissions are measured in kilotonnes (kt) per capita. Energy consumption (EC) is expressed as fossil fuel energy consumption as a percentage of total energy consumption, and comprises the consumption of coal, oil, petroleum, and natural gas products. Economic development (growth) is measured as real GDP per capita (constant 2005 US Dollars).

2.2 Time Series Features

This subsection gives a succinct description of the stationarity test and the method of estimation of the paper.

2.2.1 Stationarity Test

Testing for stationarity of all the variables is required in order to determine the order of integration. Knowing the order of integration serves as a guide to choose an appropriate estimator for the study. Not testing for stationarity before estimation could lead to spurious results. The paper tested for stationarity within the frameworks of the Augmented Dickey-Fuller test by Dickey and Fuller (1981)and the Phillips-Perron (PP) test by Phillips and Perron (1988). The PP test is used alongside the ADF test in order to augment the results due to its powerful features. It works very well in the presence of small sample size and also hetereoskedasticity. It has the potential of adjusting for serial correlation and endogeneity of the regressors (Phillips and Perron, 1988).

Both tests test the null hypotheses of unit root presence against the alternative of no unit root. The acceptance of the null hypotheses indicates non-stationarity of the variable whereas the rejection implies stationarity.

2.3 Method of Estimation
After establishing the stationarity of the variables, the paper proceeds to estimate the model so as to ascertain the relationship existing between the variables. It proposes the use of the Fully Modified Least Squares (FMOLS) estimator as put forward by Phillips and Hansen (1990). The FMOLS is chosen as the most appropriate estimator for this paper due to some advantages it possesses over other estimation techniques such as the Autoregressive Distributed Lag (ARDL) model and the Johansen Maximum Likelihood approach. The FMOLS i) does not require the testing and establishment of cointegration before proceeding to the estimation of the model ii) is applicable and robust on both I(0) and I(1) variables (regressors) and iii)performs well on small sample size.

4. RESULTS

Tables 1 and 2 show the results of the stationarity tests at the levels and first difference respectively. Table 3 presents the results of the FMOLS.

Variable	ADF			PP		
	Constant	Constant and Trend		Constant	Constant and Trend	
$\ln CO^2$	-2.01816	-3.518482		-1.920304	-3.436562	
lnENCONS	0.613965	-0.827781		-0.987121	-2.048691	
lnGDP	0.158760	-0.821533		0.052536	-0.754719	
$\ln GDP^2$	0.490645	-0.528293		0.505851	0.879953	

Source: Author's Construct

Table 2. Results of Unit Root at First Difference

Variable	ADF			PP		
	Constant	Constant and Trend		Constant	Constant and Trend	
$\ln CO^2$	-6.676166***	-6.760030***		-12.70378***	-12.95316***	
lnENCONS	-7.341045***	8.160838***		-8.457826***	-18.74078***	
lnGDP	-4.317797***	-3.047163		-4.331926***	-11.07392***	
$\ln GDP^2$	-4.318166***	-3.127773		-4.318166***	-12.30362***	

Source: Author's Construct. Note: *, represents the rejection of the null hypothesis of unit root at the 1% level of significance**

Table 3. FMOLS Regression Results

Dependent Variable: $\ln CO_2$

Regressors	Coefficient	Standard Error	t-Statistics
lnENCONS	8.33E-06***	2.70E-06	3.080408
lnGDP	2.30E-06**	1.12E-06	2.061852
lnGDP2	-2.65E-09**	1.21E-09	-2.186664

Source: Author's Construct. Note: **, ***, represent 5% and 1% level of significance respectively

4. DISCUSSION
This section discusses the results as presented in Tables 1, 2 and 3 above.

4.1 Stationarity Test
Stationarity/order of integration of the variables is checked by employing the use of the ADF and the PP unit root testing

4.2 Results of the FMOLS Regression and Discussion
Table 3 displays the estimates of the FMOLS regression. In the regression estimates, the log All the variables are found to be statistically significant. They are also very inelastic implying, a percentage change in an independent variable will lead to a less than a proportionate change in the dependent variable. Interestingly, the independent variables meet their expected theoretical signs and relationships.

The estimates of the results show a positive relationship between energy consumption and CO_2 emissions. This implies that energy consumption is pollution (CO_2emissions) intensive. An increase in the consumption of energy will cause an increase in environmental degradation in Ghana. The energy consumption variable is found to be statistically significant at 1% level of significance. This outcome is consistent with related studies in Nigeria and Japan by Akpan and Akpan (2012), and Hossain (2012) respectively.

This result is attained because Ghana is a developing country and is making many strides to develop. The development expedition requires the massive use of energy to drive production and industrialization. The more infrastructureis built to produce for development, the more energy is consumed hence leading to an increase in CO_2 emissions. The study finds a statistically significant positive relationship between real GDP per capita (lnGDP) and CO_2 emissions. An increase in economic development (real GDP per capita) leads to an increase in CO_2 emissions. Growth (development) in Ghana is CO_2 emission intensive. In addition the study also finds a statistically negative relationship between CO_2 emissions and real GDP per capita squared (lnGDP^2). This implies that as Ghana attains larger growth (development), environmental

approaches. Both tests indicate that all the series appear to contain unit root at their levels. After first differencing, all the series achieved stationarity implying they are integrated of order one, I(1). The results are displayed in Tables 1 and 2. Table 1 shows the results as tested at the levels and 2 at the first difference.

of CO_2 (lnCO$_2$) is the dependent variable and the logs of energy consumption (lnENCONS), real GDP per capita (lnGDP) and real GDP per capita squared (lnGDP^2) are the independent variables.

degradation starts to improve. That is, as higher economic growth is attained, environmental quality sets in. The signs and statistical significance of the real GDP per capita and real GDP per capita squared conform to the assertion of EKC (see Halicioglu, 2009; Akpan and Akpan, 2012, and Wang, 2012).

5. CONCLUSION
This paper examined the relationship between the environment (proxied by CO_2 emissions), energy consumption and economic development (proxied by real GDP per capita). The use of the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests proved the series to be integrated of order one. Using the FMOLS methodology, the paper found a statistically significant positive relationship between CO_2 emissions and energy consumption. It also found a statistically significant positive and negative relationship between the dependent variable (CO_2 emissions), and real GDP per capita, and real GDP per capita squared respectively. Since Ghana is a developing country, and there is a high possibility of more intensive energy use to aid development, the paper proposes the increase use of less CO_2 emitting energy sources like solar and also the planting of more trees to absorb some of the emitted CO_2.

The use of solar might be very expensive however considering our vast solar potential its benefits with regards to reducing CO_2 emissions would help the country for a very long time. Research and development into other energy sources such as biofuel and wind energy are also advised to be conducted to assess its cost and efficiency since they are very good alternatives for reducing emissions. The study indicates that about 85% of households

use biomass energy for cooking. This is very harmful to the environment and generates much emission. The study therefore proposes the massive use of liquefied petroleum gas for cooking so as to reduce the cutting down of trees and burning them into energy. Afforestation and reforestation are also proposed to be adhered to strictly if CO_2 emissions are to be reduced. This will help reduce CO_2 emissions and the harmful effects of climate change on the environment and development.

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Socio-Economic Predictors of Health Insurance Claims: Evidence From Ghana

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Abstract
The objective of this study was to determine whether there is an association between socio-economic variables and health insurance claims and if other variables mediate between these relationships. In this work, data was collected from the insured of the Ghana National Health Insurance Scheme with the help of the National Health Insurance database and the patients' attendance register of the Koforidua Regional Hospital, from 1st January to 31st December 2011. The generalized linear regression (GLR) models and the SPSS version 17.0 were used for the analysis. The result shows that socio-economic variables have a statistically significant independent association with health insurance claims, demonstrating in each case that the more socially disadvantaged the greater the health insurance claims. Alcohol drinking and cigarette smoking are mediators of the relationship between each socio-economic measure and health insurance claims. Low income has a significant effect on health insurance claims independent of the other socio-economic variables, but this becomes non-significant after adjusting for alcohol and smoking. It is suggested that the government should consider building more health centre, clinics and cheap-compounds in at least every community, to help reduce the travel time in accessing health care. The ministry of health and the Ghana health service should engage older citizens by encouraging them to use hospitals when they are sick instead of resorting to other alternative care providers.

Keywords: National Health Insurance; Claims; Logistic Regression; Socio-economic factors; Ghana.

1. INTRODUCTION

In most African and South American countries, economic problems have resulted in decreased government funding of the health sector and reduced access to health care for most of the population. For example in Nigeria, the public spending per capita for health is less than $5 and can be less than $2 in poorer parts of the country (WHO 2010). Situations like this have prompted governments of low income countries to explore alternative forms and sources of health sector financing. In many European countries, social health insurance is one of the principal methods of health financing and has a long history (Carrin et al. 2005).

"One programme which all the major political parties in Ghana have openly agreed upon, though with different approaches, is the implementation of the National Health Insurance Scheme" (Daily Graphic May 17, 2005). The financial performance of an Insurance Scheme is a function of the premium collected, the cost of health care services of the insured, the level of external subsidy, the size of the pool, and degree of economies of scale that is achieved (Aikins, 2004).

According to World Health Organization in 2010, about 1.3 billion people in the world lack access to effective and affordable health care due to financial limitations or governments inability to provide the necessary coverage. For instance, the United Nation Development Programme (UNDP) report for the year 2007 (UNDP, 2007:32-33), estimates that about 70 percent of the population of Ghana use alternative medicine which includes traditional health care while 30 percent use orthodox medical care. The report further posits that in terms of orthodox health care in Ghana, only 18.4 percent of the sick or injured consulted a health practitioner and a sizeable proportion of rural areas and northern Ghana generally are excluded due to the inability to pay. The Millennium Development Goals for poverty reduction and health will not be met without a concerted effort aimed at extending health interventions to the world's poor (Sachs et al, 2005:29). Against this background, the Ghanaian parliament in 2003 passed the National Health Insurance (NHI) Act, Act 650 promoting Mutual Health Insurance Schemes for the extension of social protection in health to the poor regardless of ability to pay at the point of accessing health services. This culminated in the official launch of the National

Health Insurance Scheme (NHIS) in March 2005. The scheme gives prominence to community/district mutual health insurance schemes as a key strategy for the extension of social security in health to every Ghanaian in a bid to enhance access to health care especially for the rural poor and combat social exclusion. There have also been debates about the levels of premium being collected currently by the Scheme. One School of thought have it that if premiums are not increased from the current levels, the scheme may run into severe financial difficulties due to high level of claims.

In this study,researcherslooked into some of the problems enumerated above and critically examined some important characteristics of the insured of the national health insurance scheme. The researchers addressed the issues of the views and attitudes of the National Health Insurance Authority (NHIA) regarding estimation of national health insurance claims as well as factors that the authority consider in premium rating. Again, the paper contributed to the existing literature on national health insurance studies in Ghana by providing empirical results pertaining to the significant effect of the insured's risk factors on claim made or otherwise. It is believed that results would have implications for the successful implementation of national health insurance policies in Ghana.

In order to achieve the aim of the study, the binary logit model was employed. The choice of this statistical technique is based on the dichotomous nature of the response variable (whether the insured has made claim or not).The data for the study was drawn from the NHIA database and the hospital records of the Koforidua regional hospital.The remaining part of the paper is organized as follows: section 2 describes the concept of the methods employed in the research. The data, empirical analysis and results are presented in section 3; Section 4 provides the concluding remarks as well as recommendations.

2. METHODS
2.1 Study Area and Source of Data
The eastern region of Ghana has 21 administrative Municipals and Districts with Koforidua as the regional capital.Eastern Region of Ghana has an estimated population of 2,194,508, with 3.1% growth rate. It is the

sixth largest region with a land area of 19,323 sq. km., thus representing about 8% of the total land area of the country (Statistical Service, 2011). The region is bounded on the East by the Volta Region, South by Greater Accra region, West by Central Region and on the North by Ashanti Region. It has the largest number of health facilities in the country. The Koforidua Regional Hospital is a state run referral hospital. The hospital, with about 250 patient beds is the largest facility in the region which serves both as the first consultation point for patients within its catchment and as a referral centre for about other 25 primary health centres. These facilities are managed by the Ministry of Health and the Ghana Health Service.

2.2 Data collection and data management
Data used in this study were obtained as primary data from hospital attendance records at the Koforidua Regional Hospital from 1st January 2011 to 31st December 2011. Data was collected from the policyholders of NHIS in Ghana using the simple random sampling technique with the help of the NHIA database. A total of 4,549 policyholders were sampled from the NHIA data base. For this study, the hospital attendance register was used which has patients' age, sex, date of admission and discharge, insurance claim or otherwise, living condition, number of children, level of education, employment status, cigarette smoking, alcohol drinking, billed charges (i.e. for treatment), marital status, health status and whether the patient was an outpatient or inpatient.From the data, the following variables were coded:
outcome(claim = 1, no claim = 0); *length of stay* (inpatient=1, outpatient = 0); *marital status* (married = 1, unmarried = 0); *distance* to the hospital ((distance > 5km) = 1, (distance ≤ 5km) = 0).

The distance of 5 km was chosen to reflect travel time of 1 hour on foot.Age, sex, health status, income level, number of children, level of education, employment, cigarette smoking, alcohol drinking, living condition, marital status, length of stay and billed charges were employed as deciding factors.

2.3 Model specification, estimation and tests
The response variable in logistic regression is usually dichotomous, that is, the response

variable can take the value 1 with a probability of success *p*, or the value 0 with probability of failure, *(1-p)*. To explain the logistic regression, we show here the logistic function *f (z)*, which describes the mathematical form on which the logistic model is based

$$f(z) = \frac{1}{1+e^{-z}} \qquad (1)$$

Where *z* denotes the values of this function, such that, $-\infty \leq z \leq +\infty$. The relationship between the predictor and response variables is not a linear function in logistic regression; instead, the logistic regression function is used, which is the *Logit* transformation of *p*. To obtain the logistic model from the logistic function, we write *z* as the linear sum.

$$z = \Gamma + \sum_{i=1}^{k} S_i x_i \qquad (2)$$

Where x_i are independent variables of interest and α and S_i are constant terms representing unknown parameters and *k* is the last term. Combining (1) and (2) gives:

$$f(z) = \frac{1}{1+e^{-\left(\Gamma + \sum_{i=1}^{k} S_i x_i\right)}} \qquad (3)$$

For notational convenience, we will denote the probability statement as simply *p(x)* where *x* is a notation for the collection of variables x_1 through x_k. Thus, the logistic model may be written as

$$f(X) = \frac{1}{1+e^{-\left(\Gamma + \sum_{i=1}^{k} S_i x_i\right)}} \qquad (4)$$

However, since the above logistic model is non-linear function, the *Logit* transformation would be used to make it linear.

$$Logit(X) = In_e\left(\frac{P(x)}{1-P(x)}\right) \qquad (5)$$

Where,

$$P(x) = \frac{1}{1+e^{-\left(\Gamma + \sum_{i=1}^{k} S_i x_i\right)}}$$

(6)

This transformation allows us to compute a number, *logitp(x)*, for an individual with independent variables given by *x*.

$$Logit\, P(x) = \Gamma + \sum_{i=1}^{k} S_i x_i \qquad (7)$$

Thus, the logit of *p(x)* simplifies to the linear sum. The quantity *p(x)* divided by *1-p(x)*, whose *log* value gives the *logit*, describes the odds for a policyholder not making a claim, with independent variables specified by *x*.

$$\frac{P(x)}{1-P(x)} = Odds\ for\ individual\ X \qquad (8)$$

The goal of logistic regression is to correctly predict the category of outcome for individual cases using the most parsimonious model. To this end, a model is created that includes all predictor variables that are useful in predicting the response variable (Kleinbaum and Klein, 1994). For this study, the risk of making an insurance claim are influenced by predictors such as age, distance, billed charges, sex, marital status, length of stay, number of children, level of education, employment, cigarette smoking, alcohol drinking, living condition, health status and income level. The following logistic regression model was fitted to the data.

$$Logit(P(y = 1)) = S + V + \sum_{i=1}^{k=14} S_i x_i$$

(9)

Where *P* is the probability of claim made, the *x*'s are independent variables of interest, and the β_i are constant term and coefficients respectively representing unknown parameters and ε is the residual term. The coefficients of the model predictors are tested via the hypothesis as follows:

$$H_o: \beta j = 0$$
$$H_i: \beta j \neq 0j = 1, 2,3,4,5,6,7,8,9,10,11,12,13,14$$

Once a logistic regression model has been fit to a given set of data, the adequacy of the model is examined by overall goodness-of-fit tests and examination of influential observations. One concludes a model fits if the differences between the observed and fitted values are small and if there is no systematic contribution of the differences to the error structure of the model. A goodness-of-fit test that is commonly used to assess the fit of logistic regression models is the Hosmer–Lemeshow test (Hosmer and Lemeshow, 1980). Although appropriate estimation methods which take into account

the sampling design in estimating logistic regression model parameters are available in various statistical packages, there is a corresponding absence of design-based goodness-of-fit testing procedures. Due to this noted absence, it has been suggested that goodness-of-fit be examined by first fitting the design-based model, then estimating the probabilities, and subsequently using iid-based tests for goodness-of-fit and applying any findings to the design-based model (Hosmer and Lemeshow, 2000). The hypothesis for model fitness can be measured by the *Hosmer and Lemeshow test* as follows

H_o: *The model fits the data*
H_1: *The model does not fit the data*

3.0 EMPIRICAL RESULTS
3.1 Descriptive Analysis

Table 3.1, shows the number of observations for the study. The total number of observations for this study was 4,549. More than 50% of the people who were sampled were females (56.0%) and the remaining (44.0%) were males. The table indicates the frequency of the respondents who made or did not make a claim. Majority of the respondents have made an insurance claim (92.0%), the rest have not made claims in the year (8.0%). The results indicate that majority of the respondents (46.3%) are in the age group of 18-39 years, followed by the age group 40-60 years (19.4%), the rest are in the age groups of 0-17 and 61-100 (19.2% and 15.1%) respectively. The results indicate that majority of the insured who made claims are among the working group aged between 18-39 years (45.2%). The results show that majority of the respondents were unmarried (58.7%) and the rest are married (41.3%).Table 3.1 shows that majority of the insured sampled have very good or good health status (65.3%), (24.0%) of the insured had fair health status and the rest had poor health status (10.7%). Again, majority of the patients that attended hospital are charged bills between GHS1-400 (58.6%), (26.2%) of the insured that attended hospital were billed between GHS 401-800, the rest were billed GHS 801 or more (9.7%).

Majority of the insured who were sampled earned incomes between GHS1-1000 (54.0%), (31.4%) of the insured earned no income and the rest earned GHS1001 or more (14.6%). Majority of the insured travel less or equal to 5km to the hospital (51.2%), and the rest travel more than 5km to the hospital. Majority of the sampled insured persons used outpatient services at the hospital (57.2%), and (36.8%) used inpatient services and the rest (6.0%) had not used the hospital services in the year. Table 3.1 indicates that majority of the insured persons who were sampled had no child (48.7%), (18.8%) had one child, (17.1%) had two children and (15.4%) had three children or more. Table 3.1 also shows that more than half of the insured persons had no education or only basic education (62.7%), (15.4%) had education up to senior high school, (6.7%) of the insured persons had professional qualification and (15.2%) had education up to the degree level. 29.9% of the insured persons were full time workers, (23.9%) were working part-time, (31.9%) were unemployed and (14.3%) were economically inactive. Majority of the insured that were sampled had never smoked (66.4%), (19.7%) were smokers, and (13.9%) were ex-smokers. Majority of the respondents (42.7%) were non drinkers of alcohol, (22.9%) were ex-drinkers, (18.9%) were regular drinkers and (15.5%) were occasional drinkers of alcohol. Majority of the insured persons (58.2%) rent single rooms or double rooms as their living apartment, (22.1%) rent flats or self-contained apartments and (19.7%) of the insured persons are living in their own houses.

Table 3.1: Composition of the survey population

Age(Years)	Numbers	%
0-17	873	19.2
18-39	2105	46.3
40-60	884	19.4
61-100	687	15.1
Sex	**Numbers**	**%**
Male	2002	44.0
Female	2547	56.0
Marital Status	**Numbers**	**%**
Married	1879	41.3
Unmarried	2670	58.7
Health Status	**Numbers**	**%**
Very Good	1165	25.6
Good	1805	39.7
Fair	1092	24.0
Poor	487	10.7
Billed Charges	**Numbers**	**%**
No	250	5.5
GHS 1-400	2666	58.6
GHS 401-800	1191	26.2
GHS 801-1200	246	5.4
GHS 1201-1600	123	2.7
>GHS 1600	73	1.6
Income Level	**Numbers**	**%**
No income	1429	31.4
GHS 1-1000	2456	54.0
GHS 1001-2000	600	13.2
GHS 2001-3000	59	1.3
GHS>3000	5	0.1
Distance	**Numbers**	**%**
>5km	2220	48.8
5km	2329	51.2
Length of Stay	**Numbers**	**%**
Non	273	6.0
Outpatient	2602	57.2

Inpatient	1674	36.8
Number of Children	**Numbers**	**%**
No Child	2215	48.7
1 Child	854	18.8
2 Children	781	17.1
3+ Children	699	15.4
Level of Education	**Numbers**	**%**
No Education	972	21.4
Basic Education	1875	41.4
Senior High School	707	15.5
Professional	307	6.7
Degree	693	15.2
Employment	**Numbers**	**%**
Working full-time	1364	29.9
Working part-time	1089	23.9
Unemployment	1454	31.9
Economically Inactive	642	14.3
Cigarette Smoking	**Numbers**	**%**
Smoker	895	19.7
Ex-Smoker	634	13.9
Never Smoked	3020	66.4
Alcohol Drinking	**Numbers**	**%**
Regular Drinker	864	18.9
Occasional Drinker	702	15.5
Ex-Drinker	1041	22.9
Non-Drinker	1942	42.7
Living Condition	**Numbers**	**%**
Own House	894	19.7
Rented Flat/Self Contained	1004	22.1
Rented Single Room/Double Room	2651	58.2
Claim	**Numbers**	**%**
Yes	4185	92.0
No	364	8.0

3.2 Odds Ratio Analysis of Risk Factors

The computation of the crude odds ratio for risk factors, *X*, is given by the estimate *Exp (B)*. The crude odds ratio of risk factor determines the influence it has on the claim outcome. The Wald's and log likelihood ratio tests are also performed to ascertain the significant effect of the risk factors. A probability value of less than or equal to 0.05 was considered to be statistically significant. Hence the inclusion of that risk factor is important in determining the claims outcome Y= 0 or 1

Table 3.2: Logistic Regression Predicting Likelihood of Health Insurance Claim

Variable	Estimates	S.E.	Wald	Df	P-Values	e^β
Sex	0.591	0.140	17.688	1	0.000	1.805
Age	-0.290	0.069	17.787	1	0.000	0.748
Marital Status (MS)	0.404	0.193	4.376	1	0.036	1.498
Health Status (HS)	0.168	0.131	1.650	1	0.199	1.183
Billed Charges (BC)	0.744	0.389	3.660	1	0.056	2.104
Income Level (IL)	0.364	0.243	2.242	1	0.136	1.439
Length of Stay (LS)	-5.620	0.521	116.294	1	0.000	0.004

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Distance (D)	0.617	0.260	5.630	1	0.018	1.853
Number of Children (NC)	0.094	0.239	0.156	1	0.693	1.099
Level of Education (LE)	-0.395	0.235	2.795	1	0.692	1.098
Employment Status (ES)	0.360	0.690	0.272	1	0.602	0.698
Cigarette Smoking (CS)	-2.927	1.104	7.033	1	0.008	0.054
Alcohol Drinking (AD)	2.793	0.263	111.112	1	0.000	16.329
Living Condition (LC)	0.153	0.077	3.907	1	0.048	1.165
Constant	3.036	0.330	84.459	1	0.000	20.828

The parameters of the model were estimated using maximum likelihood approach. The estimates for each independent variable are interpreted relative to the referenced category. The estimated odds ratio for all parameters is presented in table 3.2. The working group (18-40 years) is 0.748 more likely to make a claim compared to children (1-17 years) with 95% confidence interval (p-value=0.000) is statistically significant. The odds ratio of 1.805 and a confidence interval of 95%, indicates that females are 1.805 as likely to make a claim compared to their male counterparts, giving a similar statistically significant results. Unmarried policyholders are 1.748 as likely as their married counterparts to make insurance claim at 95% confidence interval (p-value=0.036).

Similarly the results indicate that the odds of making an insurance claim increases by a factor of 1.853 with a confidence interval of 95% when the insured persons travels less than or equal to 5km to attend to the hospital (p-value=0.018). Table 3.2 shows an odds ratio of 0.004 indicating that, inpatients make 0.004 insurance claims as likely as their outpatients' counterparts with 95% confidence interval (p-value=0.000) controlling for other factors in the model. Cigarette smokers are 0.054 more likely to make a claim compared to non-smokers with 95% confidence interval (p-value=0.008) which is statistically significant. The odds ratio of 16.329 and a confidence interval of 95% (p-value=0.000), indicates that alcohol drinkers are 16.329 more likely to make a claim compared to non-alcohol

drinkers giving similar statistically significant results. Those living in rented single/double room apartment are 1.165 more likely to make a claim at 95% confidence interval (p-value=0.048). The results suggest a non-negligible effect (p-value=0.056) of the billed charges to influence health insurance claims.

Health status and income level had probability values of more than 0.05, which means that the health status and income level predictor variables are not significant with 95% confidence interval. The logistic regression obtained was as follows (see Table 3.2 above):

$$Logit(P(y = 1))$$
$$= 3.036 + 0.591 Sex$$
$$- 0.290 Age + 0.404 MS$$
$$+ 0.168 HS + 0.744 BC$$
$$+ 0.364 IL - 5.620 LS$$
$$+ 0.617 D + 0.094 NC$$
$$- 0.395 LE + 0.360 ES$$
$$- 2.927 CS + 2.793 AD$$
$$+ 0.153 LC$$

It is noted that, the risk factors: sex, age, marital status, length of stay, cigarette smoking, alcohol drinking, living condition and distance are significant at $\alpha = 0.05$ with their respective significance values equal to 0.000, 0.000, 0.036, 0.000, 0.008, 0.000, 0.048 and 0.018. Therefore, these risk factors are relevant in predicting national health insurance claims in Ghana. From Table 3.2, it is revealing to note that, the risk factors- health status, billed charges, income level, number of children, level of education and employment status are not **statistically** significant when the other factors are held constant.

Table 3.3 Odds Ratio Analysis for risk factors in Logistic Regression Model for Health InsuranceClaims

	Model 1 Age + Sex		Model 2 Demographic		Model 3 Socio-Economic		Model 4 smoking/Alcohol Drinking	
	OR	95% C.I.	OR	95% C.I.	OR	95% C.I.	OR	95% C.I.
Sex								

Male	1.00		1.00		1.00		1.00	
Female	1.80**	1.33-1.68	1.42**	1.26-1.60	1.23**	1.08-1.40	1.17*	1.11-1.46
Age								
0-17	1.00		1.00		1.00		1.00	
18-39	0.75**	1.26-2.04	1.39*	1.05-1.83	1.56**	1.17-2.08	1.65**	1.23-2.22
40-60	1.06	0.83-1.36	1.02	0.79-1.33	1.24	0.94-1.62	1.21	0.91-1.60
61-100	1.51**	1.18-1.94	1.28	0.95-1.71	1.06	0.78-1.44	1.36	0.98-1.86
Marital Status								
Married			1.00		1.00		1.00	
Unmarried			1.49	1.20-1.69	1.35**	1.13-1.61	1.27**	1.05-1.53
Number of Children								
No Child			1.00		1.00		1.00	
1 Child			1.03	0.85-1.25	0.92	0.75-1.12	0.94	0.76-1.16
2 Children			0.92	0.75-1.13	0.77*	0.62-0.96	0.80	0.64-1.00
3+ Children			1.09	0.66-1.20	0.58**	0.42-0.79	0.59**	0.43-0.82
Income Level								
No Income					1.43**	1.11-1.95	1.32	0.99-1.77
GHS 1-1000					1.28	0.99-1.66	1.19	0.91-1.56
GHS 1001-2000					1.26	0.98-1.61	1.24	0.96-1.60
GHS 2001-3000					1.25	0.96-1.63	1.24	0.94-1.62
GHS>3000					1.00		1.00	
Level Education								
No Educ.					1.098	0.88-1.40	1.16	0.92-1.47
Basic Educ.					1.12	0.91-1.38	1.19	0.94-1.50
S.H.S.					1.24	1.00-1.54	1.33*	1.06-1.66
Professional					1.36*	1.07-1.71	1.46**	1.15-1.86
Degree					1.00		1.00	
Employment Status								
Working Full-Time					1.00		1.00	
Working Part-Time					1.18	0.97-1.43	1.18	0.97-1.44
Unemployed					0.69**	1.18-2.32	1.58	1.10-2.24
Econ. Inactive					2.14**	1.79-2.56	2.06**	1.71-2.48
Living Condition								
Own House					1.00		1.00	
Rented Flats/Self Contained					1.35**	1.10-1.67	1.22	0.98-1.52
Rented Single/Double Room					1.65**	1.22-1.68	1.32*	1.11-1.56
Cigarette Smoking								
Smoker							0.05*	1.04-1.46
Ex-Smoker							0.98	0.83-1.14
Never Smoked							1.00	
Alcohol Drinking								
Regular Drinker							10.09**	1.77-2.47
Occasional Drinker							6.24**	4.05-5.39
Ex-Drinker							1.76**	1.45-2.13
Non-Drinker							1.00	
-2log likelihood	7481.59		7415.25		7186.16		6711.49	
Δ df	6		6		6		6	
Nagelkerke R²	0.017		0.030		0.075		0.164	

*P<0.05, **P<0.01

We now look at how other variables affect the relationship between socio-economic variables and health insurance claims using logistic regression models (n=4549).The order of variables entered into the models reflects an a priori judgment of the primary causal ordering between variables. Age and gender are prior variables (model 1), followed by inclusion of

marital status and number of children in model 2. The primary direction of association assumes that socio economic factors have an effect on smoking and alcohol drinking. Smoking and alcohol drinking are assumed to be causally prior to making health insurance claims and included in the model. The independent effects of each of the socio-economic characteristics on national health insurance claims are shown in model 3 after adjusting for age, marital status, number of children, and the other variables.

Being unemployed or economically inactive is associated with making national health insurance claims (model 3). The odds ratio for the unemployed reduces slightly following adjustment for alcohol drinking and cigarette smoking. The unemployed and economically inactive retain significantly elevated odds of national health insurance claims. Educational qualifications are linked to national health insurance claims with significantly higher odds ratios for respondents with no qualifications. However, these associations with national health insurance claims become greater in model 4 after adjusting for alcohol drinking and cigarette smoking. The findings suggest that health insurance claims is linked to a portion of the insured persons who are more disadvantaged in socio-economic circumstances.

Table 3.4 Odds Ratios and Coefficients for interaction effects in Logistic Regression Models of GNHIClaims

Variables	O.R.	B	Standard Error
Sex*Income	0.2	-1.79	(0.48)***
Sex*Length of Stay	4.9	1.60	(0.31)***
Sex*Distance	2.1	0.73	(0.27)**
Sex*Cigarette Smoking	7.7	2.04	(0.33)**
Sex*Alcohol Drinking	5.1	1.63	(0.29)***
Sex*Living Condition	0.3	-1.32	(0.46)**
Age*Income Level	2.0	0.68	(0.21)***
Age*Length of Stay	0.4	-0.98	(0.49)*
Age*Distance	0.1	-2.44	(0.54)***
Age*Cigarette Smoking	1.7	0.56	(0.34)
Age*Alcohol Drinking	0.3	-1.24	(0.47)**
Age*Living Condition	1.4	0.33	(0.32)
Age*Level of education	0.7	-0.37	(0.53)
Cigarette Smoking*Alcohol Drinking	20.0	2.99	(0.37)***
Living Condition*Income Level	7.9	2.07	(0.34)***

Note:+$p<0.10$;*$p<0.05$;**$p<0.01$;***$p<0.001$, adjusted for design effects. Notes: Coefficients are shown for the intercept and variables included in interaction terms. Estimates are based on logistic regression using normalized sampling weights and taking the sample design into account. Sample sizes are final, weighted samples.

Table 3.4 shows estimated effects of sex, age, income level, length of stay, distance, cigarette smoking, alcohol drinking, living condition and level of education and terms representing the interaction between sex, age and those variables on the odds of making national health insurance claims. Sex*Income interaction shows that there is a positive association with national health insurance claims and this does not vary significantly by sex. Females who are in-patients are 4.9 times likely to make an insurance claim compared with males who are out-patients. Females who live 5km or more from the hospital are 2.1 times more likely to make an insurance claim compared with men who live less than 5km from the hospital. Table 3.4 shows that women who are cigarette smokers are 7.7 times more likely to make an insurance claim compared with men who are cigarette smokers at 95% confidence interval. The table shows that females who take alcohol have a positive association with national health insurance claims. Females who take alcohol are 5.1 times more likely to make an insurance claim compared to men who drink alcohol at 95% confidence interval. Sex had a significant effect with living condition at 95% confidence interval. It shows that females who live in rented single/double rooms are 0.3 times likely to make an insurance claim compared with

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men rent single/double rooms. Age and income interaction shows that there is a positive association with national health insurance claims at 95% confidence interval. Those who are 40 years and below, and have no income are 2.0 times more likely to make health insurance claims compared with the aged who earn high income at 95% confidence interval.

The table shows that age and length of stay interaction has a positive association with national health insurance claims. Those who are 40 years and below and in-patients are 0.4 more likely to use the hospital services and therefore make an insurance claim compared to the aged who use out-patient services of the hospital. Age and distance interaction shows there is a positive association with national health insurance claims at 95% confidence interval. Those who are 40 years and below and stay less than 5km to the hospital are 0.1 more likely to make an insurance claim compared to the aged who stay more than 5km to the hospital at 95% confidence interval. The interaction between age and cigarette smoking shows that there is no association with national health insurance claims. The interaction between age and level of education shows no association with national health insurance claims and the interaction is statistically insignificant at 95% confidence interval. Cigarette smoking and alcohol drinking interaction shows that there is a positive association with national health insurance claims. Those who are regular smokers and regular alcohol drinkers are 20 times more likely to make health insurance claims compared to non-smokers and non-alcohol drinkers at a confidence interval of 95%.

4.0 CONCLUSION
In this study, almost all of the socio-economic and demographic factors were found to have significant association with claims made in the national health insurance scheme. Associations with socio-demographic variables were explored using multiple logistic regressions. The first model looked at associations of each major variable (odds ratios) adjusting for cigarette smoking and alcohol drinking which emerged as a strong determinant in univariate analyses. The second model was fully adjusted to disentangle interactions. The dependent variable is the national health insurance claims. Independent variables were self-explanatory.

The pattern was similar among men and women. When adjusted for cigarette smoking and alcohol drinking, those living in rented single rooms/double rooms were twice as likely to make national health insurance claims as those in own house. With all variables entered, cigarette smoking and alcohol drinking remained strong determinants. Women reporting no or low income status tended to make more insurance claims. Together both confirm that women have the propensity to make national health insurance claims more than men according to socio-economic characteristics. The regression model was fully adjusted, with variables entered simultaneously. Less educated women were more likely to make an insurance claim. Disadvantaged people (younger people, with lower education and people with no income, and among women) were more likely to make an insurance claim.

In a previous study carried out in Malaysia (Aizuddin et al., 2011) on willingness to join and contribute to national healthcare financing scheme, it focused on the farmers in Selangor in which age, education level and per capita income of respondents influenced willingness to pay for National Healthcare Financing scheme.

This study provides evidence that health insurance claims, in the eastern region of Ghana could be described as high. One major shortcoming of using this data is that they only represent those patients who visited the Koforidua regional hospital. Meanwhile, some insured persons may have sought care in other health facilities in the region.

The paper systematically analyzed the main factors that affect the pricing of national health insurance premiums in Ghana and proposed that sex, age, marital status, cigarette smoking, alcohol drinking, living condition, distance and length of stay at the hospital should be used in the determination of the Ghana National health insurance premiums since they considerably influence claims.

Based on the statistically significant influential factors which should be used to determine claims, the study with the help of logistic regression has developed a model to predict the likelihood of the Ghana national health

insurance claims.The paper has designed amechanism for evaluating prospective insured persons and determining their risk factors which will help the insurance company to determine the appropriate premium for prospective clients.

The paper established that insured persons who stay 5km away from the hospital make less National health insurance claims. The paper has established a scientific model for insurance premium that include the cost of transportation. This will enable the poor to have access to means of transport easily especially in times of emergency. This measure will relieve majority of the insured who may be denied access to health care at the time when they cannot afford the cost of transportation to the health facility.

The Ghana National Health Insurance Scheme is on course. Much more needs to be done beyond what currently pertains, for the appropriate determination of premiums for Health Insurance in Ghana; since the sustainability and credibility of the health insurance industry is dependent on getting it right so far as the determination of premiums is concerned. This can be facilitated by institutionalizing the collection of appropriate data on a continuous basis, to assist this important area of the industry's administration, and all effort must be made in this direction if success is envisaged. The government should consider building more health centers, clinics and cheap-compounds in at least every community, to help reduce the travel time in accessing health care. The ministry of health and the Ghana health service should engage older citizens by encouraging them to use hospitals when they are sick instead of other alternative care providers.

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The Impact of Entrepreneurial Orientation on Performance and the Role of External Environmental Factors: A Comparative Study of Ghanaian and Nigerian Creative Arts Service Industry

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Abstract

The objective of the study was to compare the level of Entrepreneurial Orientation and Performance of the Ghanaian and Nigerian Creative Arts Industry and also assess how the external environmental factors affect the link between the two concepts. An adaptedmodel, based on the original work of Dess and Lumpkin was used. A one-on-one interview was conducted on four famous members of the industry; two Nigerians and two Ghanaians. The interviews provided patterns of themes which were matched with the main variables in the model. A survey of Ghanaian and Nigerian Musicians and Actors followed the interviews, based upon which descriptive and inferential statistics were compiled. Because of the small number of the sample, a non-parametric statistics, such as Spearman's Rank Order Correlation and Mann-Whitney U Test, were used in the quantitative analysis. The results showed that there was no significant difference in the level of Entrepreneurial Orientation (Risk Taking, Pro-Activeness and Innovation) as well as the external environment and Performance of the two countries, even though on average Nigeria scored more favorably on Performance and External environment. The paper has shown that the sector engages in a lot of entrepreneurial initiatives thatdepicts the potential for job creation and employment. However, there are some environmental factors which are affecting its progress. To sustain the development of such initiatives,these environmental factors need to be looked into by the Ministry responsible for the sector. A lot more of such comparative study is suggested for Ghana and other countries.

Keywords: Entrepreneurial Orientation; Environmental Factors; Creative Arts Service Industry; Ghana; Nigeria

1. INTRODUCTION

A famous face on Ghana's TV3, known as Chemu Funny Face,   who stares as a trotro(commercial vehicle) mate in a comedy series, known as trotro,has undoubtedly made fame and has improved his wealth over s short period. His visual rendering appears in most television advertisementsand billboards on major roads in the Accra and Kumasi Airports. Patience Ozorkora Nigerian Actor, appears almost every day on the entertainment screens in Ghana and Nigeria, and also appears in most Nigerian Commercials. She has been made a queen mother in a village in the northern part of Nigeria(via a one-on-one interview with her). These personalities are members of the Ghana and Nigeria Creative Arts service industry. The creative arts industry in Ghana comprises the music industry, writing industry, film industry, theatre arts, among others. The Nigerian Creative artsindustryhas two similar unions (Graphic showbiz)For the purpose of this paper, the focus is going to be on the creative arts service industry, that is the Music industry and the Film industry.

The essential act of entrepreneurship is new entry (Dess and Lumpkin, 1997).New entry is the act of launching a new venture, either by a start-up firm, through an existing firm, or via "internal corporate venturing" (Burgelman, 1983). New entry can be accomplished by entering new or established markets with new or existing goods or services (Dess and Lumpkin, 1997).What the researcher gathers from the definitions by the two authors is that members of the creative arts service industry are highly entrepreneurial. They have made numerousnewentries in the industry. Patience, for example, has appeared in not less than one hundred different films. In marketing terms, one can say that this creative artist has manufactured not less than 100 different products! What accounts for this wonderful feat?

There is a general consensus that entrepreneurial orientation influences performance. However, the author has developed much interest in the model created by Dess& Lumpkin(Figure 1) in which, in addition to linking entrepreneurial orientation and performance, has alsoincorporated within the

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model, the impact of the external environment on the entrepreneurial orientation(EO) and Performance. In their model, they used the definition of EOfrom(Child, 1972), as "the processes, practices, and decision-making activities that lead to new entry". Whilst the authors used the model to assess the relationship at the firm level, this research intends to use it at the individual level. Thus, the research will explore the relationship between EO and performance and the role of environmental dynamism, making a comparison between members of the Ghanaian creative arts service sector and that of Nigeria.

The problem statement is that whilst the model has been mostly used in theEuropean and American context, little application has been made in the Ghanaian and Nigerian context. The objective of this paper is therefore to test the model using the Ghanaian and Nigerian context. Specifically, the author will look at the relationship between EO and Performance and the impact of the internal environment. The rest of the paper is structured in the following order; a description of the model and a literature reviewof the main concepts and hypothesis, the methods used in the study, the results, discussions and conclusions.

1.1 Model
The original model of Lumpkin and Dess is reproduced below.

Figure 1:
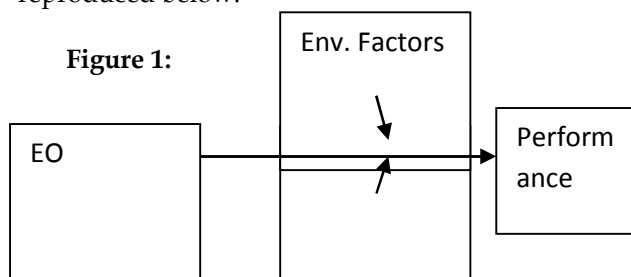
Source: Lumpkin and Dess (1997)

The authors identified under EO, Risk taking, pro-activeness, innovation, competitive aggressiveness and autonomy. Under environmental factors they identified, Dynamism, Munificence, Complexity and Industry characteristics. Under organizational factors they identifiedSize, Structure, Strategy, Strategy-making processes, Firm resources, and Culture and Top management team characteristics. Under performance they identified Sales growth, Market share, Profitability. Competitive Factors and satisfaction. The author of this paper adapted the original work done by Lumpkin and Dess in order to explore the relationships at the individual level as shown in Figure 2.
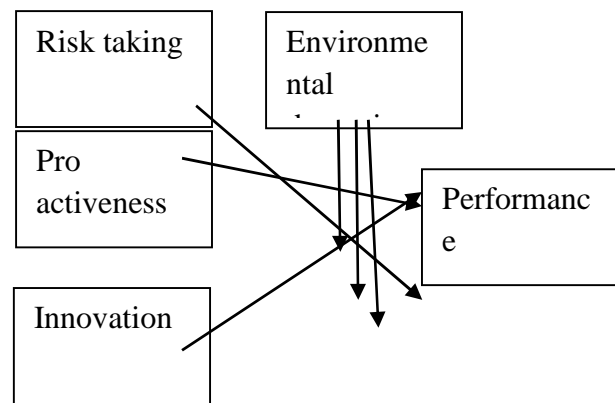
Figure 2:EO Moderator Performance
Source: Author,2014 (Adapted version of original work by DESS and Lumpkin (1997)

1.2 Literature review and hypothesis
Under this section a review the literature based on the factors identified under the adapted model, is done.

1.2.1 Entrepreneurial orientation and performance
The key dimensions that characterize an EO include a propensity to act autonomously, a willingness to innovate and take risks, and a tendency to be aggressive towards competitors and proactiveness relative to marketplace opportunities (Dess& Lumpkin, 1997). Other writers have identified risk, taking, innovation, competitive aggressiveness and autonomy as the factors of EO(Miller, 1983, Covin &Slevin, 1989 Ginsberg, 1985; Morris & Paul, 1987; Neman & Slevin, 1993; Schafer, 1990).Three of the five, which has been adapted from the original model, are going to be looked into.

1.2.2 Risk Taking
Risk taking consists of activities such as borrowing heavily, committing a high percentage of resources to projects with uncertain outcomes, and entering unknown markets(Dess and Lumpkin, 1997). Borrowing heavily cannot be associated with most creative artist. That was the impression the researcher had from the interview granted by the four members of the industry. They all created an impression that financial institutions are reluctant to grant them credit facility.However; all four recognized that they had contributed immensely from their own resources to their trade. Also, they had entered into unknown markets on so many occasions. Ghanaian and Nigerian products flood the markets of both

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countries and some other countries such as The Gambia and Sierra Leone. Thus, the following hypothesis is made:

H1: There will be no difference in the level of risk taking of Ghanaian and Nigerian creative service artists

1.2.3 Pro-activeness

Dess& Lumpkin (1997) defined pro-activeness based onWebster's Ninth New Collegiate Dictionary (1991: 937) as "acting in anticipation of future problems, needs, or changes."

Lieberman and Montgomery (1988) emphasized the importance of first-mover advantage as the best strategy for capitalizing on a market opportunity. By exploiting asymmetries in the marketplace, the first mover can capture unusually high profits and get a head start on establishing brand recognitionas such, proactiveness may be crucial to an entrepreneurial orientation because it suggests a forward-looking perspective that is accompanied by innovative or new-venturing activity (Dess and Lumpkin Dess, 1997). An act of proactiveness identified amongst the Ghanaian and Nigeria creative artist was that of the tendency of some of them to engage in collaborations with each other. In the creative art service industry, collaboration involves getting into partnership with a competitor either locally or internationally. For example the popular Nigerian actress Patience Ozorkor had been seen on the screens together with act Nadia Buari, a Ghanaian actress. Information gathered from the one-on-one interview is that those in the industry who took the initiates (the first-movers)made high profits than those who followed. Such initiative as indicated above involved both Nigerians and Ghanaians. One other nature of proactiveness that creative artist have engaged in anticipation of future problems is the use of U-TUBE to curb the high incidence of pirating. Both Nigerians and Ghanaians have been partnership with Information Technologists to utilize software that have a way of preventing pirating of a song or films originally produced on compact disks. Thus the following hypothesis is made:

H2: There will be no difference in the level of proactiveness of Ghanaian and Nigerian creative artists

1.2.4 Innovativeness

iews on performance (see APPENDIX A). Thus the following hypothesis s made:

Schumpeter (1942) outlined an economic process of "creative destruction," by which wealth was created when existing market structures were disrupted by the introduction of new goods or services that shifted resources away from existing firms and caused new firms to grow. The key to this cycle of activity was entrepreneurship: the competitive entry of innovative "new combinations" that propelled the dynamic evolution of the economy (Schumpeter, 1934). Thus "innovativeness" became an important factor used to characterize entrepreneurship(Dess and Lumpkin 1997). The aspect of innovativeness of creative artist is quiet difficult to detect. This is obvious. They are not physical producers. They provide intangible products. However, the outcomes of the one –on-one interview on innovativeness indicated that appearing on commercial videos and researching and experimenting the performances of others were some of the ways that creative artists innovate. Views from both countries were similar. Thus the following hypothesis is made:

H3: There will be no difference in the level of innovativeness of Ghanaian and Nigerian creative artists.

1.2.5 The role of external environment

The external environment reflects the political, legal, economical, social, technological and competitive conditions in the country of operation. To understand better the role of the external environment, the interviewees were asked to rank the major factors and explain the impact of the external environment on performance. The major factors were pirating and lack of financial support from financiers. Both countries had similar views of the role of the external environment.

Thus the following hypothesis is made:

H4: There will be no difference in the level of the role of the external environment of Ghanaian and Nigerian creative artists

1.2.6 Performance

Performance reflects in summary the qualitative and quantitative rewards since joining the profession. Based on the responses of interviewees, some qualitative and quantitative measures were used. Both countries gave similar

H5: There will be no difference in the level of level of performance of Ghanaian and Nigerian creative artists.

2. METHODOLOGY

A combination of one-on one interview and a survey was utilized in order to achieve the purpose of the research. Firstly a one-on-one interview (Appendix A) was conducted with four famous members of the Ghanaian and Nigerian creative arts service industry: two from each country. They were Patience Ozorkor (actress), Femi Kuti (Nigerian musician and the son of the legendary FelaFunny Face, a well known Ghanaian artist and Reggie Stone(who claims to be the originator of Ghanaian Hip-life). Thefour were interviewed after a symposium, involving Ghanaian and Nigerian creative artist was held at the British Council last November. Using the pattern matching approach, as suggested by Saunders et al (2009), the authors were guided by the theories based on the EO-Performance in conducting the one-on-one interviews.The interview helped in giving more details and thus made the understanding of the concepts better. An interview note is attached as Appendix A. Secondly, a survey was conducted via questionnaires to fifty members of the industry in Ghana and same to Nigeria.

3. RESULTS

The results of the Correlations amongst the concepts are attached as Appendix C. The quessiioniries for Ghana were placed at the offices of the Actors Guild (25) and The Musician Union of Ghana (25). The officers assisted in making the questionnaires available to the members. The exercise was done over a period of three months. The responses gathered from the two offices were twenty six. A similar arrangement was done for Nigeria. However, this exercise was conducted by the kind courtesy of some Nigerian students of the Ghana Christian University, in Accra. Fifteen responses were received. Thus the response rate for Ghana was fifty two percent (52%) and thirty percent (30%) for Nigeria.

The contents of the questionnaires, including the scales, were originally prepared by the author. A non-parametric statistic was employed due to the small sample of forty one (Pallant, SPSS, version 18). Statistic measures such as Spearman's Rho for correlations (attached as Appendix C) and MANN-WHITNEY U TEST for differences between the two independent groups on the continuous measures of Risk taking, Innovativeness, Proactiveness, environmental dynamic factors and performance were conducted. The Likert-5-point scale of measurement was used. A copy of the questionnaire is attached as AppendixB.
results of the tests of hypothesis (SPSS ver.18 REPORT) are attached as Appendix E. A summary of the results is shown under Table1, below

Table 1 mann u test for differences between two independent groups (ghana and nigeria) on continuous measures

Variable Hypothesis	Assumed sig (2 tailed)	Alpha value	Comments
Innovativeness	.477	0.05	Null hypothesis supported
Risk taking	.079	0.05	Null hypothesis supported
Proactiveness	.857	0.05	Null hypothesis supported
Environmental dynamic factors	.232	0.05	Null hypothesis supported
Performance	.062	0.05	Null hypothesis supported

Source: AUTOUR (2014)

4. DISCUSSIONS OF RESULTS

The results show that there were positive correlations amongst the major variables except for a few that show negative correlations amongst each other (see Appendix C). The negative correlations are a bit surprising since most works have shown positive correlations. A probable explanation could be the small nature of the sample. The one-on-one interview (seeAppendix A) identified such major themes as entrepreneurship, collaboration, first movers in the industry, research and specialization, pirating and lack of financial support the major themes significantly matched the major concepts identified in the adapted model. Allfive hypothesis generated by the authors are supported. All showed significant levels above the alpha level of .05(two tailed).

The similarity in the scores of Ghana and Nigeria on all variables has business implications. The two countries are engaging in similar entrepreneurial activities and this has consequences for a possible similar markets and products. The markets and demand for services are larger than practitioners may think. A possible threat may however be the influx of fake products.

The strength of the research design is based on the fact the qualitative studies(one-on-one interview) provided the basis of hypothesis for the quantitative study.

5 CONCLUSIONS

An adapted model based on the relationship between EO and Performance and the role of Environmental factors (Original work by Lumpkin and Dess, 2000) was tested on the creative arts service industry of Ghana and Nigeria. The purpose was to compare the score of the two countries on the major concepts. In order to delve deep into the underpinnings of the concepts, as to how they relate to the industry, a one-on –one interview was conducted on four famous members of the industry: two from Nigeria and two from Ghana. The interview provided essential themes which were pattern-matched with the variables. A survey of nationalities of Nigeria and Ghana was conducted to corroborate the findings of the interview. The difference in the scoreon risk taking. Innovativeness, proactiveness, the role of the external environment and performance for the two countries was insignificant. This research has shown that the creative arts service industry is one area where a lot of entrepreneurial activities go on. The interviewees are, in total, creditedwith not less than one thousand (1000) new entries,in spite very harsh external environmental factors, such as pirating and lack of financial support. Just the four of them! The Graphic showbiz reports that at a point in time the group ABBA of Denmark was contributing not less than 5% gross domestic product of that country! Given that EO leads to high performance, it is one area which needs some attention, especially in the area of research. Such research would be useful in unearthing the potentials of the sector for job creation and how it can contribute to the gross domestic product of the country. To further sustain the sector, it is reccommneded that policy makers look into such impediments as lack of financial support and pirac

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Isolation and characterization of hydrocarbon-degrading bacteria from some petroleum storage facilities within the Kumasi Metropolis

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Abstract

Bacteria and archaea are the only members of the domain prokaryote, but bacteria are far-flung; abounding in the air, water and soil.They are endowed with the genetic machinery to break down every conceivable substance alone or in a consortium synergy. They carry out metabolic activities gratuitously or non-gratuitously for energy and growth. This paper focus on isolating and characterising hydrocarbon degrading bacteria from five different petroleum storage facilities in the Kumasi Metropolis. Bacterial culture-based techniques including surface plating and isolation, enumeration, purification and biochemical tests were employed in the study.A total of five bacterial isolates (*Pseudomonas cepacia, Pseudomonas aeruginosa, Enterobacter, Proteus and Bacillus*)were obtained from the petroleum sludge samples, i.e. gasoline, diesel and keroseneusing purposive sampling (proportional quota). A composite of sludge samples from a depth of two centimetres from two places within a site inwas considered.The experiment (culturing) was carried out in triplicate, the averages morphology and other microbial characteristics were considered. The highest microbial distribution was*Pseudomonas* (40%) followed by *Bacillus* (33%), *Enterobacter* (20%) and *Proteus* (6%). These were confirmed by theAnalytical Profile Index for *Enterobacter* and Analytical Performance Index for carbohydrate, test kits (API 20 E and API CH 50).

Keywords: Bacteria; Petroleum Sludge; API Test Kits.

1.0 INTRODUCTION

One of the world's traded commodities is petroleum. It is a dense energy source for powering vast majority of vehicles and as the base of several industrial chemicals,making it one of the world's most traded items (New York Mercantile Exchange 2006; Mabro, 2006). Sources of environmental contamination with petroleum include seepages and anthropogenic activities such exploration, drilling, extraction, refining and combustion (Kenovolden and Cooper, 2003).

Although it is an important resource,petrochemicals are well known pollutants the environment, having a wide – scale distribution with hazardous physicochemical and biological properties (Lisovitskaya and Mozharova; 2008).

microorganisms adapted for survival and proliferation in suchharsh environment (Bundy *et al.*, 2004.Kim *et al.*, 2005).

3. METHODOLOGY
3.1 Sample Collection
Petroleum sludge samples were collected from five (5) petroleum storage facilities located

The discharge of petroleum products inlarge quantities into the environment has impacted negatively on various ecosystems such as the sea, lands, wetlands and underground water). The consequences are the detrimental effects on plants and animals lives (Atlas and Philp. 2005).Regardless of the source of contamination, petrochemicaleffects on theenvironment are far reaching.Soil contaminations are from cars and trucks, leaky containers thus underground storage tanks (usts), industrial accidents, and field operations involving fuel storage, refuelling of vehicle and industrial plants and improperlydisposed wastes. Hydrocarbon – contaminatedenvironmentsabound in

within theKumasi Metropolis using the systematic area sampling technique. Clean and sterile spatula was employed in collecting a composite of the samples into clean and sterile plastic bags and bottles. The areawhere the samples were taken from included Goil filling station at Suame–Maakro (North of Kumasi) Goil filling station at South (Kwamo), Goil

filing station at East (Tafo), BulkOil and Storage Transportation (BOST) at West (Kaase)andfrom local retailer at Kotei.The geographic locations of the sites are shown below.
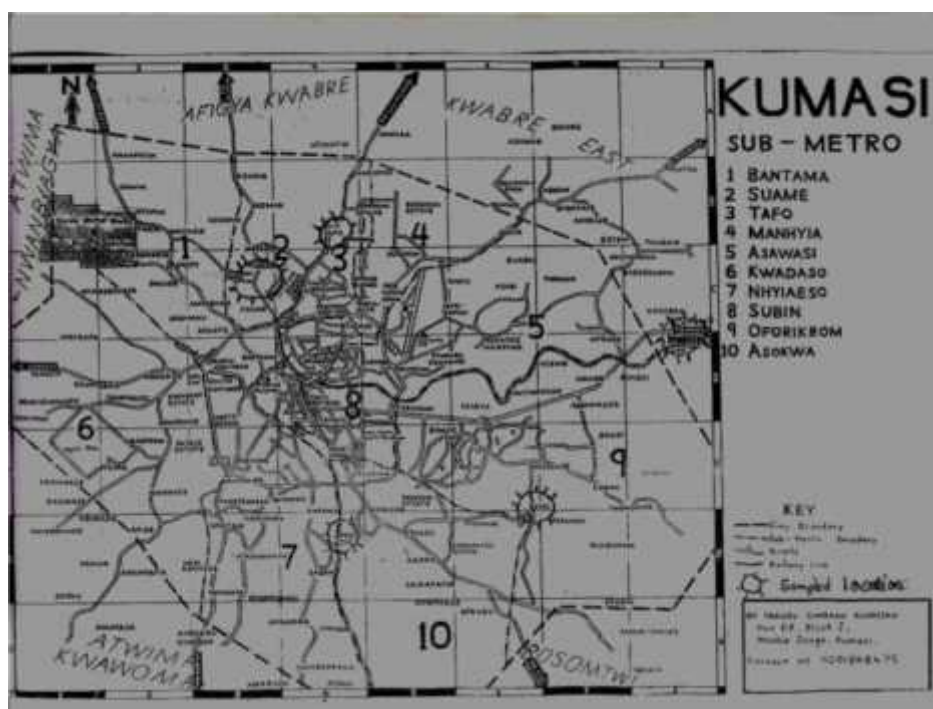

Figure 1(a): Map ofKumasi Metropolis showing areas (spiked circles) where petroleum sludge samples were collected.

3.1 Isolation and enumeration of total heterotrophic bacteria (THB) cultures

One gram of oil sludge sample each from petrol, diesel and kerosene samples collected from each of the five study locations were weighed into test tubes containing 9 ml of sterile distilled water. The contentswere shaken vigorously to obtain a homogenous mixture. Ten-fold serial dilutions in the range of10^{-6} – 10^{-9} were prepared using sterile distilled water. No negative controls were introduced since the experiment was carried out under aseptic conditions. Pour plate technique was used to isolatetotal heterotrophic bacteria (THB) (Oxid). Aliquots (1ml) of sample dilutions of 10^{-6} – 10^{-9} wereeach plated. The above experiment was performed in duplicates. The mixture was allowed tosolidify and then incubated at 37°C for 24 hrs. Total Heterotrophic bacteria (THB) and colonyforming units per gram sample (CFU g^{-1}) of the sludge which is index of microbial contamination of the wasteand site wascalculated usingeach of the following formula

i.e. No of CFU/g of sludge = Average number of colony x Initial weight of soil
Dilution factor

3.2 Purification of culture isolates

Discrete colonies from each of the isolated microorganisms were picked and sub-cultured onNutrients agar (NA) by streaking to obtain pure cultures. The culture plates were incubated at 37°C for 24 hrs, and later stored at 4°C until further use.

3.3 Bacteria identification

The bacterial isolates obtained from the representative samples from the study areas were identified bytheir morphological characteristics based on the shape, size of colony and colour of colony on nutrient agar plates(NA) (Oxid). All isolates were subjected to Gram's staining reaction and catalase test todifferentiate between Gram–positive and Gram–negative bacteria. Physiological characteristicswere determined based on battery of biochemical tests set within the API Test kits i.e. (API 20Eand API CH 50).
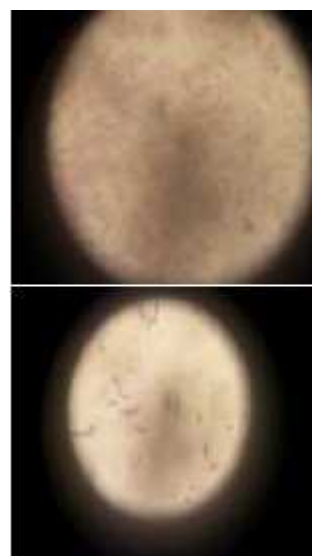
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4.0 Results

Figure 1 (d) Gram–positive (N2)(1000x) Figure 1 (e) Gram–negative (N1)(1000x)

Figure I (d) and (e): A representative Gram status of two bacteria isolates.

Figure 1(c)   figure 1 (b)

Figure 1(c) and 1(b): representative petri dish showingbacteria colony and a purified representative petri dish.

Table 1 (a);Colony characteristics of bacterial isolates from the five petroleum storage facilities in the Kumasi Metropolis

Sample	colony size (cfu g^{-1})	colony colour	average colony forming unit cfu g^{-1}	log of bacteria	shape of bacteria	Gs	Ct
N1	medium	cream/white	1.4×10^7	7.1	short rods	+	++
E1	medium	white/cream	7.4×10^6	6.9	short rods	+	++
W1	medium	white/cream	1.2×10^9	9.1	rods in chains	-	-
S1	medium	white/ cream	1.8×10^9	9.3	long rods	-	-
K1	medium	cream/white	7.2×10^8	8.9	rods	-	-
N2	medium	cream/white	1.25×10^9	9.18	short rods in chains	-	-
E2	medium	white/ cream	1.00×10^9	9.00	small coliforms (spores)	-	-
W2	medium	white/ cream	1.5×10^9	9.10	rods	-	-
S2	medium	white/ cream	1.4×10^9	9.15	rods	-	-
K2	medium	white/ cream	1.00×10^9	9.00	short rods	+	+
N3	medium	yellow	8.0×10^6	6.9	rods in chains	+	++
E3	medium	white/ cream	1.0×10^9	9.00	rods	-	-
W3	medium	white/ cream	1.8×10^9	9.26	short rods	+	+
S3	medium	cream/white	1.28×10^9	9.11	short rods	-	-
K3	medium	cream/white	1.36×10^9	9.13	short rods	+	+

Gs =Grain Stain, Ct = catalase test, N =Suame–makro, S=Kwamo, E=Tafo, W=Kaase, K=Kotei
1=gasoline sludge sample, 2= diesel sludge sample and 3=kerosene sludge sample.

Table 1 (b).Microorganism identified using API CH 50 test kit

Sample code	API CH 50 test	identified organism
N1	positive rods	*Bacillus firmus*
N3	positive rods	*Bacillus firmus*
E1	positive rods	*Bacillus firmus*
K2	positive rods	*Bacillus firmus*
K3	positive rods	*Bacillus firmus*

Table 1(c). Microorganism identified using API 20E test kit.

Sample code	API 20 E code	identified organism
N2	2 202 004	*Pseudomonas aeruginosa*
S2	2 213 004	*Pseudomonas aeruginosa*
S3	4 302 004	*Pseudomonas cepacia*
E2	4 302 004	*Pseudomonas cepacia*
E3	2 202 004	*Pseudomonas aeruginosa*
W1	2 212 004	*Pseudomonas aeruginosa*
W2	3 304 573	*Enterobacter cloacae*
W3	3 305 573	*Enterobacter cloacae*
K1	0 636 000	*Proteus mirabilis*

Table 1 (d) Average microbial population [cfu/g ($\log_{10}$)] of five bacterial isolates from all the five locations.

Bacteria isolate	microbial population (log of cfu g^{-1})
Bacillus firmus	7.80 ± 1.03
Pseudomonas aeruginosa	9.10±0.068
Pseudomonas cepacia	9.10±0.05
Enterobacter cloacae	9.18±0.08
Proteus mirabilis	8.85±0.05

Table 1(e). The percentage of bacteria in gasoline, diesel and kerosene sludge samples from the five locations within the Kumasi Metropolitan area.

ORGANISMS	Gasoline	Diesel	Kerosene	over all percentage (%)
Bacillus firmus	2	1	2	33%*
Pseudomonas sp.	3	2		40%
Enterobacter cloacae	1	1	1	20%
Proteus mirabilis	1	0	0	6.7%*
total				100%

* approximate value(s).

5. DISCUSSION

From the research a myriad of bacteriaidentified that thrive in facilities or sites having oil spills asindicated in Table 1 (b) and 1(c) and confirmed in Table 1 (d) and (e).The table (1b) (c) reveals N1, N3, E1, K2 and K3 samples were the same (*Bacillus firmus)* with an average population of 7.80 ± 1.03.

N2, S2, E3, W1 were also *Pseudomonas aeruginosa* with a log population of 9.10±0.068.S3 and E2 were also members of *Pseudomonas cepacia* 9.10±0.05. W2 and W3 samples contained *Enterobacter cloaca* with a microbial population of 9.18±0.08, whilst sample K1 was mainly *Proteus mirabilis*(average population density of 8.85 ±0.05 log cfu/g-1).The averagecolony forming units (cfu/g-1results)demonstrates thatbacterial populations at the sites (Table 1(a)were significantly high as compared with the minimumvalue of 10^5that had been prescribed by Forsyth *et al*., (1995). In our estimation these are sufficiently high enough to be used for any successful bioremediation activity.In confirming the biochemical identity of the above microorganisms, the isolates were subjected to the API test kits systems (API CH 50 and API 20 E).

Bacteria species identified in the test sludge were Bacillus firmus(Gram-positive), Pseudomonas aeruginosa, Pseudomonas cepacia, Enterobacter cloacae and Proteus mirabilis (all Gramnegative) (tables 1(c) and 1(d)). Theseidentified bacterial species have been reported by other researchers. The study revealed that,ten of the fifteen (15) isolates were found to be Gram-negative while the remaining Gram-positive.Of the ten isolates, Pseudomonas aeruginosa, Pseudomonas cepacia, Enterobacter cloacae andProteus mirabilis were predominant. While the remaining five all belonged to Bacillus firmus. The dominance of Gram-negative bacteria especiallyPseudomonas, at the study locations is not surprising as it has been documented by several researcher publications(Rahmanet al., 2002; Obohet al., 2006., Munoz-Castellanoset al., 2006, Arvanitiset al., 2008, Abdulsalamet al., 2011)and that Gram-positive bacteria if found in an oil spill environment are rarely dominant.

6.0 CONCLUSION

The ubiquitous nature of bacteria cannot be denied as they are found to be active inhabitants of such hostile environment. Statistically, the microbial population from the locations considered did not show much variation as reveal in the mong the microbial load with respect table 1 (d). The bacterial population ranged from higher value of 9.26 cfu/g (log10) to a low value of 6.9 cfu/g (log10) for *Enterobacter cloacae* (W3) and *Bacilli* (E1) respectively. It was reckoned that old petroleum storage facilities at Kaase (W3) and Tafo (E1) respectively abound in greater quantity of the microbes compared with the rest of the filling stations.

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Energy Consumption Patterns In Tamale North Sub-Metropolitan Area

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Abstract
The present energy consumption pattern is a threat to Ghana's sustainable development. Till today, the use of traditional bio-mass as cooking fuel is common place in the country; being a primary energy source to over 80% of Ghanaians. As a result, the nation's forest is fast deteriorating at a rate of 2% per annum leading to an adverse climate change. While this cannot continue to be the case, the energy consumption pattern of key cooking energy sources in the country must be investigated. It is the objective of this study, therefore, to analyze the consumption patterns of key cooking energy sources by key cooking energy consumers in the Tamale Metropolis. Multistage sampling technique was applied to collect data from a total of three hundred (300) respondents who were household heads, and food vendors in the Tamale Metropolis. The study revealed that male consumers were more likely to choose modern cooking sources such as LPG and electricity than their female counterparts. In respect of age, level of education, occupation and monthly income of respondents, it was indicated that the younger generation was more likely to use modern energy sources for cooking than their older counterparts but, the better ones source of income, the higher ones level of education, the higher his/her likelihood to use modern sources of fuel for cooking in the Tamale metropolitan area of Ghana.

Keywords: Cooking Energy; LPG; Kerosene; Electricity; Firewood; Charcoal.

1-INTRODUCTION

Energy is essential to the sustainable development of every economy. It is also important in the reduction of poverty and plays a key role in almost all aspects of economic, social and environmental development. The United Nations Development Programme (UNDP) relates that none of the Millennium Development Goals (MDGS) can be met without major improvement in the quality and quantity of energy services in developing countries (UNDP, 1995). This, thus, gives energy the recognition that it is one of the most important players in economic and human development.

Various fuel sources are applied for various purposes including cooking, lighting, space heating, space cooling, water heating and water cooling. These sources of energy include kerosene, firewood, LPG, electricity etc. The energy consumption dynamics of people have bearing on a number of factors relating to socio-economic conditions, population and demographic changes. Such factors are closely related to energy consumption patterns to the extent that the United Nations Development Programme (UNDP) uses energy consumption as one of human development indicators(UNDP, 1995). In the past few decades, for instance, member countries of the Economic and Social Commission for Asia and the Pacific (ESCAP)

experienced changes in their energy consumption patterns - increasing by 5.6% annually compared to a world average of 1.1% between the periods of 1990 to 1997 - and the reasons given for these changes according to Song et al, 2002; have been in respect of two factors; first, increase in economic activity and development; and second, increase in population and demographic change such us the change in age groups and household size.In related reports,Dzioubinski et al (1999) in a discussion paper indicated that, the average per capita household energy use in developed countries is about nine times higher than in developing countries. In most low-income developing countries only a small affluent minority consumes various forms of commercial energy, similar to most people in the industrial world. Thus, most people in low-income developing countries rely on traditional, non-commercial energy source(WEAO, 2004). Fossil fuels consumption accounts for 83% of the energy consumed in industrial countries, 89% in transition-economy countries, and significantly less in some other regions [WEAO, 2004]. Comparatively, traditional and modern biomass accounts for 16% of the energy consumed in the developing countries of the Latin America and Caribbean; for 25% in developing Asia, and almost 60% in sub-Saharan Africa [WEAO, 2004].

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Studies have shown that, non-commercial energy sources are widely consumed than commercial energy in rural parts of many developing countries, especially the least developed ones. A report by TWAS (2008) indicated that, as societies have industrialized, they have not only used more energy but they have used energy in various forms; typically switching from traditional fuels such as wood, crop residue, and dung, to commercial fuels as oil, natural gas, propane and electricity; as household income increase. Indeed, a number of reports have related energy consumption patterns to factors bordering on socio-economic development including; income levels, urbanization, economic activity, increased desire for comfort, etc[Sokona et al (n.d); Dzioubinski et al, (1999); Karekezi et al, (2002); World Energy Council, (1999)].

Sources have indicated that in Sub-Saharan Africa, commercial fuel consumption is about the lowest in the World, clearly reflecting the low level of economic activity in the region. Mathanguane et al (2001) reported that biomass consumption in sub- Saharan Africa is dominant even in the more developed countries of the region such as Botswana andcommercial oil producers such as Nigeria.

In Ghana, the present energy consumption pattern is a threat to sustainable development. Up till date the use of traditional biomass as fuel for cooking is common place in the country. Amissah-Arthur &Amoo, (2012) found that in rural Ghana, firewood and charcoal consumption accounts for 84.0% and 13.0% respectively. And all other sources such as electricity, kerosene and LPG account for less than 3.0% and are therefore relatively insignificant (KITE, 2005).

The Kumasi Institute for Technology and Environment (KITE) further indicated that the bulk of Ghana's energy use is from biomass in the form of firewood and charcoal whichaccounts for about 59.0% of total energy consumption followed by petroleum products (32.0%) and electricity (9.0%). While these fuels are inefficient the traditional solid biomass (firewood and charcoal) are also injurious to the lives of the population and creates an undue pressure on

women and children who are mostly tasked for collection.

Ghana's forests are fast disappearing due to among other things, the over exploitation of the country's scanty vegetation (Boon et al, 2009); as a result of which the country is now experiences the adverse effect of climate change such draught and adequate supply of potable water (Friends of the Earth-Ghana, 2011;Modern Ghana, 2013).

The Government of Ghana and its development partners have intervened in diverse ways to change the energy demand pattern in the country so as to mitigate the worsening situation of deforestation, climate change and all other associated adverse effects. For instance, in addition to three other West African countries, Ghana signed an agreement for the construction of 678km gas pipeline to supply gas from Nigeria's Escravos region of Niger Delta area to Ghana (Alexander's Gas and Oil Connections, 2006).Also, a number of studies have been conducted on the subject matter in the past and present, locally and internationally. However, as much as the northern region of Ghana is ignored in these studies so do factors such as gender, age, education, occupation and monthly income of key cooking energy consumers are ignored; thus, leaving a wide gap in the intervention strategies. In addition, eventhough commercial food vendors hold an enormous shear of the cooking energy demand in the northern region of Ghana; they have been overlooked entirely in every study. Households together with commercial food vendors contribute substantially to the bulk of cooking energy demand in Ghana, hence the socio-economic wellbeing of the country is likely to suffer serious consequences if they are continually overlooked, especially; in an area where much of the vegetation has already suffered a serious decline due to over-exploitation to meet the growing socio-economic needs of the population (EPA, 2004). As a way forward, this study analyses the relationship between consumers' choice of cooking energy and factors such as gender, age, level of education, monthly income and occupation as well as the consumption patterns of cooking energy in the Tamale north sub-metropolitan area of Ghana with respect to domestic consumers and food vendors who use energy sources for commercial purposes.

2. METHODS
2.1-About Tamale Metropolitan District

Tamale is a tropical dry forest located on the coordinates 09°24'27"N 00°51'12"W. The city has a total land size of 750 km², and home to about 537,986 inhabitants. The average annual rainfall is 1100mm within 95days of rainfall in the form of tropical showers. The mean day temperatures range from 28 ℃ to 43 ℃.The Metropolis is one of the 26 districts in theNorthern Region. It is located in the central part of the Region and shares boundaries with the Sagnarigu District to the North-West, Mion District to the East,East Gonja to the South and Central Gonja to the South West. The people are predominantly Muslims (58%) and of the Mole-Dogbane ethnic group (55.8%) with average household size of 5.5. Even though the city is the fourth largest in the country, the inhabitants are among the poorest and most residents do not have access to the basic urban services.
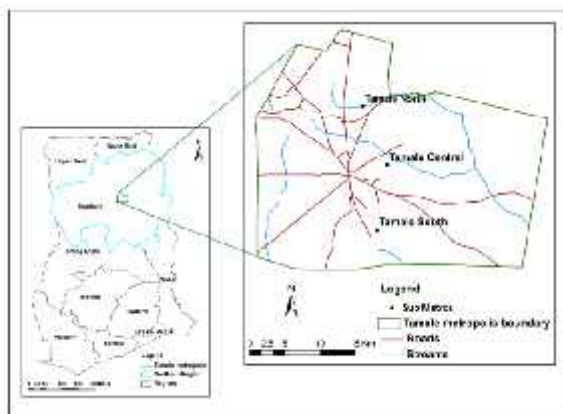

Figure 1: Map of the study area (researchers' own construct)

2.2-Data Collection and Analysis

The studywas carried out between the periods of August to December, 2013. A population of up to 300 respondents consisting of heads of households and food vendors was considered for the study. Data was collect with the aid of a questionnaire. All questionswere closed ended with all possible categories included and coded accordingly in order to obtain quantitative data from respondents. This is because, for an explanatory research design like this, positivists approach to science is the most appropriate to adopt (Marlow, 2000); so that quantitative data can be collected and analyzed.

A multistage sampling technique was applied in sampling the various elements involved in the study. These elements include the communities, households, heads of households and food vendors.Having selected the Tamale North sub-metro by way of simple random sampling technique, it was sorted out into its constituent communities according to low, average and high socio-economic status. An observation tour was conducted by the researchers and their assistants with due attention to the living standard disparities among the people living in the communities. The criteria which were used to categories communities under the various wealth groups include, estimate of educated people, economic activities, type of houses and type of schools among others. Results from the observation tour indicated that, while majority of households about (50%) were under low socio-economic conditions their counterparts under average and high socio-economic conditions represented about 35% and 15% respectively. By virtue of the same criteria, communities within the Tamale North sub-metro were also categorized out of which Fuo, Ward-K and SSNIT flats were selected to represent low, average and high socio-economic status respectively.In sampling households and food joint operatives, stratified random sampling with proportional allocation was used. This was necessitated by the fact that the respondents from the study communities under the three wealth groups,and the peculiar nature of the activities of food vendors, have different characteristics in terms of their demand for cooking energy whose impact on the research was very significant. From the results of the observation tour food vendors who represented about 20% (60) of the entire population of 300, due to the enormity of their cooking energy demand, were sub-stratified into 10 each for heavy food joint, fast food joint and restaurants; and then 30 for petty way-side food vendors, given their varying demand for cooking energy. The remaining 80% (240) of the population which was apportioned to households was then also stratified into 50%(120), 35% (84) and 15% (36) for households under low, average and high socio-economic status respectively. This was then followed by the use of simple random sampling technique insampling household heads while applying convenience sampling technique to obtain data from food vendors.The quantitative data drawn from the study was analyzed using the

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statistical package for social sciences (SPSS), having pre-coded the closed ended questions on the questionnaire. Simple descriptive statistics and Pearson chi-square test was used in the data analysis and cross tabulations used to study the association between two or more variables. Significance level was pegged against p=0.005.

3- RESULTS

3.1-Energy Consumption Patterns of Households

The gender of respondents with respect to their preferred sources of cooking energy was analyzed and the results showed an interesting trend. While male respondents were more likely to consume LPG than other sources of cooking energy, their female counterparts were rather more likely to consume firewood than other cooking energy sources (fig. 1). (χ^2=39.233, P-value=0.000).
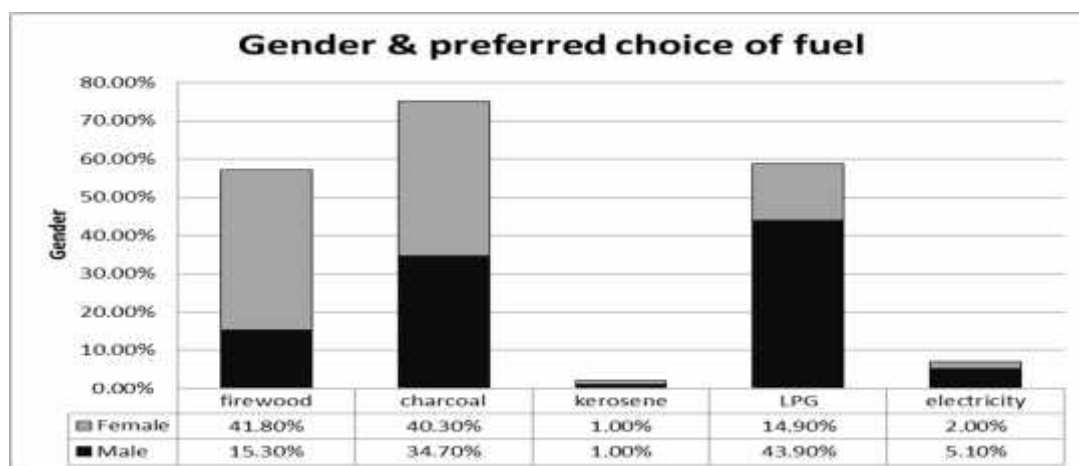
Figure 2: A graph of gender and preferred cooking fuel

Also, analysis of preferred sources of cooking energy with respect to ages of respondents yielded a positive association between the two variables (table 1). People who were within the ages of 36-45years were more likely to use firewood, charcoal and kerosene than their counterparts within the various age groups. Respondents within the age range of 26-35years were rather more likely to consume LPG and electricity than their counterparts within the various age groups.

Table 1:Age and Main Source of Cooking Energy $^2 = 41.942$, p – value = 0.000

Age	Main source of energy %					
	Firewood	Charcoal	Kerosene	LPG	Electricity	**Total**
< 25	4 (4.0%)	9 (8.0%)	0 (0.0%)	5 (6.8%)	3 (33.3%)	21 (7.1%)
26-35	9 (9.1%)	26 (23.0%)	1 (33.3%)	24 (32.9%)	5 (55.6%)	65 (21.9%)
36-45	34 (34.3%)	39 (34.5%)	2 (66.7%)	19 (26.0%)	0 (0.0%)	94 (31.6%)
46-55	33 (33.3%)	25 (22.1%)	0 (0.0%)	19 (26.0%)	1 (11.1%)	78 (26.3%)
>56	19 (19.2%)	14 (12.4%)	0 (0.0%)	6 (8.2%)	0 (0.0%)	39 (13.1%)
Total	**99 (33.3%)**	**113 (38.0%)**	**3 (1.0%)**	**73 (24.6%)**	**9 (3.0%)**	**297 (100.0%)**

The energy consumption trends of respondents were also analyzed taking into accounts their various educational backgrounds. The results indicated that people who have never been in school at all were more likely to consume firewoodthan their counter parts that had been to school (table 2). Those with basic education were likely to consume firewood than their counterparts who had up to secondary and tertiary education. The trend was indifferent for charcoal. However the reverse was the case for LPG and electricity with increasing likelihood of consumptions being with respect to increasing level of education among respondents. (χ^2=1.657; p=0.000)

Table 2: Level of education and main source of energy for cooking

Level of Education	Main source of cooking energy %					
	Firewood	Charcoal	Kerosene	LPG	Electricity	Total
Illiterate	67 (72.8%)	36 (33.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	103 (36.1%)
Basic	20 (21.7%)	25 (22.9%)	2 (66.7%)	3 (4.2%)	1 (11.1%)	51 (17.9%)
Secondary	4 (3.3%)	24 (22.9%)	0 (0.0%)	19 (26.4%)	2 (22.2%)	49 (17.2%)
Tertiary	1 (1.1%)	24 (22.0%)	1 (33.3%)	50 (69.4%)	6 (66.7%)	82 (28.8%)
Total	92 (32.3%)	109 (38.2%)	3 (1.1%)	72 (25.3%)	9 (3.2%)	285 (100.0%)

After analyzing energy consumption patterns with regards to the occupation of consumers, it was noticed that subsistence farmers were more likely to consume firewood than their counterparts. People who were petty traders and businessmen/women were rather equally more likely to consume charcoal (26.1%) than their counterparts under the various groups. Table 3. Also, the unemployed and tradespersons were also equally likely to consume kerosene than those under the various employment groups. The association between occupation and source of cooking energy were found to be statistically significant.

Table 3: Occupation and main source of cooking energy

$$^2 = 1.853, p - value = 0.000$$

Occupation	Main source of energy %					
	Firewood	Charcoal	Kerosene	LPG	Electricity	Total
Unemployed	15 (15.2%)	8 (7.0%)	1 (50.0%)	3 (4.1%)	4 (44.4%)	31 (10.4%)
Petty trader	29 (29.3%)	30 (26.1%)	0 (0.0%)	3 (4.1%)	0 (0.0%)	62 (20.8%)
Business	12 (12.1%)	30 (26.1%)	0 (0.0%)	14 (19.4%)	0 (0.0%)	56 (18.8%)
Trades person	5 (5.1%)	15 (13.0%)	1 (50.0%)	1 (1.4%)	0 (0.0%)	22 (7.4%)
Civil servant/public servant	1 (1.0%)	26 (22.6%)	0 (0.0%)	50 (68.5%)	4 (44.4%)	81 (27.2%)

Farmer	32 (32.3%)	5 (4.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	37 (12.4%)
Others	5 (5.1%)	1 (0.9%)	0 (0.0%)	2 (2.7%)	1 (11.1)	9 (3.0%)
Total	**99 (33.3%)**	**115 (38.0%)**	**2 (1.0%)**	**73 (24.6%)**	**9 (3.0%)**	**298 (100%)**

Income levels of people were also detected to have a bearing on energy consumption patterns. People who earned<GH¢150 were likely to use firewood than their counterparts under the various range of income levels.The trend was almost the same for charcoal consumption with people whose monthly income was between <GH¢50-GH¢150 more likely to consume the fuel than their counterparts. Similarly low income earners were more likely to consume kerosene than their counterpart under <GH¢50-GH¢150 and GH¢150-GH¢250(66.7%). The reverse was the case for LPG with the likelihood of its consumption almost increasing with increasing income levels. Table 4

associated characteristic such as occupation, gender, level of education and age a person is likely to use one cooking fuel or the other.

Table 4: Monthly income and main source energy for cooking

(x^2=87.532, P-Value = 0.000).

Monthly income (GH¢)	Main source of cooking energy					
	Firewood	Charcoal	Kerosene	LPG	Electricity	**Total**
<150	41 (47.1%)	3 (43.2%)	12 (33.3%)	7 (10.6%)	4 (44.4%)	101 (7.1%)
150-250	32 (36.8%)	21 (18.9%)	2 (66.7%)	5 (7.6%)	1 (11.1%)	61 (22.1%)
250-350	12 (13.8%)	20 (18.0%)	0 (0.0%)	17 (25.8%)	1 (11.1%)	50 (18.1%)
350-450	1 (1.1%)	9 (8.1%)	0 (0.0%)	14 (21.2%)	1 (11.1%)	25 (9.1%)
>450	1 (1.1%)	13 (4.7%)	0 (0.0%)	23 (34.8%)	2 (22.2%)	39 (14.1%)
Total	**87 (31.5%)**	**111 (40.2%)**	**3 (1.1%)**	**66 (23.9%)**	**9 (3.3%)**	**279 (100.0%)**

4.0-DISCUSSION

4.1-Energy Consumption Pattern of Households

Household cooking fuel consumption is characterized by a number of factors that influence the consumption dynamics of common cooking fuels in Ghana. Commonly used fuel for cooking in Ghana include, firewood, kerosene, charcoal, LPG and electricity. This research has revealed that depending upon an individual

4.2-Gender and preferred source of cooking fuel

Analysis of energy consumption patterns with respect to the gender of consumers indicated that male consumers were more likely to use LPG than other cooking fuels (electricity, kerosene, charcoal and firewood in decreasing tendency for consumption) while their female counterparts were more likely to consume firewood than other cooking fuels (charcoal, kerosene, electricity and

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LPG in decreasing tendency for consumption). This trend has socio-economic and environmental implications. In the Tamale Metropolis women are responsible for household duties including cooking, hence firewood and charcoal are widely used for cooking in the Tamale Metropolis.

Further analysis was conducted as to the reasons behind this trend and it was discovered that while male consumers used LPG for cooking for the sake of convenience, their female counterparts used firewood for the sake of its availability/accessibility. In line with this finding, Amissah-Arthur & Amoo (2005) reported that the majority of Ghana's energy use is from bio-mass in the form of firewood and charcoal which accounts for about 82% of the total energy consumption in Ghana. Also, KITE (2005) in a related study indicated that, traditional fuels such as firewood and charcoal provide the bulk of energy demand followed by petroleum and then electricity. It added that the majority of Ghana's energy consumption is in the home rather than industry.

4.3-Age and preferred source of cooking fuel

Analysis of preferred cooking fuel with respect to the ages of respondents indicated a significant relationship between the two variables (table 1). There was an indication that the older population was more inclined to the use of traditional biomass fuels (firewood and charcoal) while their younger counterparts are inclined to the use of commercial fuel as LPG and electricity for domestic cooking purposes. This is not surprising because the use of the commercial cooking fuels is facilitated by equipments whose designs tend to discourage the older population from using them. Also, the past experiences of accidents such as fire outbreaks resulting from the use of these commercial fuels could also contribute to this development. With time the younger population has developed the dexterity and awareness of the safe use of the commercial fuels. Also, while the younger generation chooses their cooking fuel for the sake of convenience, their older counterparts choose their fuel for the sake of availability/accessibility. This makes the younger consumers more likely to use LPG and electricity than their older counterparts who prefer to use firewood and charcoal.

4.4-Level of education and preferred source of cooking fuel

The influence of formal education on energy consumption patterns was brought to the fore when analysis of the results from this research indicated that there is a significant relationship between the level of education of domestic cooking energy consumers and their preferred cooking fuel (table 2). Consumers without formal education background or lower education levels are mostly the consumers of traditional bio-mass in the Tamale Metropolis, while their counterparts with higher education levels rather consume the commercial energy resources (LPG and electricity) for cooking purposes. And as there are more illiterates than literates in Ghana (KITE, 2005), the socio-economic and environmental implications of this trend cannot be over emphasized.

4.5-Occupation and preferred source of cooking fuel

Occupation and energy consumption pattern of respondents have a significant relationship after analysis was carried out between the two variables (table 3). Traditional biomass fuels are consumed mostly by the unemployed, subsistence farmers, petty traders and generally people in lower paid jobs, while people in white collar jobs tend to consume the commercial fuels. In line with this development, Dzioubinski, O. & Chipman, R. (1999) say that there is a correlation between choice of energy for cooking and the value of women's time. Thus, women who are in formal employment demand convenience in their choices for domestic cooking energy.

It is worthy of note that income levels of consumers in the Tamale metropolitan area are a key determinant of the type of cooking fuel consumed by people (table 4). Analysis of this study seam to point out a direct linkage between occupation and income level since Low income earners tend to consume the cheapest and less convenient fuels (firewood and charcoal) while their counterpart high-income earners use the commercial fuels (which are cleaner and more convenient to use). Dzioubinski, O. & Chipman, R. (1999) indicated that, with increasing disposable income and changes in the life styles of people, domestic energy consumers tend to move from the cheapest and least convenient fuels to more expensive and convenient ones as LPG and electricity.

5- CONCLUSION

This paper was aimed at determining the relationship between choice of energy source for cooking and factors such as gender, age, level of education, monthly income and occupation as well as the energy consumption patterns in the Tamale north sub-metropolitan area of Ghana with respect to domestic consumers and food vendors who use energy sources for commercial purposes. The paper concludes that there is a significant relationship between consumers' choice of energy for cooking and factors such as gender, age, level of education monthly income and occupationof consumers. Also, the energy consumption pattern of households in the Tamale north sub-metropolis is presently unfavorable leading to the over reliance on traditional biomass for cooking in the area. If the trend remains unchanged over time, so that residents continue to depend on unclean sources of energy for cooking, the socio-economic situation of the Northern Region of Ghana will be negatively affected in diverse ways.

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Analysis of Life Satisfaction and Gender Differences Using Multiple Regression. A Case Study of Koforidua Polytechnic

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Abstract
The overall aim of the study was to examine individual's life satisfaction and gender differences using multiple regression. A stratified sampling technique was employed to select respondents for the survey where a sample proportional to size was used to select each stratum which were Junior Staff, Senior Staff and Senior Members. The study found no relationship between gender and life satisfaction but men tend to rate themselves higher than women. Frequent body pains or discomfort and ageing frails are found to affect life satisfaction directly. It was found that there are association between life satisfaction and education, income, job, health and family.

Keywords: Principal Component Analysis (P.C.A); Spearman's Correlation; Multiple Regression; Proportional to Size; Ageing frailties

1.0 INTRODUCTION

A great deal of psychological research has explored the sources of people's life satisfaction. These sources include one's overall wealth, whether one is single or married, male or female, or young or old. Since most researchers investigating the predictors of life satisfaction have not specifically focused on the experiences of women, this review of the life satisfaction literature will describe research conducted with both sexes. Fortunately, however, the findings of many of these studies are directly relevant to women's lives. Life circumstances such as bearing and raising children, marriage, poverty, and inequality all influence the life satisfaction of women, despite the fact that studies of these factors have not necessarily been conducted with women participants only or been specifically analyzed for gender differences. Thus, this review will focus on life satisfaction in general but with women's lives and experiences in mind.

Economists have discovered happiness (or rediscovered) or at least research on subjective well-being and its economic correlates (see, e.g., Layard; 2005, Clark, Frijters and Shields, 2008). The rapidly growing research has touched on several important themes. These have included the so-called Easterlin paradox whereby average happiness remains relatively constant over time in spite of large increases in income per capita (Easterlin, 1974, 1995). In contrast, within country cross-sectional and panel data almost always show that rising incomes 'buy' additional satisfaction, although the magnitude of the within country cross-sectional effect of income on satisfaction is under dispute (Blanchflower and Oswald, 2004, Tella et al., 2007; and Stevenson and Wolfers, 2008).

People have different ways of perceiving happiness in life. Life in this world is a great struggle between young and adult, rich and poor, and healthy and unhealthy people.
What makes people satisfied in life; is it when their successes are more than their failures?
Life satisfaction has been conceptualized as a judgmental or cognitive component of subjective well-being. One may get all the wealthy things human beings desire on earth but cannot find satisfaction with his inward feelings which affect productivity. The same feelings may be found among the staff of Koforidua Polytechnic. This study seeks to find out what variables are staff now satisfied (is it health, income, education etc…) with.
The objective of the research is to investigate life satisfaction similarities across gender and among staff of Koforidua Polytechnic.
The specific objectives are to:

  i. Study the relationship between life satisfaction and socio-demographic variables
 ii. Investigate associations between life satisfaction and health-related issues
iii. determine if there are significant differences in perceived life satisfaction of the Polytechnic staff men and women according to their educational level, income, and family

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Data about life-satisfaction is used for several purposes such as measuring quality of life and monitoring social progress. The most elementary use of life-satisfaction data is to estimate apparent quality of life within a country or a specific social group. This is typically done to assess the extent of a social problem or issue and to recommend possible policy interventions. High satisfaction suggests that the quality of life, in the population concerned, is good.

According to Maria et al., (2011), income variables have a positive and highly significant ($p < 0.01$) effect on life satisfaction (the coefficient for the middle-income variable is 0.2001 while that for the high-income variable is 0.2523); therefore, the results point to a significant relationship between income and life satisfaction, with increasing satisfaction with life as one moves from the lowest to the highest income group. As expected, being unemployed has a negative impact on life satisfaction whereas enjoying improved health has a significant positive effect on subjective wellbeing. The results also suggest that being religious or being married has a significant positive impact on satisfaction with life (all these variables are significant at $p < 0.01$). Life satisfaction shows a U-shaped relationship with age, and men tend to report lower satisfaction with life than women do. Only the gender variable loses significance for individuals in the high-income class, but parameters estimated for the other control variables remain relatively stable in sign and significance across income groups.

2.0 MATERIAL AND METHODS
2.1 Sources of Data
This study adopted the descriptive study design to find out the public perception of life satisfaction

The main source of data was primary data, which sample was picked from workers of Koforidua Polytechnic. Primary data was collected through a survey with questionnaires and interviews as the research instruments.

2.2 Population
Workers at Koforidua Polytechnic numbered 576 as of March, 2012; which consisted of junior staff, senior staff, and senior members.

Population is popularly defined as the aggregation of the elements, and these elements are the basic units from which information is sought. According to Kothari (1989), population for a study is the aggregation or the totality of all units under study

2.3 Sample
Demographic characteristics of the selected sample concerning gender, education, and socioeconomic status correspond to the overall population of Koforidua Polytechnic staff.

A sample of two hundred and forty (240) was drawn across junior staff, senior staff, and senior members to solicit their opinion on similarities in their lives. In order for the results of the research to be reliable, working with a total sample size of 240 is adequate and acceptable because it represents about 42% of target population. The population of junior staff was 250 workers, senior staff accounted for 154 and senior members were also 172 in that manner. A sample of 104 junior staff, 64 senior staff, and 72 senior members respectively represented a proportional sample of the workers; and in each category sample was canvassed across gender group.

2.4 Sampling Technique
A stratified sampling technique was employed; where the Polytechnic was divided into strata and each stratum represented junior staff, senior staff, and senior members. Sample was then drawn from each stratum which was based on Probability Proportional to Size (PPS). 104 respondents were drawn from junior staff, 64 respondents were from senior staff, and 72 senior members. A simple random sampling method was then employed to select the respondents from each stratum and solicit their ideas on life satisfaction variables.

2.5 Method of Data Analysis
Data analysis was done immediately after data collection. The analysis was performed by the principal investigators. Data collected from the field were edited for consistency. The coding was provided on the question to make analysis easy. The Statistical Package for Social Sciences (SPSS) Version 16 was used to analyse the data.

2.5.1 Data Processing
Tables, charts, cross tabulation, correlation, and Principal Component Analysis were used to analyse the data. Multiple regression analysis was used for the hypothesis testing.

The satisfaction model was based on multiple regression. It is a statistical technique that uses several explanatory variables to predict the outcome of a response variable. The goal of multiple regression is to model the relationship between the explanatory and criterion satisfaction variables.

In this study, the dependent variable is Satisfaction and the independent (explanatory) variables were education, income, occupation, health, and family. Education was included because most people are of the opinion that the higher education one attains in life, the more recognize one becomes and also increases one's wealth. Income was also inclusive because people perceive having money as being satisfied with most things in life. Occupation is essential in one's life because it reliefs one from thinking and also generates income for family. But people also think that occupational hazards result in unhappiness of an individual at work site. More so, health is paramount in everyone's life, which makes one either satisfied or dissatisfied in life basing on prevailing condition at any present time. Lastly, marriage promotes happiness but can also give problems to an individual; which may affect the satisfaction. The role of children and the extended family could pose problems to individuals which may affect their satisfaction either negatively or positively.

All the variables used in the model were categorical variables but were quantified by the researchers. With this, the researchers averaged the five scaled indicators (1-very satisfied, 2-satisfied, 3-satisfied or dissatisfied, 4-dissatisfied, and 5-very dissatisfied) as 2.5 and this scale was multiplied by any response given by respondent. For instance, a respondent rating satisfied in response to a question was quantified as 2 x 2.5= 5 and such was performed for the rest of 239 respondents before it was analysed.

The model is specified as:

Satisfaction = β_0 + β_1Edu. + β_2Inc.+ β_3Occ.+ β_4Hea.+ β_5Fam. +V_{ij} ………………………[1.0]

β_0 = Intercept of the equation
β_1= regression coefficient of Education
β_2= regression coefficient of Income
β_3= regression coefficient of Occupation
β_4 = regression coefficient of Health
β_5 = regression coefficient of Family

The V_{ij} is random error term.

Hypothesis was formulated to guide the researchers deliver the objectives of the study in an effective manner:
α:Education, health, income, job, and family are indirectly related to life satisfaction

Collinearity diagnostic Statistics was employed to verify whether the explanatory variables were correlated within themselves.

Four of such tests were employed to attest whether multicollinearity is/are present in the model. First, is the use of Eigen values; values close to zero reveal high intercorrelation among predictors. Secondly, condition index greater than 15 indicated possible problem with multicollinearity. Condition index, greater than 30 stipulates serious problem with collinearity. Again, tolerance level of each explanatory variable was verified. Tolerance close to zero indicates high multicollinearity, which indicates the standard errors of the coefficients are inflated. Lastly, Variance Inflation Factor (VIA) helped determine multicollinearity. VIF greater than two indicates possible collinearity problem.

Once, the model has been found to have problems with multicollinearity, a stepwise regression was then employed to eliminate correlated predictors.

2.5.3 Theory for Multiple Linear Regression

In multiple linear regression, there are p explanatory variables, and the relationship between the dependent variable and the explanatory variables is represented by the following equation

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_p X_{pi} + \varepsilon_i \quad \text{………………………………………[2.0]}$$

Where:
β_0 is the constant term
β_1 to β_p are the coefficients relating the p explanatory variables to the variables of interest and
ε is the random error term

So, multiple linear regression can be thought of an extension of simple linear regression, where there are p explanatory variables, or simple linear regression can be thought of as a special case of multiple linear regression, where p=1. The term 'linear' is used because in multiple linear regression one assumes that y is directly

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related to a linear combination of the explanatory variables.

2.5.4 Coefficient of determination (R²)

This is the proportion of the variation in the dependent variable explained by the regression model, and is a measure of the goodness of fit of the model. It can range from 0 to 1, and is calculated as follows:

where **Y** are the observed values for the dependent variable, $\overline{Y}$ is the average of the observed values and Y_{est} are predicted values for the dependent variable (the predicted values are calculated using the regression equation).

$$R^2 = \frac{\text{explained variation}}{\text{total variation}} = \frac{\sum(Y_{est}-\overline{Y})^2}{\sum(Y-\overline{Y})^2}$$

R²-adjusted: this is the coefficient of determination adjusted for the number of independent variables in the regression model. Unlike the coefficient of determination, R²-adjusted may decrease if variables are entered in the model that do not add significantly to the model fit.

$$R^2_{adj} = 1 - \frac{\text{unexplained variation}/(n-k-1)}{\text{total variation}/(n-1)}$$

or

$$R^2_{adj} = 1 - \frac{\sum(Y_{est}-Y)^2}{\sum(Y-\overline{Y})^2}\frac{(n-1)}{(n-k-1)} \quad \text{........[2.2]}$$

2.5.5 Multiple correlation coefficient

This coefficient is a measure of how tightly the data points cluster around the regression plane, and is calculated by taking the square root of the coefficient of determination. ....[2.3]

When discussing multiple regression analysis results, generally the coefficient of multiple determination is used rather than the multiple correlation coefficient.

2.5.6 Residual standard deviation

The standard deviation of the residuals (residuals = differences between observed and predicted values). It is calculated as follows:

$$S_{res} = \sqrt{\frac{\sum(Y-Y_{est})^2}{n-k-1}}$$

2.5.7 The regression equation

The different regression coefficients b_i with standard error s_{bi}, $r_{partial}$, t-value and P-value. The partial correlation coefficient $r_{partial}$ is the coefficient of correlation of the variable with the dependent variable, adjusted for the effect of the other variables in the model. If P is less than the conventional 0.05, the regression coefficient can be considered to be significantly different from 0, and the corresponding variable contributes significantly to the prediction of the dependent variable.

2.5.8 Analysis of variance

The analysis of variance table divides the total variation in the dependent variable into two components, one which can be attributed to the regression model (labeled Regression) and one which cannot (labeled Residual). If the significance level for the F-test is small (less than 0.05), then the hypothesis that there is no (linear) relationship can be rejected, and the multiple correlation coefficient can be called statistically significant.

2.5.9 Zero order correlation coefficients

These are the simple correlation coefficients for the dependent variable Y and all independent variables X_i separately.

2.5.10 Checking the assumptions

Most of the underlying assumptions of multiple linear regression can be assessed by examining the residuals, having fitted a model. The various assumptions are listed below.

1. The residuals have constant variance, whatever the value of the dependent variable. This is the assumption of **homoscedasticity.** Also **heteroscedasticity** is simply the opposite of homoscedasticity.

2. That there are no very extreme values in the data. That is, that there are no **outliers.**

3. That the residuals are **normally distributed**.

4. That the residuals are **not related to the explanatory variables**.

5. It is also assumed that the residuals are not correlated with one another.

2.5.11 Residual plots.

By plotting the predicted values against the residuals, enables to assess the **homoscedasticity** assumption. Often, rather than plotting the unstandardised or raw values,

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we would plot the standardised predicted values against the standardised residuals.

2.5.2 Multicollinearity
By carrying out a correlation analysis before the fit regression equations, determines if any of the explanatory variables are very highly correlated and avoid the problem of inflating coefficients (or at least this will indicate why estimates of regression coefficients may give values very different from those we might expect). For pairs of explanatory variables with very high correlations > 0.8 or very low correlations < 0.8; it is best to consider dropping one of the explanatory variables from the model.

2.5.13 Model selection methods
When there are a large number of explanatory variables, the use of statistical criteria to include/exclude explanatory variables, especially if one is interested in the 'best' equation to predict the dependent variable. This is a different fundamental approach to the substantive approach where variables are included on the basis of the research question and this variables are often chosen given the results previous research on the topic and are also influenced by 'common sense' and data availability.

Two examples of selection methods are **backward elimination** and **stepwise**. The main disadvantage of these methods is that we might miss out important theoretical variables, or interactions. Two selection methods are postulated by Howell (1992) are briefly described the methods.

2.5.14 Backward elimination.

This begin with a model that includes all the explanatory variables. Remove the one that is least significant. Refit the model, having removed the least significant explanatory variable, remove the least significant explanatory variable from the remaining set, refit the model, and so on, until some 'stopping' criterion is met: usually that all the explanatory variables that are included in the model are significant.

2.5.15 Stepwise
It is the reverse of backward elimination, in that there are no explanatory variables in the model, and then build the model up, step-by-step. We begin by including the variable most highly correlated to the dependent variable in the model. Then include the next most correlated variable, allowing for the first explanatory variable in the model, and keep adding explanatory variables until no further variables are significant. In this approach, it is possible to delete a variable that has been included at an earlier step but is no longer significant, given the explanatory variables that were added later. Ignoring such possibility, and do not allow any variables that have already been added to the model to be deleted, this model building procedure is called **forward selection.**

3.0 RESULTS
3.1 Life Satisfaction and Socio-Demographic Variables
3.1 .1 Satisfaction between Total Income and Daily activities
Table 3.1 shows the relationship between life satisfaction and income receives by respondents' in their household.

Table 3.1   How satisfied are you with your job or other daily activities? * How satisfied are you with the total income of your household? Crosstabulation

			How satisfied are you with the total income of your household?			Total
			Satisfied	Satisfied or dissatisfied	Not satisfied	
How satisfied are you with your job or other daily activities?	Very satisfied	Count	7	0	0	7
		% of Total	3.1%	.0%	.0%	3.1%
	Satisfied	Count	50	2	58	110
		% of Total	21.9%	.9%	25.4%	48.2%
		Count	36	4	0	40

	Satisfied or dissatisfied	% of Total	15.8%	1.8%	.0%	17.5%
	Not satisfied	Count	0	0	71	71
		% of Total	.0%	.0%	31.1%	31.1%
Total		Count	93	6	129	228
		% of Total	**40.8%**	**2.6%**	**56.6%**	**100.0%**

Source: Field Data, 2012

3.1.2 Association between Daily activities and Income Receive

Table 3.2   Symmetric Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Interval by Interval		Pearson's R	.414	.049	6.835	.000[c]
Ordinal by Ordinal		Spearman Correlation	.378	.058	6.137	.000[c]
N of Valid Cases			228			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Source: SPSS Output, 2012

3.2 LIFE SATISFACTION AND HEALTH-RELATED ISSUES

3.2.1 Health Condition that affect satisfaction using Principal Component Analysis

Table 3.3 is a Principal Component analysis model derived from Table 4.6 using extraction and rotation method

Table 3.3: Health conditions that affect one's satisfaction in life using Rotated Component Matrix[a]

Indicators	Components	
	1	2
Frequent body pains or discomfort	.886	-.178
Inability to Rest/Sleep well	.743	.223
Ageing Frailities	.821	.162
Poor Sexual life	.680	.319
Stress/Depression	.076	.766
Visual problems	.079	.857
Long term diseases (e.g. hypertension, diabetes, stronke, etc)	.202	.781

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Source: SPSS Output, 2012

3.3 Significant Differences in Perceived Life Satisfaction of the Polytechnic Staff Men and Women

3.3.1 Assessment of one's life satisfaction and gender

Respondents were asked to assess themselves on their satisfaction level on a polytechnic staffladder in Table 3.4.

Table 3.4: Suppose 1 -10 represent the best possible life for you and the bottom of the ladder the worst possible life. Where on the ladder do you feel you personally stand at this present time? Please one represents the least.
* Gender Cross-tabulation

			Gender		Total
			Male	Female	
Suppose 1 -10 represent the best possible life for you and the bottom of the ladder the worst possible life. Where on the ladder do you feel you personally stand at this present time? Please one represents the least.	Three	Count	0	12	12
		% of Total	.0%	5.5%	5.5%
	Four	Count	7	0	7
		% of Total	3.2%	.0%	3.2%
	Five	Count	42	24	66
		% of Total	19.2%	11.0%	30.1%
	Six	Count	28	2	30
		% of Total	12.8%	.9%	13.7%
	Seven	Count	0	12	12
		% of Total	.0%	5.5%	5.5%
	Eight	Count	61	17	78
		% of Total	27.9%	7.8%	35.6%
	Nine	Count	12	2	14
		% of Total	5.5%	.9%	6.4%
Total		**Count**	**150**	**69**	**219**
		% of Total	**68.5%**	**31.5%**	**100.0%**

Source: Field Data, 2012

3.3.2 Multiple Regression Analysis of Life Satisfaction

Appendix (iia) illustrates ANOVA table test, which states the acceptability of the model from a statistical perspective. The Regression row displays information about the variation accounted for by the model whereas the Residual row displays information about the variation that is not accounted for by the model.

The regression and residual sums of squares are respectively 4.334 and 0.058, which indicates that most of the variations in life satisfaction model have been accounted for.
The significance value of the F statistic is less than 0.05, which means that the variation explained by the model is not due to chance.

Though, the ANOVA table is a useful test of the model's ability to explain any variation in the dependent variable but it does not directly address the strength of the relationship.
Due to this, the model summary table in appendix iib reports the strength of the relationship between the model and the dependent variable which is satisfaction. R represents the Multiple Correlation Coefficient, which is the linear correlation between the observed and model-predicted values of the dependent variable. The R-value is 0.801 which

is a large value indicating a strong relationship between satisfaction and the other explanatory variables. R–Square is the coefficient of determination, which is the squared value of the Multiple Correlation Coefficient. It indicates that about 64% of the variation in satisfaction model has been explained by the predictors.

The regression model is specified below:
Satisfaction = 0.474 + 0.135Edu. + 0.123Inc.– 0.281Occ.+ 0.209Hea.+ 0.428Fam…….[3.0]
Std. Error   (0.090) (0.026) (0.023)   (0.048) (0.044)   (0.027)
t-value C.   (5.258) (5.144) (5.457)   (-5.814)   (4.807)   (15.999)
P-value (0.000)   (0.000)   (0.000)   (0.000) (0.000)   (0.000)
β_0 = Intercept of the equation
Edu = Education
Inc = Income
Occ = Occupation
Hea = Health
Fam = Family

3.3.2.1 Hypothesis
α: Education, health, income, job, and family are indirectly related to life satisfaction
β: Education, health, income, job, and family are directly related to life satisfaction
3.3.2.2 Decision Rule

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The model shall reject the null hypothesis, which states that education, health, income, Occupation, and family are indirectly related to life satisfaction when the significance value of t-computed in the above model is less than 0.05 and vice versa.

3.3.3 Testing for Multicollinearity in the Model

Table 3.5 CollinearityDiagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions					
				(Constant)	Income	Education	Family	Occupation	Health
1	1	5.710	1.000	.00	.00	.00	.00	.00	.00
	2	.138	6.425	.00	.08	.07	.42	.00	.00
	3	.066	9.293	.01	.00	.19	.17	.04	.21
	4	.047	11.055	.11	.76	.14	.14	.02	.00
	5	.026	14.723	.76	.05	.28	.06	.17	.00
	6	.013	20.943	.11	.10	.32	.21	.78	.79

Source: SPSS Output, 2012

a. Dependent Variable: How do you feel about your life-as-a-whole or in general?

Table 3.5 illustrates collinearity diagnostic Statistic; this helps to verify whether the explanatory variables are correlated within themselves, a situation which does affect the model.

Using Stepwise Regression to Verify the Extent of Multicollinearity

Table 3.6 explains whether life satisfaction and the other demographic variables such as education, income, family, occupation, and health are correlated among themselves using Stepwise Regression Analysis.

Table 3.6   Stepwise Regression Model Summary[f]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.616[a]	.379	.376	.314	.379	129.967	1	213	.000
2	.750[b]	.562	.558	.264	.183	88.885	1	212	.000
3	.762[c]	.581	.575	.259	.019	9.478	1	211	.002
4	.776[d]	.602	.594	.253	.020	10.694	1	210	.001
5	.801[e]	.641	.633	.241	.040	23.105	1	209	.000

a. Predictors: (Constant), Family

b. Predictors: (Constant), Family, Income

c. Predictors: (Constant), Family, Income , Education

d. Predictors: (Constant), Family, Income , Education, Occupation
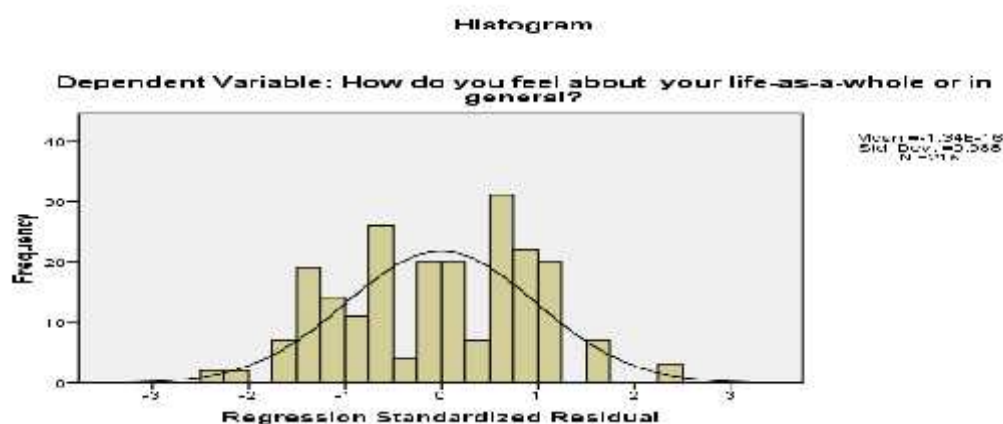
e. Predictors: (Constant), Family, Income , Education, Occupation, Health

f. Dependent Variable: How do you feel about your life-as-a-whole or in general?

Normality verification using histogram and P-P plot

The histogram and P-P plot of the residuals enabled the researchers to ascertain whether the assumptions of normality of the error term are not violated.

Source: SPSS Output, 2012
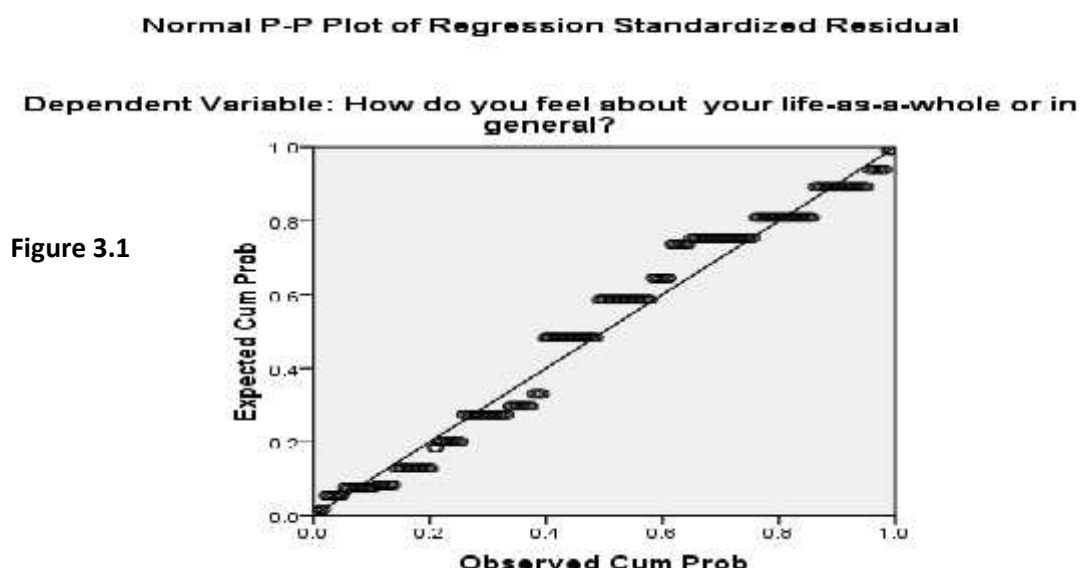
Figure 3.1

Figure 3.2

Source: SPSS Output, 2012

4.0 DISCUSSIONS

4.1 Satisfaction between Total Income and Daily activities

It was realized from table 3.1 that 40.8% of respondents were satisfied with the total income received by the household in a month whereas 2.6% were neutral on their satisfaction of total income they receive. Also, 56.6% of respondents were not satisfied with their total income received by their household.

Of the respondents interviewed, 3.1% were very satisfied with their job or daily activities they performed of which all were satisfied with their total income they receive whereas 48.2% of the respondents were satisfied with their daily activities out of which 21.9% were satisfied with the income they received in a month, However, 0.9% were neutral about their income and 25.4% of respondents were not satisfied about the income they received in a month. Also, 17.5% of respondents were also neutral about their satisfaction with their job or daily activities. Out of this, 15.8% respondents were satisfied with their income whiles 1.8% respondents were neutral.

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Lastly, 31.1% of respondents interviewed were not satisfied with their job or daily activities they engaged in whiles the same percentage were not satisfied with their total income they received.

It was realized that 51.3% of respondents agreed that there is a relationship between satisfaction with income they receive and satisfaction with job or daily activities.

4.1.1 Association between Daily activities and Income Receive

The study aimed at finding the extent of relationship existing between one's satisfaction with total income receive by an individual and satisfaction with job or daily activities performed using correlation. This is useful for determining the strength and direction of the association between the respective variables. It was realized that the Spearman's value was 0.378 with an asymptotic standard error of 0.058. The approximated correlation test was 6.137 at a significant value of 0.000. This confirms that there is correlation between one's satisfaction with total income and satisfaction with job or daily activities performed.

4.2 Health Condition that affect satisfaction using Principal Component Analysis

It was observed from table 3.3 that frequent body pains or discomfort (0.886) was the most highly correlated variable on factor one. On the same factor, the next highest correlated variable (0.821) was associated with ageing frailties. All the variables on factor one are well positively loaded on one's health condition affecting life satisfaction with the exception of stress or depression (0.076) and visual problems (0.079), which are weakly correlated with health condition affecting life satisfaction.

Conversely, on factor 2 the indicator which is highly correlated with health conditions affecting life satisfaction is visual problems followed by long term diseases with correlated values of 0.857 and 0.781 in that order. The other indicators are well correlated with health condition affecting life satisfaction with only frequent body pains or discomfort being negatively correlated variable (-0.178).

This portrays that the variables addressing issues concerning health conditions affecting life satisfaction are better explained on both

factors whiles it is only frequent body pains or discomfort which is indirectly correlated with health condition affecting life satisfaction on factor 2.

4.3 Assessment of one's life satisfaction and gender

Table 3.4 stipulates how respondents assess themselves on the satisfaction ladder. A total of 219 respondents took part in this exercise out of which 150 were males. On a scale of one to ten, respondents who rated their satisfaction level to be 3 accounted for 5.5% of which all were females whereas 3.2% of respondents rated their satisfaction level as 4 and were all males.

Out of the respondents interviewed, 30.1% rated their life on the satisfaction ladder as 5 out of which 19.2% accounted for male respondents. Respondents who rated their satisfaction on the ladder as 6 accounted for 13.7% out of which 12.8% were males whiles females amounted to 0.9%. Also, 5.5% of respondents scaled their satisfaction level as 7 all of whom were female.

Respondents who rated their satisfaction level as 8 accounted for 35.6%, out of which 27.9% were males. Furthermore, 6.4% of respondent rated their satisfaction as 9 on the ladder out of which 5.5% accounted for males.

It was realized that none of the respondents rated their satisfaction level as being on scale 1 or 2 and also no one rated him/herself as being on the top of the ladder (10). On the ladder of satisfaction, scale 8 is where many respondents placed themselves followed by scale 5. This indicates that from the middle of the satisfaction ladder to the top accounted for 91.3% of respondents' ratings.

It was revealed on the satisfaction ladder that most females placed themselves on scale 5 (11%) whereas most men placed themselves on scale 8 (27.9%). It was seen that respondents who rated their satisfaction on the ladder as 3 were all females. This demonstrates clearly from women's perspective that men tend to gain more satisfaction in life than they do.

Sirgy (1998) theory makes mention of several comparisons that women may consider before arriving at a judgment of their life satisfaction.

The author suggested that expectations of what one is capable of accomplishing, one's past circumstances, one's ideals, what one feels one deserves, what one minimally requires to be content and what one ultimately believes will occur are comparisons that help to determine overall life satisfaction.

4.3.1 Multiple Regression Analysis of Life Satisfaction

This model was used to verify which explanatory variables were closely related to life satisfaction and its direction of interest. The coefficients of the explanatory variables, the standard errors and its associate t-values helped to draw valid inferences about life satisfaction. 0.05 significance value was used to test for the model.

Actually, the value 0.474 is the intercept of the model and has no practical interpretation. The coefficient of education was 0.135 and its standard error of 0.026 implies that a change in one's education increases the person's satisfaction level by 0.135 with 0.026 margin of error. At a t-value of 5.144 and its associate significance value of 0.000, it is realized that there is direct association between education and life satisfaction. This indicates that as one pursues higher education, one becomes happier in life but education cannot suffice all one desires. Thus going by the decision rule one can state that education is directly related to life satisfaction. According to Maria del Mar Salinas Jiménez, Joaquín Artés, Javier Salinas Jiménez (2011), education variable significantly contribute to explain satisfaction with life (p<0.01), with a positive impact of holding a secondary school level or following higher education (the coefficient of the secondary education variable is 0.0882 while that of higher education is 0.1029). However, the impact of the education variables on satisfaction with life significantly differs across individuals in different income groups.

The explanatory variable income has a coefficient of 0.123 and a standard error of 0.023, which implies that as one's income increases by a unit margin, the satisfaction one acquires in life also increases by 0.123 with a deviation of 0.023. The t-value of 5.457 and a significance value (0.000) shows that income is directly related to life satisfaction. Since the significance value (0.000) is less than 0.05, we reject the null hypothesis, which states that income is not related to satisfaction. This shows that although income increases satisfaction, income cannot give the life satisfaction one desires to its full extent. Pinquart and Sorensen in 2000, found the association between income and well-being to be relatively small. However, Maria et al., (2011), said income variables have a positive and highly significant (p<0.01) effect on life satisfaction (the coefficient for the middle-income variable is 0.2001 while that for the high-income variable is 0.2523); therefore, the results point to a significant relationship between income and life satisfaction, with increasing satisfaction with life as one moves from the lowest to the highest income group.

The relationship between occupation and life satisfaction was examined. It was realized from a coefficient of -0.281 and standard error of 0.044 that a unit change in occupation decreases one satisfaction by -0.281. This indicates that as one is demoted or loses a job the person satisfaction reduces. At a t-value of -5.814 and its significance value of 0.000 the relation between occupation and satisfaction is significance. This shows that having occupation does mean having satisfaction in life. This goes against the null hypothesis which states that occupation has no relationship with life satisfaction. As shown Maria et al., (2011) indicated that being unemployed has a negative impact on life satisfaction.

Furthermore, health is paramount in one's life and therefore life satisfaction indicators cannot exclude such a variable in the analysis. The coefficient variable of health (0.209) and the standard error of 0.044 indicated that a positive change (strength) in one's health will result in an increase of the person's satisfaction by 0.209. At a t-value of 4.807 and its associate significance value (0.000), revealed that the relationship between a person's health and life satisfaction is directly related. This study rejects the null hypothesis, which states health is not related to life satisfaction. According Maria et al., (2011) enjoying improved health has a significant positive effect on subjective wellbeing.

Issues concerning family at times have influence on a person's satisfaction. It is found

that a change in a family status increases a person's satisfaction by 0.428. The t-value was 15.999 and a significance value of 0.000. The null hypothesis, which states that family issues are indirectly related to life satisfaction is rejected. This signifies that family issues are directly related to life satisfaction. This appears to confirm earlier studies by Helliwell, (2003) and Bjornskov, (2003) that family status is a strong predictor of individual life satisfaction. Also, Maria et al., (2011) suggested that being religious or being married has a significant positive impact on satisfaction with life (all these variables are significant at p<0.01).

Mroczek and Spiro (2005) found a peak in life satisfaction at the age of 65 and then a decrease during later life. In contrast to their findings, individuals did not differ in pattern or rate of decrease in the present study. The conflicting results may stem from the application of different time metrics. Mroczek and Spiro used an age-based model in which individuals were recruited to the study at different ages, a model that is unable to separate the cohort effects from the developmental changes in life satisfaction. Consequently, the age-based time metric includes cohort-effects that resemble results from cross-sectional studies. An age-based time metric, which reflects changes related to time from birth, also fails to properly account for the heterogeneity in level of functioning and health status that characterizes the oldest-old age segment.

In addition to the age-graded processes that are assumed to underlie psychological change across the lifespan, psychological change in old individuals in contrast to younger samples also comprises mortality and pathology related processes (Baltes & Smith, 1997; Berg, 1996). The consideration of the mortality-related processes that may contribute to life satisfaction changes in the oldest-old is preferably investigated in a time-to-death time metric of change.

4.3.2 Testing for Multicollinearity in the Model
Table 3.5 illustrates collinearity diagnostic Statistic; this helps to verify whether the explanatory variables are correlated within themselves, a situation which does affect the model.

The first test is the use Eigen values; values close to zero reveal high intercorrelation among predictors. In the table above all the explanatory variables are closer to zero indicating possible intercorrelation among predictors. This indicates that the predictors are little inter-correlated and that small changes in explanatory variables may lead to large changes in the estimates of the coefficients.

The second test is the use of condition index. The condition indices are computed as the square roots of the ratios of the largest Eigen value to each successive Eigen value. Index greater than 15 will indicate possible problem with multicollinearity. In the model above, it is realized that all the predictor variables are less than 15, which shows that the model does not suffer from multicollinearity with the exception of the indicator health, which has a condition index of 20.943. It is noted that condition index which is greater than 30 stipulates serious problem with collinearity. This model does not have any indicator closer to 30.   The model does not suffer from multicollinearity problems.

The third test to verify for collinearity is checking of the tolerance level of the model, which is found in appendix iic. Tolerance close to zero indicates high multicollinearity, which indicates the standard errors of the coefficients are inflated. In this model, the tolerance levels of the various indicators are not close to zero signifying that the standard errors of the indicators are not inflated.

Variance Inflation Factor (VIF) helps determine multicollinearity in a model which is indicated at appendix iic. VIF greater than two indicates possible collinearity problems. The explanatory variables occupation and health have VIFs of 2.716 and 2.472 respectively. The rest of the predictors' values are less than two which show the predictors do not have problem with collinearity.

It is therefore essential to test the predictors using stepwise regression whether some have little correlation that may influence the model; so that such predictors are removed from the model.

4.3.3 Using Stepwise Regression to Verify the Extent of Multicollinearity

The study further examined whether life satisfaction and the other demographic variables such as education, income, family, occupation, and health are correlated among themselves using Stepwise Regression Analysis. Stepwise is the most sophisticated of statistical methods; each variable (predictor) is entered in sequence and its value assessed. The variable that contributes to the success of the model is retained. If they no longer contribute significantly they are removed. Thus, the method ensures that one ends up with the predictor variables significant for the model.

As demonstrated earlier some of the indicators are correlated to some extent. It is therefore essential to use stepwise regression to verify whether such collinearity may affect the predictor variables in the model. In Appendix iii it is realized that none of the predictors were eliminated from the model. Table 4.11 shows none removal of predictor variables in the model. It is realized that the coefficient of determination of the explanatory variables which explains variations accounted for in the model have all exceeded 50% with the exception of the predictor 'family issue', which variation presented 38%. It is noted that at the change statistics column, all the significant values indicate that the variations accounted for in the model were not due to chance. This makes the model prediction reliable and its margin of error less. It was realized that all the predictor variables strongly correlated with the criterion variable which is good for the model. None of the explanatory variables has correlation less than 0.5 with the smallest among the predictors being 'Family Issue' (0.616).

4.3.4 Normality verification using histogram and P-P plot
The histogram and P-P plot of the residuals help to check whether the assumptions of normality of the error term are not violated.
The shape of the histogram should approximately follow the shape of the normal curve. Figure 3.1 illustrates that the shape of the model follows a normal distribution curve with the variables clearly distributed. This histogram is acceptably close to the normal curve and therefore makes the model inferences reliable.

Figure 3.2 indicates that the P-P plotted residuals follow the 45-degree line. It is revealed that all distribution follows the normal assumption with no deviation. The plot of residuals by the predicted values showed that the variance of the errors increases with increasing predicted satisfaction. This is a good scatter plot without inconsistencies.

The researchers found that neither the histogram nor the P-P plot indicates that the normality assumption is violated. Hence the model for prediction is reliable.

5.0 CONCLUSIONS
Life satisfaction measures differences between success and failures encountered by individuals in life rather than assessing their current feeling. Life satisfaction is found to be relative among individuals and across gender.

It was realized there is no relationship between gender and life satisfaction and that women seem to rate themselves lower on the satisfaction ladder than men. It was also established that there is a correlation between one's satisfaction with total income and satisfaction with daily activities performed. Frequent bodily pains or discomfort, ageing frailties, visual problems, and long term diseases which affect individuals' health conditions influence one's satisfaction in life. Almost 83% of respondents interviewed were satisfied with their health condition whereas only few indicated that they were dissatisfied with their health conditions. The study revealed that the issues of most concern to respondents were health followed by family issues and job security.

Health issues, education, income, occupation, and family issues are found to influence life satisfaction which is directly related to satisfaction.

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Appendix iia

ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	21.669	5	4.334	74.694	.000[a]
	Residual	12.126	209	.058		
	Total	33.795	214			

a. Predictors: (Constant), Health, Education, Family, Income , Occupation

b. Dependent Variable: How do you feel about your life-as-a-whole or in general?

Source: SPSS Output, 2012

Appendix iib

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change

| 1 | .801a | .641 | .633 | .241 | .641 | 74.694 | 5 | 209 | .000 |

a. Predictors: (Constant), Health, Education, Family, Income , Occupation

b. Dependent Variable: How do you feel about your life-as-a-whole or in general?

Source: SPSS Output, 2012

Appendix iic

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.474	.090		5.258	.000		
	Income	.123	.023	.298	5.457	.000	.577	1.732
	Education	.135	.026	.274	5.144	.000	.606	1.650
	Family	.428	.027	.747	15.999	.000	.788	1.269
	Occupation	-.281	.048	-.397	-5.814	.000	.368	2.716
	Health	.209	.044	.313	4.807	.000	.405	2.472

a. Dependent Variable: How do you feel about your life-as-a-whole or in general?

Source: SPSS Output, 2012

Appendix iid Variables Entered/Removeda			
Model	Variables Entered	Variables Removed	Method
1	Family	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Income	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Education	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Occupation	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	Health	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: How do you feel about your life-as-a-whole or in general?

Broadcast Storm Impedance on Network Performance:A Study of Koforidua Polytechnic Local Area Network

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Abstract
Internetslowness and other IP services on institutional local area network are mostly not caused by the limited amount of bandwidth available or purchased from the Service Provider but rather congestion that may exist on the Local Area Networkwhichcauses congestion to packets sent to a destination network.This paper researches on certain factors that contribute to the lack of effective bandwidth utilization which lead to network congestion and slow internet access on Koforidua Polytechnic Institutional Local Area Network. Excessive User Datagram Protocol (UDP) broadcast and lack of broadcast storm radiation control are the factors to be considered in this paper. A virtual manageable switch was attached to the physical network infrastructure of the Polytechnic's network. Anopen source Network Protocol Analyzer was used to capture traffic traversing over the virtual switch through the physical switch connected to the Polytechnic network. Analyzed data revealed that there are excessive User Datagram Protocol (UDP) packets more thanTransmission Control Protocol (TCP) packets requests on the network. This phenomenon causesnetwork congestion thereby causing data loss, slowness of internet access, and other services on the network, hence internet and other IP services requested on institutional local area network should not be attributed to only the amount of bandwidth available or to be purchased from the service provider but rather control the level of broadcast radiation.

Keywords: Bandwidth; Storm control; Network Congestion; Internet Protocol.

1. INTRODUCTION

Bandwidth is defined as the amount of information that can flow through a network connection in a given period of time. In other words, regardless of the media used to build the network, there are limits on the capacity of that network to carry information. Bandwidth is limited by the laws of physics and by the technologies used to place information on the media. .. For Wide-Area Network (WAN) connections, it is almost always necessary to buy bandwidth from a service provider. In either case, an understanding of bandwidth and changes in demand for bandwidth over a given time can save an individual or a business a significant amount of money. A network manager needs to make the right decisions about the kinds of equipment and services to buy. A networking professional understand the tremendous impact of bandwidth and throughput on network performance and design. Information flows as a string of bits from computer to computer throughout the world. These bits represent massive amounts of information flowing back and forth across the globe in seconds or less. In a sense, it may be appropriate to say that the Internet is

bandwidth. As soon as new network technologies and infrastructures are built to provide greater bandwidth, new applications are created to take advantage of the greater capacity. The delivery over the network of rich media content, including streaming video and audio, requires tremendous amounts of bandwidth. IP telephony systems are now commonly installed in place of traditional voice systems, which further adds to the need for bandwidth.

The materials through which current flows offer varying amounts of opposition, or resistance to the movement of the electrons. The materials that offer very little, or no, resistance, are called conductors. Those materials that do not allow the current to flow, or severely restrict its flow, are called insulators. The amount of resistance depends on the chemical composition of the materials. All materials that conduct electricity have a measure of resistance to the flow of electrons through them. These materials also have other effects called capacitance and inductance associated with the flow of electrons. The three characteristics comprise impedance, which is

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similar to and includes resistance (Cisco Networking Academy Curriculum, 2005).

The Polytechnic Local area Network access settings are deployed by a Dynamic Host Configuration Protocol (DHCP) server configured on a Cisco2900 series router.The configuration parameter provides both public and private IP addresses to hosts connected to the Polytechnicnetwork,these includes IP address,Subnetmask,default gateway IP and Domain Name Service (DNS) servers IP.The public IP address released by the DHCP server is the DNS server IP address of the service providers (SP).The Polytechnic Management Information System and Student Information Portal (SIP) operates on the Local Area Network. Most of the traffic engaged on the network are mostly Hypertext Transmission Protocol (HTTP) requests which includes web traffic by students and staff members, access to the Online Student Information System (OSIS) server by a web browser and access to student portals also by a web client.

LITERATURE REVIEW

To communicate with all collision domains, protocols use broadcast and multicast frames at Layer 2 of the OSI model. When a node needs to communicate with all hosts on the network, it sends a broadcast frame with a destination MAC address 0xFFFFFFFFFFFF. This is an address to which the network interface card (NIC) of every host must respond. Layer 2 devices must flood all broadcast and multicast traffic. The accumulation of broadcast and multicast traffic from each device in the network is referred to as broadcast radiation. In some cases, the circulation of broadcast radiation can saturate the network so that there is no bandwidth left for application data. In this case, new network connections cannot be established, and existing connections may be dropped, a situation known as a broadcast storm. The probability of broadcast storms increases as the switched network grows. Because the NIC must interrupt the CPU to process each broadcast or multicast group it belongs to, broadcast radiation affects the performance of hosts in the network. Figure 1 shows the results of tests that Cisco conducted on the effect of broadcast radiation on the CPU performance of a Sun SPARC station 2 with a standard built-in Ethernet card.(Cisco system,2005).
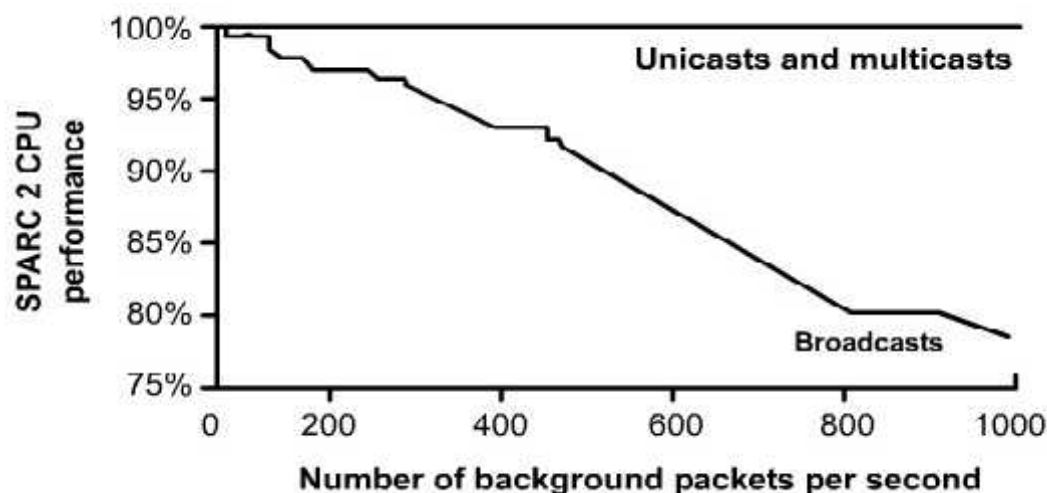
Figure 1: Effects of Broadcast Radiation on Host in an IP network (Adapted from Cisco System)

 As indicated by the results shown in figure 1, an IP workstation can be effectively shut down by broadcasts flooding the network. Although extreme, broadcast peaks of thousands of broadcasts per second have been observed during broadcast storms. Testing in a controlled environment with a range of broadcasts and multicasts on the network shows measurable system degradation with as few as 100 broadcasts or multicasts per second,(Cisco System,2005).

Most often, the host does not benefit from processing the broadcast, as it is not the destination being sought. The host does not

care about the service that is being advertised, or it already knows about the service. High levels of broadcast radiation can noticeably degrade host performance. The three sources of broadcasts and multicasts in IP networks are workstations, routers, and multicast applications.Workstations broadcast an Address Resolution Protocol (ARP), Dynamic Host Configuration Protocol (DHCP),Hypertext Transmission Control Protocol (HTTP) and Domain Name Service request every time they need to locate a server address that is not directly connected to the work station. When broadcast and multicast traffic peak due to storm behavior, peak CPU loss can be orders of magnitude greater than average. Broadcast storms can be caused by a device requesting information from a network that has grown too large. So many responses are sent to the original request that the device cannot process them, or the first request triggers similar requests from other devices that effectively block normal traffic flow on the network (Cisco System,2005).

IP multicast applications can adversely affect the performance of large, scaled, switched networks. Although multicasting is an efficient way to send a stream of multimedia data to many users on a shared-media hub, it affects every user on a flat switched network. A particular packet video application can generate a seven megabyte (MB) stream of multicast data that, in a switched network, would be sent to every segment, resulting in severe congestion.(Norton M, Networking as a 2nd language (2001).

As the transport layer sends data segments, it tries to ensure that data is not lost. A receiving host that is unable to process data as quickly as it arrives could be a cause of data loss. The receiving host is then forced to discard it. Flow control avoids the problem of a transmitting host overflowing the buffers in the receiving host. TCP provides the mechanism for flow control by allowing the sending and receiving host to communicate. The two hosts then establish a data-transfer rate that is agreeable to both.

TCP is responsible for breaking messages into segments, reassembling them at the destination station, resending anything that is not received, and reassembling messages from the segments. TCP supplies a virtual circuit between end-user applications. Protocols that use TCP includes File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), Hypertext Transmission Protocol(HTTP), Secure Socket Layer(SSH).TheUser Datagram Protocol (UDP) is the connectionless transport protocol in the TCP/IP protocol stack. User Datagram Protocol (UDP) is a simple protocol that exchanges datagram, without acknowledgments or guaranteed delivery. Error processing and retransmission must be handled by higher layer protocols. UDP uses no windowing or acknowledgments so reliability, if needed, is provided by application layer protocols. UDP is designed for applications that do not need to put sequences of segments together. Protocols that use UDP includes Dynamic Host Configuration Protocol (DHCP) Domain Name Service (DNS),Trivial File Transfer Protocol(TFTP),Simple Network Management Protocol(SNMP),(Cisco Systems,2005).

Although it is not possible to prevent all types of packet storms and excessive broadcasts, it is possible to suppress them using storm control. Storm control prevents traffic on a Local Area network (LAN) from being disrupted by a broadcast, multicast, or unicast storm on one of the physical interfaces. Storm control (or traffic suppression) monitors packets passing from an interface to the switching bus and determines if the packet is unicast, multicast, or broadcast. The switch counts the number of packets of a specified type received within a certain time interval and compares the measurement with a predefined suppression-level threshold. Storm control then blocks traffic when the rising threshold is reached.

Figure 2 illustrates Local Area Network (LAN) storm control over Ethernet network.
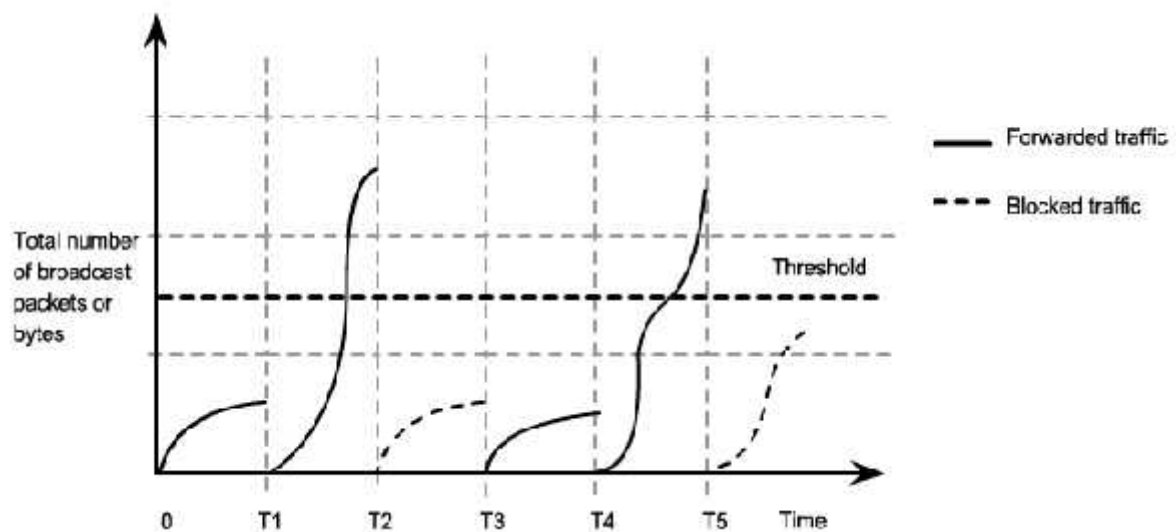

Figure 2: LAN storm radiation attack (Adapted from Cisco systems,2009)

If storm control is ensured, when the amount of specified traffic exceeds the threshold within a specific time period, all traffic of that kind is dropped for the next time period. In figure 2, the broadcast traffic being forwarded exceeded the configured threshold between time intervals T1 and T2 and between T4 and T5. Therefore, broadcast traffic is blocked during the intervals following T2 and T5. At the next time interval (for example, T3), if broadcast traffic does not exceed the threshold, it is again forwarded, (Cisco Systems, 2009).

2. METHODOLOGY

Virtualization and simulation was used in this paper. Graphical Network Simulator (GNS3) software was used to simulate a virtual switch which enables connection to a physical switch on the Polytechnic Network. The virtual switch configured on GNS3 enabled the virtual switch to build up its Content Addressable Memory (CAM) table on the Polytechnic network.Port one (1) on the virtual switch was configured by GNS3 simulatorwhich connects to an Ethernet adaptor of a laptop connected to the Polytechnic network. The simulated virtual switch port was virtualized to the physical adaptor connected to the polytechnic network. This virtualization enables all unicast, multicast and broadcast packets forwarded to the laptop adaptor be transmitted over to the virtual switch. Open source Network Protocol Analyzer(International Journal of Computer Applications (0975 – 8887)Volume 6– No.7, September 2010) was used to capture traffic sent to the laptop adaptor over to the virtual switch. The captured packets on the laptop adaptor connects to the institutional network, over 598,700,760 bytes of packets were captured. Packets captured include all packets traversing over the polytechnic network. Among the packets captured were Domain Name Service(DNS),Dynamic Host Configuration Protocol (DHCP),Transmission Control Protocol(TCP),User Datagram Protocol (UDP),Address Resolution Protocol (ARP),Link Local Multicast Name Resolution (LLMNR),Internet Group Management Protocol (IGMPV3),IPV4,NetBIOS Name Service (NBNS),Transport Level Security(TLSV1),Simple Service Discovery Protocol (SSDP),Simple Network Management Protocol(SNMP)and Multicast Domain Name Service (MDNS) packets.

3. RESULT AND ANALYSIS

The open source Network Protocol Analyzer (wireshark) was used to analyze the captured packets over the polytechnic's network. A filter was applied to the captured packets to sort out only ethernet Broadcast (ffffffffff), UDP and TCP packets. Figure three (3) depicts a snapshot of the filtered packet.

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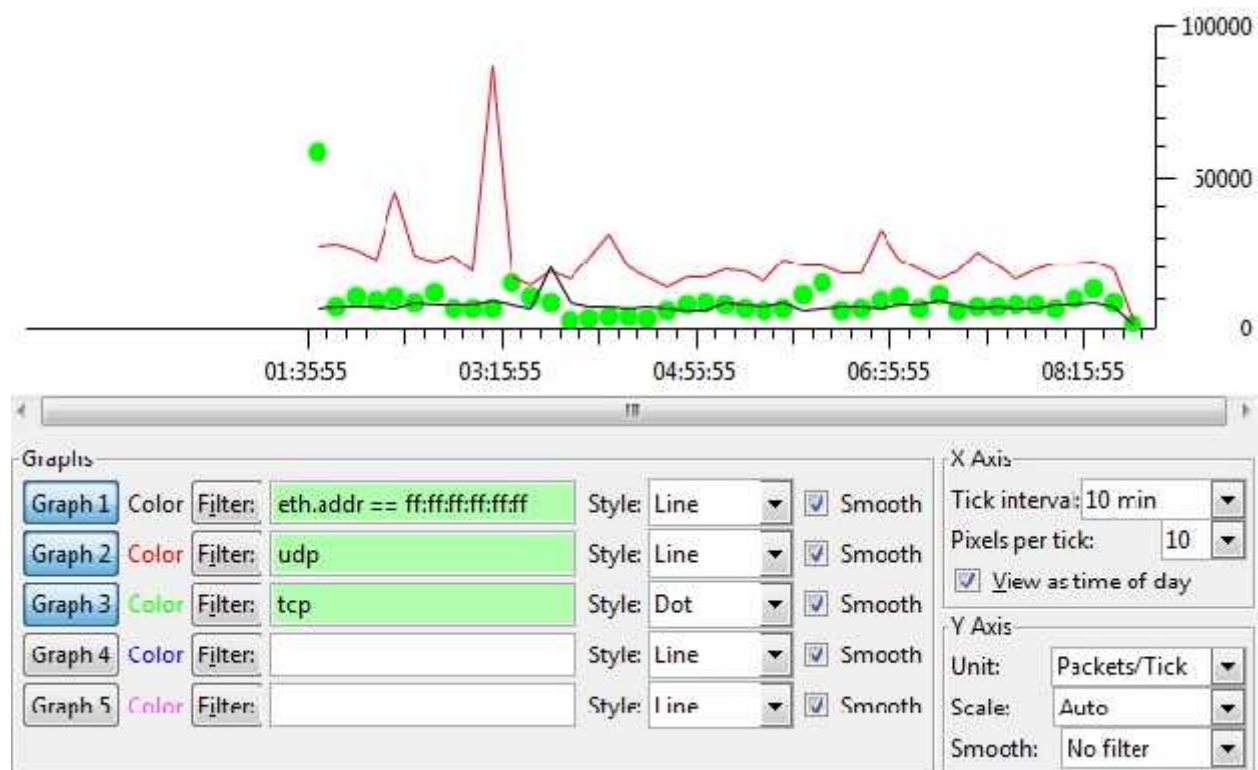
Figure 3: Broadcast storm radiation on Polytechnic's LAN

Graph 1 filters Ethernet broadcast with a black color and a "line" style, graph 2 filters UDP packets with a red color and graph 3 filters TCP packets with a green color and a "dot" style. User Datagram Protocol (UDP) radiation exceeds Ethernet broadcast and Transmission Control Protocol (TCP) packets traversing over the Polytechnic's network. Figure 3 depicts the saturations of User Datagram Protocol (UDP) on the network causing network congestion,

slowness and network downtime.Thisphenomenon also causes network service disruption and data loss on the network. Figure 4 depicts a statistics of a UDP packet typecaptured on the Polytechnic network. Dynamic Host Configuration Protocol as a type of UDP packets depicts statistics of DHCP requests that floods the network within a time range. The statistics is shown in figure 4.

Figure 4:Filtered DHCP statistics over Polytechnic's LAN

Figure 4 depicts that within the hours of 01:35pm to 08:15pm a DHCP filter was applied to the captured packets on the Polytechnic network, 1,318 DHCP request were sent to the DHCP server and out of which the server was only able to release 7 IP addresses to the requested host,The question is "what then happens to the other 1310 requests sent to the DHCP server'?Thisphenomenon means that there are excessive DHCP broadcast traversing over the Polytechnic's network within 8 hours

of packets traversing over the Polytechnic network.

4. CONCLUSION

The accumulation of User Datagram Protocol (UDP) and Ethernet broadcast and multicast traffic from each device in the network floods the entire network causing congestion and data loss. In some cases, the circulation of broadcast radiation can saturate the network leading to no bandwidth left for application data. In this

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case, new network connections cannot be established, and existing connections may be dropped, a situation known as a broadcast storm significantly affects the performance of computer network. Bandwidth utilization and access to network resources are impaired as a result of the excessive broadcast storm radiation on the network.

Recommendation

To alleviate the deteriorating effects of broadcast storm traversing over the Polytechnic network and to boost internet and other IP services accessibility. The following should be considered:

- Broadcast storm radiation should be controlled on the Polytechnic's network
- The Polytechnic's Local Area Network should be segmented to control the broadcast storm radiation.
- Web traffic on the Polytechnics network should be streamlined to ensure Quality of Service (QoS) to services running on the network.

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Fabrication and Optimisation of Biquad Antenna for Wireless Local Area Network

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Abstract
Wireless technology is one of the main areas of research in the world of communication systems today. It is important to know that the study of wireless communication systems is incomplete without the understanding of the fabrication and operation of antennas. A vast number of RF devices such as the microwave ovens, cordless telephones and medical devices currently operate in the 2.4 GHz band. In this paper, a biquad antenna whose central working frequency is 2.445 GHz was fabricated and optimised by placing it in a mesh dish. The Biquad Antenna was tested on the first floor of the four story building at the Regent University College. Results showed that the antenna achieved 70% to 80% range of signal strength, improving the directivity of a WLAN covering as far as the third floor, the ground floor as well as the surroundings. This was achieved by placing the Biquad Antenna feed in the focal point of a mesh dish which helps to focus the radio waves onto the Biquad Antenna. Comparing to omnidirectional antenna whose signal strength was 56%, the performance of the biquad antenna was better. The results from the testing of both antennas were simulated separately in a Matlab. The combined effect of these was also simulated using a parabolic reflector mathematical model which gave a new waveform propagating pattern resulting in the better performance.

Keywords: Biquad Antenna; Signal Strength; Omnidirectional Antenna; Optimisation; Fabrication

1 INTRODUCTION

An antenna is an electrical conductor or system of conductors that can be use as a transmitter which radiates electromagnetic energy into space and receiver which collects electromagnetic energy from space. The IEEE definition of an antenna as given by Stutzman and Thiele, 2012; is that part of a transmitting or receiving system that is designed to radiate or receive electromagnetic wave.

According to Prasanna Ramachandran, 2007, a biquad antenna which is fairly directive, cheap and simple to construct is a wide band antenna. A biquad antenna is a two single turn loop antennas forming an array where each one is a driven component. The working principle of a biquad antenna is similar to that of a dipole antenna, generating the same radiation pattern as a dipole with more directivity and bandwidth (Gary M. Miller). Furthermore, by its nature, the biquad antenna can be considered as a modified form of a folded dipole antenna. Rob Flickenger et al also underscored the fact that the biquad antenna, consisting of a two squares of the same size of 1/4 wavelength as a radiating element and of a metallic plate or

grid as reflector is simple to build and offers good directivity and gain for Point-to-Point communications. It was furthermore stated that the biquad antenna has a beamwidth of about 70 degrees and a gain in the order of 10-12 dBi and can be used as stand-alone antenna or as feeder for a Parabolic Dish.

Folded dipole antenna offers the same radiation pattern as the standard Hertz antenna but has an input impedance of 288Ω approximately 4 × 73 Ω and offers relatively broadband operation as stated by Phumzile, Malinda and Walter Sisulu, 2009. The folded dipole is a useful receiving antenna for broadcast FM and VHF TV. Its input impedance matches well with the 300 Ω input impedance terminals common to these receivers (Gary M. Miller). A loop antenna being a single turn of wire whose dimensions are normally much smaller than a wavelength, the current in it may all be considered in phase. This results in a magnetic field that is everywhere perpendicular to the loop. The resulting radiation pattern is sharply bidirectional, and is effective over an extremely wide range of frequencies for those having diameter of

about $\lambda/16$ or less. The antenna is usually circular, but any of the shape according to (Gary M. Miller) is effective, because of its sharply defined pattern, small size and broadband characteristics and the direction finding (DF) applications.

The ability of a parabolic antenna to focus light rays or sound wave at a point is common knowledge. Some common applications include dentist's lights, flashlights and automobile headlamps. The same ability is applicable to electromagnetic waves of lower frequency than light as long as the paraboloid's mouth diameter is at least 10m wavelengths. This precludes their use at low radio frequencies but allows use at microwave frequencies. In highly critical applications, Cassegrain feed is used to shorten the length of feed mechanism (Gary M. Miller). They provide huge power gains with a good approximation provided by the equation, $A_P = 6(D/\lambda)^2$ where A_P is power gain with respect to a half wave length dipole, D the mouth diameter of primary reflector and λ the free space wavelength of carrier frequency. Dish antenna performs equally well in transmitting or receiving as predicted by antenna reciprocity, (Rob Flickenger et al, 2007). The router used is the wireless – N broadband router branded Tenda model W307R with a frequency range of 2412 – 2472 MHz. Its transmit power is 19.32 dBm EIRP max – 802.11b/g and uses modulation type of OFDM. The router has power adapter and a model number of ILA41V – 0901200. Orthogonal Frequency Division Multiplexing (OFDM) is a multicarrier digital communication system which combines a large number of low data rate carriers to construct a composite high data rate. Orthogonality give the carriers a valid reason to be closely spaced, even overlapped, without inter – carrier interference. Low data rate of each carrier implies long symbol periods, which greatly diminishes inter – symbol interference.The goal of this research paper was to determine the direction and coverage of radiation pattern and the optimization of biquad antenna.

3. METHODOLOGY
Fabrication and Testing of the Antenna.

A square piece of blank printed circuit board (PCB), 123 × 123mm was cut out. Note that from the working frequency of 2.445GHz, the wavelength, , and because it is generally recommended that an antenna's ground plane be at one wavelength in size, the dimensions of 123mm x 123mm was used for the biquad antenna. 50mm section of a copper pipe was taken and filed smoothly at both ends. Using sandpaper the copper pipe was polished up including the inside of copper pipe. This was done to ensure a good connection with the coax braid. A notch was then cut into one end of the copper pipe, removing approx 2mm from half the circumference as shown Figure 1 below:

Figure 1: 50mm copper pipe with 2mm notch cut off.

A hole was drilled in the center of the blank PCB so that the copper pipe was a tight fit in the hole. A small hole was drilled and then widened using file for making it precisely fit for inserting the copper pipe as shown in Figure 2 below:
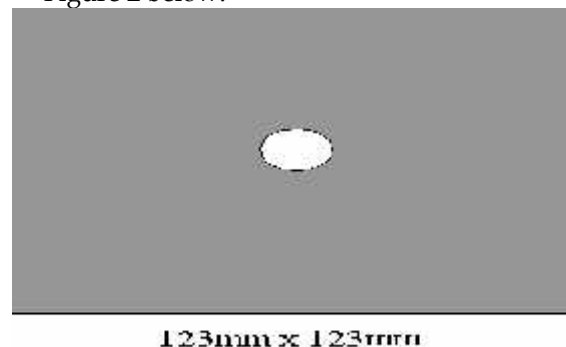

123mm x 123mm

Figure 2. Rectangular reflector plate.

The copper pipe was inserted into the hole, with the notched end on the copper side of the blank PCB. The copper pipe protruded approx 16mm through the hole, measured on the copper side of the PCB. The copper

pipe was soldered to the PCB to ensure better electrical connectivity.

The element was now attached to the reflector. Only the two ends of the copper wire were to be attached to the copper pipe. It was ensured that the centre of the copper wire did not touch the copper pipe hence the notch which was cut off from the end of the copper pipe. Assembling everything as discussed, our antenna looks as shown in Figure 3 below.
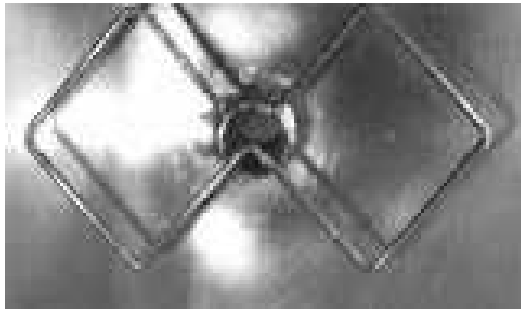
Figure 3. The complete biquad antenna with its reflector.

For feeding antenna, an approximate 30mm of the outer sheath from the end of the coaxial cable was stripped. The braid was folded back over the outer sheath as shown in Figure 4 and the centre conductor was trimmed so that about 4mm protruded.
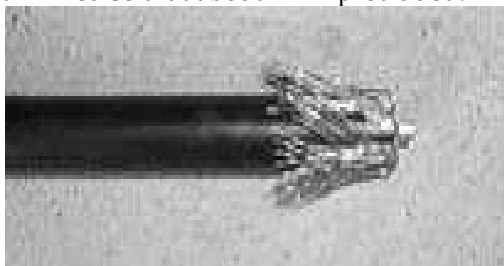
Figure 4. Copper cable with the braided shield exposed.

The braid was inserted into the copper pipe so that the end of the centre conductor lined up with the extreme end of the copper pipe and the centre of the element was soldered to the biquad antenna, ensuring the centre of the element was not in contact with the copper pipe. At this stage, the biquad antenna as shown in Figure 5 is completely constructed.
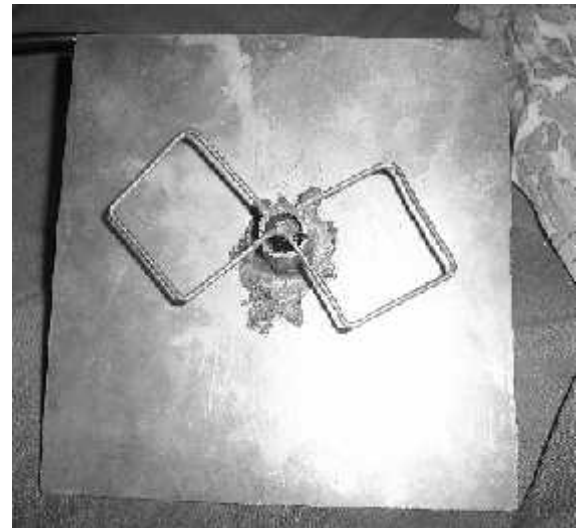
Figure 5. The complete biquad antenna with the coaxial cable connected.

The parabolic antenna is of special interest in this research because this was used to optimize the performance of biquad antenna by placing it at focal point. The parabolic reflector feed was used to improve the radiation pattern directivity, performing well in transmitting or receiving as predicted by antenna reciprocity. This provides huge power gains, with a good approximation provided during testing as shown in table 1, Figure 6 and Figure 7.
Table 1. Performance comparison of biquad antenna and omnidirectional antenna.

Antenna	Biquad	Omni directional
Signal Strength (dBm)	-33	-45
Signal Strength (%)	71	56
Speed (Mbits)	11	5
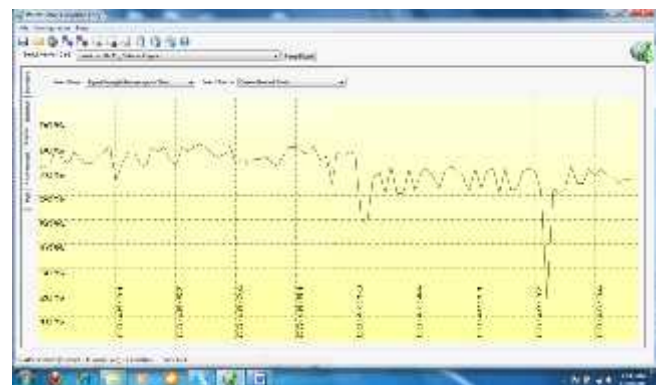
Figure 6. Signal Strength Percentage versus Time for the Biquad Antenna.
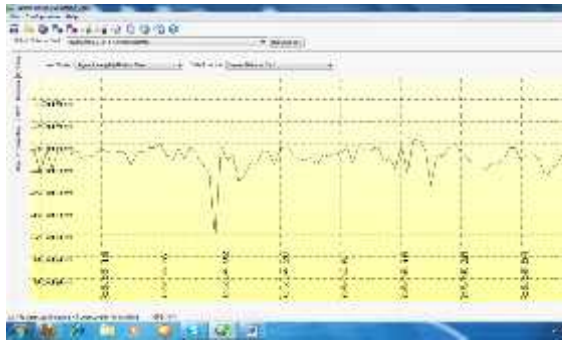
Figure 7. Signal Strength (dBm) versus Time for the Biquad antenna

2.2 Mathematical Modelling.

The radiation pattern of antenna is a representation (pictorial or mathematical) of the distribution of the power out-flowing (radiated) from the antenna in the case of transmitting antenna, or inflowing in the case of receiving antenna as a function of direction angles from the antenna. According to (Constantine A. Balanis), the principal characteristics of aperture amplitude, phase, and polarization for a parabolic cylinder as contrasted to those of a paraboloid are as follows:

4. The amplitude taper, due to variations in distance from the feed to the surface of the reflector, is proportional to $1/\rho$ in a cylinder compared to $1/r^2$ in a paraboloid.
5. The focal region, where incident plane wave converge, is a line source for a cylinder and a point source for a paraboloid.
6. When the fields of the feed are linearly polarized parallel to the axis of the cylinder, no cross-polarized components are produced by the parabolic cylinder.

The surface of a paraboloidal reflector is formed by rotating a parabola about its axis. Its surface must be a paraboloid of revolution so that rays emanating from the focus of the reflector are transformed into plane waves. The design is based on optical techniques, and it does not take into account any deformation (diffractions) from the rim of the reflector through the focus. As shown in Figure 8 below, it follows that:

Putting equations (2) and (3) in (1) gives:
Making r′ the subject from equation 4 result in the expression below:

Since a paraboloid is a parabola of revolution about its axis, so is the equation of a paraboloid in terms of the spherical coordinates ′, Θ′, Ø′. Equation 5 can also be written in terms of the rectangular coordinates x′, y′ and z′. That is,
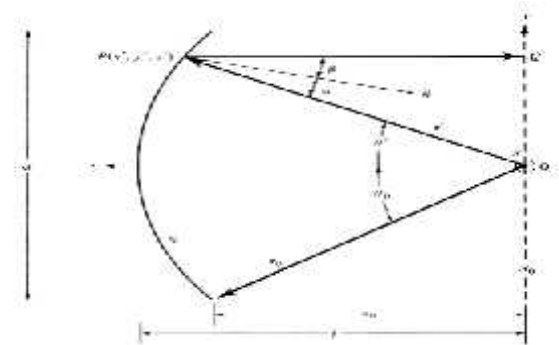

Figure 8. Two-dimensional configuration of a paraboloidal reflector.

In the analysis of parabolic reflectors, it is desirable to find a unit vector that is normal to the local tangent at the surface reflection point. To do this, equation 5 is first expressed as:

The biquad antenna with a gain function of $G_f (\Theta', \emptyset')$ is placed at the focal point of a paraboloidal reflector as shown in Figure 9 below.
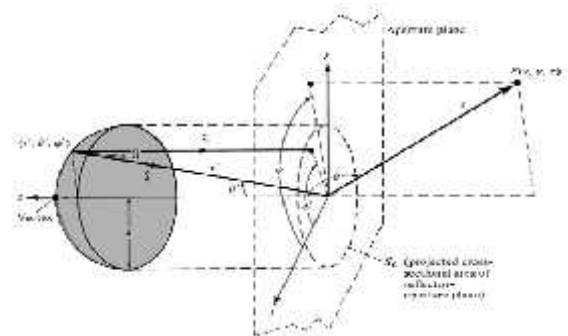
Figure 9. Three-dimensional geometry of a paraboloidal reflector system.

The radiation intensity of this source is given by;

Where P_t is the total radiated power at a point r′ in the far-zone of the source. The incident field, with a direction perpendicular to the radial distance, can then be written as;

Where $\bar{e}_i$ is a unit vector perpendicular to $\bar{a}_r'$ and parallel to the plane formed by $\bar{a}_r'$ and $\bar{a}_y$, as shown in Figure 10.
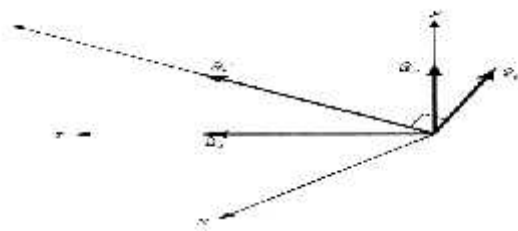
Figure 10. Unit vector alignment for a paraboloidal reflector system.

3. **MATLAB Simulation Results.**
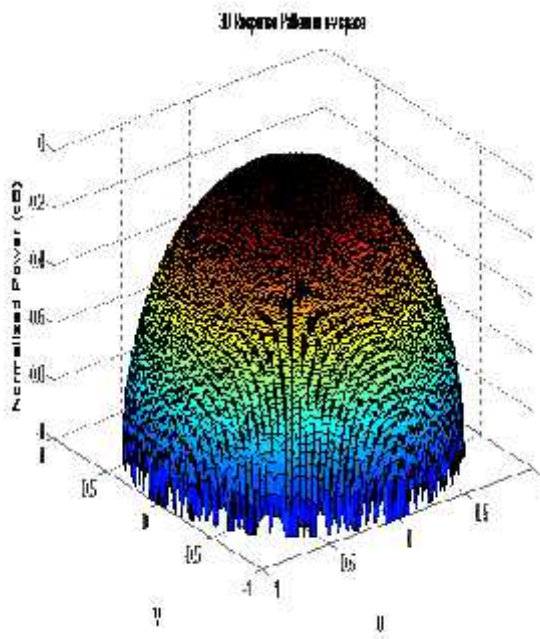
Figure 11. Radiation pattern for parabolic mesh without biquad antenna.
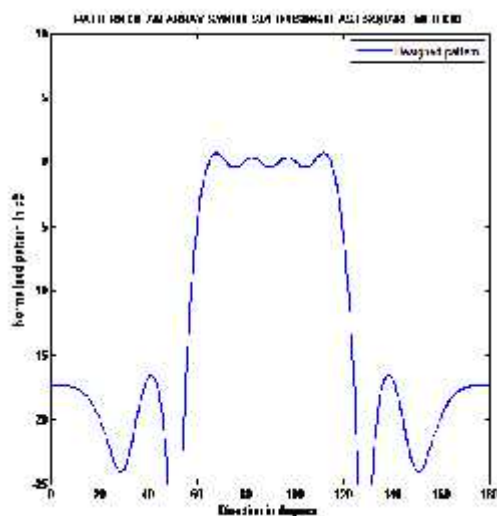
Figure 12. Rectangular radiation pattern for biquad atenna.
Power in dB

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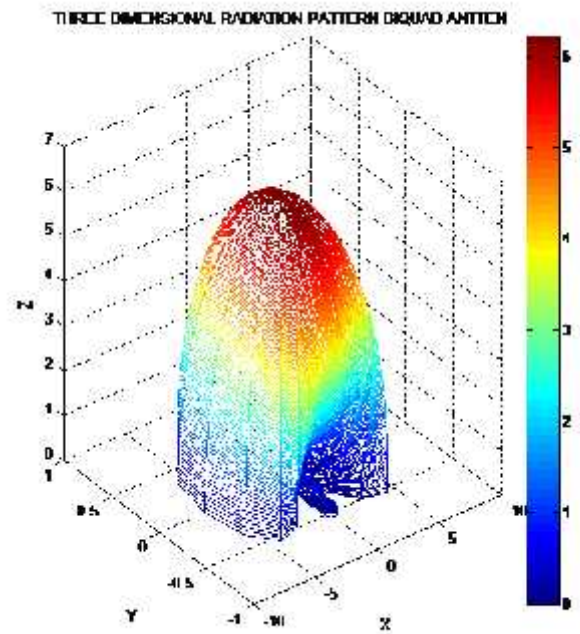
Figure13. Radiation pattern for the combined effect of biquad antenna and the parabolic mesh (paraquad).
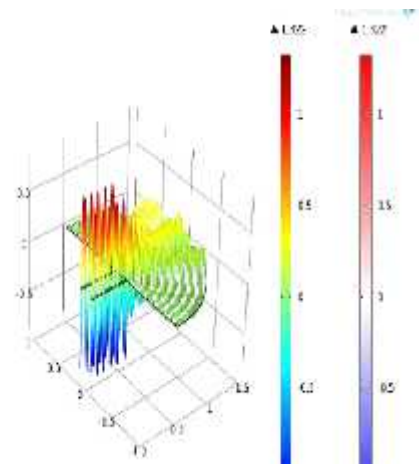
dB
With the wire mesh dish on the antte
Figure 14. Biquad Antenna radiation pattern without the parabolic mesh in Comsol Multiphysics

4. DISCUSSIONS
Table 1 shows the comparative analysis of the biquad antenna and the omnidirectional antenna using the performance measure of signal strength (dBm, %) and speed. It can be seen from the table that the signal strength in (dBm) for the biquad antenna is -33 and that of omnidirectional antenna is -45. Similarly, the signal strength in percentage for the biquad antenna is 71% while that of the

omnidirectional antenna is 56%. On the other hand the speed in Mbits for the biquad antenna is 11 and that of omnidirectional antenna is 5. The analysis therefore shows that performance of the biquad antenna is better than the omnidirectional antenna.

Figure 6 and Figure 7 show the signal strength in dBm and percentage against time respectively for the biquad antenna confirming the result in table 1.

The patterns of an antenna can be measured in the transmitting or receiving mode, the mode is dictated by the application. However, if the radiator is reciprocal as is the case for most practical antennas, then either the transmitting or receiving mode can be utilized. In this research work, the receiving mode is selected.

Figure 12 shows a radial taper radiation characteristic for parabolic mesh with distribution half-power beamwidth of 36.4 ÷ (a/λ) , distribution first-null beamwidth of 93.4 ÷ (a/λ), first sidelobe maximum in dB of -24.6 and directivity factor of $0.75 \times (2\pi a/\lambda)^2$, where a is the normalized excitation coefficient and λ is the wavelength in meters. Furthermore, Figure 12 shows the radiation pattern of the biquad antenna with it various parts which are subclassifed into major or main, minor, side and back lobes. Radiation lobe is a portion of the radiation pattern bounded by regions of relatively weak radiation intensity. In the Figure these are in ranges of 0 to 50 degrees and 135 to 180 degrees. Major lobe is the radiation lobe containing the direction of maximum radiation. In the Figure these are in ranges of 53 to 130 degrees. Side lobe is a radiation lobe in any direction other than the intended lobe. In the Figure it is in the ranges of 30 to 50 degrees and 135 to 150 degrees. Back lobe is a radiation lobe whose axis makes an angle of approximately 180^0 with respect to the beam of an antenna. In the Figure it is in the ranges of 0 to 30 degrees and 150 to 180 degrees.

Figure 13 shows the combination of parabolic mesh and biquad antenna radiation pattern which resulted in the optimization of the antenna. The x and y axis indicate the combined reflection of the copper plate and the parabolic mesh and the z axis indicate the length of radiation in meters. The new radiation pattern is named as paraquad three

dimensional patterns. When Figure 13 is compared with figure 11, it can be seen that figure 13 outperformed.

Figure 14 also shows the radiation pattern of the biquad antenna without the parabolic mesh as simulated in Comsol Multiphysics whichexplains the wider coverage of the biquad antenna.The vertical section in Figure 14 shows the standing waves inside the coaxial cable and the antenna which represents pockets of energy concentrations and storage as indicated in Figure 15. The semicircle section in Figure 14 shows radiation in free- space propagation as indicated in Figure 15.
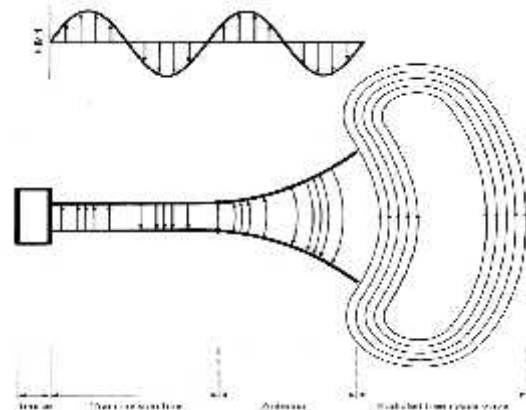
Figure 15. Antenna as a transition device.

Hence the simulation in Matlab and Comsol Mutiphysics was used to predict working operation of the antenna design.

5.   CONCLUSION

The aim of this research work was to design and fabricate a biquad antenna and optimize it by placing it in a parabolic mesh. The biquad antenna designed and tested operated at the frequency and power levels as indicated in the table of results. The table also showed results obtained for the performance of an omnidirectional antenna. Comparing the results for the optimised biquad antenna and that of the omnidirectional antenna, the biquad antenna performed better in terms of coverage and signal strength. This performance was confirmed during the testing. The experimental radiation patterns of the constructed antenna was also obtained by mathematical modelling and simulation in Matlab and Comsol Mutiphysics and compared with theoretical patterns. The hardware and software results obtained matched the theoretically predicted results. The new wave radiation pattern for the combined

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effect of the biquad antenna and the parabolic mesh is termed paraquad. Again the radiation pattern for the parabolic mesh alone, biquad antenna alone and the two put together were compared. The performance of the biquad antenna alone was better than that of the mesh alone and that of the combined effect was better than the two.

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Factors Affecting Loan Repayment among Fisher Folks in Ghana

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Abstract
This paper investigated factors influencing loan repayment performance of fisher folks in Ghana. A survey of 90 sampled fishermen were done using interview guide. Descriptive statistics and measure of central tendency were also employed to describe the socio-economic characteristics of the respondents and also their acceptance to factors such as macroeconomic, MFI related, bank staff related and customer related factors as influencing credit non-payment. The findings revealed that majority of the Fisher folks in the paper study area were semi literates. About half of the Fisher folks who applied for credit from microfinance institutions did so for commercial purposes while more than a third of the Fisher folks applied for credit for personal purposes. Majority of the respondents agreed that macroeconomic and bank related factors such as high inflation, exchange and interest rate, time of disbursement, time of repayments being too short and the credit being inadequate also contributes to the inability of Fisher folks credit non-payments. It was recommended that, the microfinance institutions should attempt to reduce their lending rates and other credit related charges and provide technical assistance to businesses. Furthermore, a concerted effort should be made to keep the rate of inflation at a low level to aid business growth so as to place Fisher folks in a better position to repay their credit.

Keywords: Loan non-payment; Microfinance; Macroeconomic Factors; Non-collateral; Fisher Folks.

1.0 INTRODUCTION

Access to finance has been identified as a dominant constraint facing SMEs (Lader, 2010). A World Bank study found that about 90% of small enterprises surveyed indicated that credit as was a major constraint to new investment (Parker, Riopelle, & Steel, 2007). Levy (2007) also found that, there is limited access to financial resources available to smaller enterprises compared to larger organizations and the consequences for their low growth and development. This stems from the fact that SMEs have limited access to capital markets partly due to the perception of higher risk, informational barriers, and the higher costs of intermediation for smaller firms. In Sub-Saharan Africa, most small businesses fail in their first year due to lack of support from government and traditional banks (Biekpe, 2010).

In Ghana, the idea that problems in financing small firms have significantly hindered the role they play in the overall macroeconomic performance of the Ghanaian economy is deeply rooted since the overthrow of the first Republic led by Dr. Nkrumah (Boapeah, 2010). Previous studies have identified a growing gap in the financial support offered to Ghanaian SMEs. The high interest rates, collateral requirements and the cumbersome processes have often been mentioned as the main impediments to SMEs' access to bank loans in Ghana (Sowa, Baah-Nuakoh, Tutu, & Osei, 2010; Barnes, Gary, & Richard, 2010; Buatsi, 2010). These studies however focused mainly on the difficulties SMEs face in accessing credit from conventional banks and other financial institutions.

Many microfinance institutions in developing countries provide financial services such as savings and loans to aid Small Scale Enterprises (SMEsSEEs). This is an effort in line with the "Millennium Development Goals" which seeks to reduce poverty by 50% by the year 2015. However, the sustainability and continuity of the microfinance institutions to increase the volume of credit to stimulate the poverty reduction goal depends on the client repayment rates. High repayment rates allow the institutions to lower the interest rates and processing costs and consequently increase patronage of loans. High repayment rates reduce the subsidy-dependence of the credit institutions to help them reach a better sustainability level. Repayment performance thus serves as a positive signal for increasing the volume of credit availability to various sectors of the economy.

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However, in Ghana, microfinance institutions continue to deny credit to the agricultural and fisheries sectors. This decline is partly due to poor loan repayment performance from these sectors. Most of the loan defaults in these sectors arise from poor management procedures, loan diversion and unwillingness to repay loans as well as other socio economic characteristics.

In the absence of sufficient collateral to pledge, the poor generally have to rely on loans from informal moneylenders at high interest rates or from friends and family, whose supply of funds is generally limited (Weiss & Montgomery, 2004; Conning & Udry, 2007). In order to supply cheaper credit, many developing countries intensively implemented large-scale subsidized credit programs between the 1950s and 1970s.

Nevertheless, a growing body of evidence suggests that the subsidized credit programs will be unsuccessful in that they induced local political elites to take advantage of below-market interest rates, leading to their rent-seeking activities, insufficient outreach to the rural poor farmers, very low loan repayment rates, and inefficiency in financial markets with excess demand (Adams, Graham, & Von Pischke, 2010; Robinson, 2011; Zeller & Meyer, 2011).

As an alternative, microfinance has recently attracted growing attention as a means of overcoming such a situation (Morduch, 2010). Most microfinance institutions (MFIs) provide collateral free small loans to low-income households, who have long been deemed to be un-bankable. These loans are generally expected to be used for self-employment and income-generating activities.

However, recent theoretical as well as empirical studies have cast doubt on this and show there are other mechanisms underlying the high repayment rates among the fisher folks. In addition, the belief that the increase in the number of MFIs relaxes credit constraints of the fisher folks has come under challenge. There is also a growing concern that MFIs, often operated by nongovernmental organizations, should put more effort into becoming regulated for-profit financial institutions that work to enhance financial sustainability instead of primarily pursuing services to the poor. This kind of commercialization of microfinance has gained momentum since the 1990s (Drake & Rhyne, 2011; Cull, Demirguc-Kunt & Morduch, 2010). Yet, there is still concern that MFIs might shift away from serving poorer clients in pursuit of commercial viability, which is called "mission drift."

1.1 Statement of the Problem

The ability of borrowers to repay loans collected is crucial for the long-term sustainability of the credit institutions. As a result, many studies have tried to examine loan repayment performance of many socio-economic groups.

Boateng (2007) examined the determinants of loan repayment under the indigenous financial system in Southeast Ghana. Empirical results from multiple regression analysis revealed amount of loan received, age of beneficiary, household size, and years of formal education and occupation are important predictors of loan repayment under the system.

The issue of non-payment of loans by fisher folks has been one of the topical issues in SME financing. The interest in the concept has arisen mainly due to the alarming rate of non-performing credits in the MFIs which threaten financial sector stability. According to the Business News of the Daily Graphic (2012), MFIs are reviewing their internal controls, credit appraisal and risk management policies to reduce the soaring rate of non-payment of loans. The Non-Performing Loans (NPL) ratio, which measures the ratio of loan losses to gross advances, deteriorated from 16.2 per cent in December 2011 to 17.6 per cent as at December 2012. This had reduced the share of the top five MFIs in the industry from 49.5 per cent in 2011 to 45 per cent in 2012.

From the foregoing discussion, it is clear that no paper has investigated factors that affect loan repayment of the fisher folks in the KEEA district of Ghana. The thrust of this paper is therefore to fill this gab by investigating the factors that influence loan repayment of fisher folks in the KEEA district in the central region of Ghana.

1.2 Objectives of the Study

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The main objective of the paper is to investigate factors affecting loan repayment of fisher folks in KEEA district in the central region of Ghana.

Specifically, the paper seeks to:
1) Examine whether the socio-economic characteristics of fisher folks influence loan repayment.
2) Examine the loan processing and disbursement procedures of Microfinance institutions in Ghana.
3) Determine the size of loan borrowed and invested by the fisher folks.
4) Identify the factors that affect loan repayment by fisher folks in KEEA district in the central region of Ghana.

2.0 METHODOLOGY
The paper proposed to test the hypothesis (Ho): High interest rates, high service charge on loans, and inadequate credit do not account for non- payment of credit among fisher folks in Ghana against the alternative hypothesis (Hi): High interest rates, high service charge on loans, and inadequate credit do account for non- payment of credit among fisher folks in Ghana. that the study adopted both descriptive and exploratory approaches to identify the factors that affected loan repayment among fisher folks in the growth of microfinance institutions and its relation to performance of microfinance institutions. The choice of design gave the researcher an in-depth view, (Easterby-Smith 2010, Deshpande´, 2007). The selected MFIs includes, Beige Capital and Loans Investment, Express funds and Loans, Trust Vision saving and Loans, Snapi Aba Savings and Loans, Bayport Financial Services, Ernest Financial Services, First African Financial Services, Diamond Financial Services, and NDK Financial Services. The researcher considered these MFIs because they are the MFIs around the KEEA district that grant loans to SMEs in the districts which includes the fisher folks.
The sample frame of the fisher folks in the KEEA district is not known but for the purpose of the study, the researcher considered, ninety (90) fisher folks who have received loans from the (9) selected microfinance institution in the KEEA district in the central region of Ghana. Due to the large number of fisher folks in the KEEA district in the central region the researcher used the purposive and quota sampling techniques for convenience seek.

Questionnaires were design to elicit demographic information such as age, gender, professional experience, size of loan and the perception of fisher folks and management of MFIs about factors that affect loan repayment among fisher folks in Ghana. This study employed two different scales in its measurement of the perception of respondents about the factors that prevents them from paying back their loans and their satisfaction of the terms of the payment given. Each scale has its own range and options. The variety and number of scales are Likert'sfive point scale and bipolar scale (eg. Yes / No type).The questionnaires comprised both optional type and statements in Likert's five points scale. The responses of these sections are obtained from the fisher folks and management of selected MFIs in the five point scale, which ranges as follows: 5 –Strongly Agree, 4-Agree, 3 –Neutral, 2 –Disagree, 1-Strongly Disagree.

This allowed for the standardization of results as well as making it easier for respondents to complete the questionnaire. The researcher and supervisor discussed the Likert's five point scale and decided to assign the numerical value 3 for undecided or neutral. By referring to several approaches in statistics, it was decided to assign 3 to neutral. Undecided had a connotation that, the statements in the interview schedule do not have proximity to the respondents. But neutral implies that they are well acquainted with the statements in the questionnaire but they want to remain equidistant from the two extremities of agreement and disagreement.

3.0   RESULTS AND DISCUSSIONS

Bio Data of Fisher Folks
Table 3.1: Demographic InformationSummary

RespondentsAge inYears	NoofRespondents	Percentage
19 – 30	15	18.8
31 – 40	40	50.0
41 – 60	25	31.3
Total	10	
Mean Age		33.35
Education		
Basic School	12	13.3
JHS	41	45.5
SHS	5	5.5
No Education	32	35.5
Total	90	
Mean of Formal		19.3

Source: Field Survey 2013

In an attempt to examine whether the socio-economic characteristics of respondents influence loan repayment, it was revealed that, fisher folks had a mean age of 33.4 years with majority (50%) of them in the age range between 31-40 years. 18.8% were between 19-30 years; only 31.3% were between 41-60 years. The results from the distribution of the ages of the fisher folks revealed that most of them fall within the productive age.

The fisher folks interviewed had a mean of 19.3 of formal education; with majority (45.5%) having junior high school education. 13.3% had obtained basic education; while only 5.5% had obtained senior secondary education. However, 35.5% had no formal education. It must be emphasized that this high average illiteracy is expected to positively influence loan repayment of fisher folks.

Table 3.2: Duration of Loan Processing

S/N	Duration	Frequenc	Percentag
1	1-3 months	56	62%
2	4-6 months	10	11%
3	1-3 weeks	22	25%
4	less than a	2	2%
	ColumnTotal	90	100%

Source: Field Survey 2013

It was revealed that, 62% of the fisher folks had to wait for about 1-3 months before loans were disbursed; 11% waited between 4-6 months; 25% waited between 1-3 weeks before receiving the loans; only 2% waited for less than a week. Of the 90 fisher folks interviewed, 40.3% had to provide collateral substitutes before loans were given out. Items used as collateral included plots of land, houses, fishing nets, and canoes/boats. However, 62 % did not provide collateral security before loans were given out to them.

Table 3.3: Cost of Loan Processing

S/N	Cost of L	Frequenc	Percentag
1	GH¢15 -	46	51%
2	GH¢51 -	34	38%
3	GH¢201-	10	11%
	ColumnTotal	90	100%

Source: Field Survey 2013

The distribution of loan processing costs revealed that 51% spent between GH¢15-GH¢50 to process the loans; 38% of the fisher folks spent between GH¢51GH¢100. However, only 11% spent between GH¢201-GH¢250 to process loans. It must be emphasized that the distribution of loan processing costs is proportional to the size of loans received (See table 4.6 above).

Table 3.4: Size of Loan Borrowed

S/N	Size of L	Frequenc	Percentag
1	less than	13	26%
2	between	60	55%
3	between	12	15%
4	between	4	3%
5	more than	1	1.1%
	ColumnTotal	90	100%

Source: Field Survey 2013

Of the fisher folks interviewed, 26% borrowed less than GH¢1000; 55% obtained between GH¢1000-GH¢4000; 15% obtained between GH¢4001-GH¢7000; 3.0% obtained between GH¢7001-GH¢10000. Only 1% borrowed more than GH¢10000. The average size of loans

borrowed was GH¢2423.13 (see Table 3.4 above).

Table3.5: Size of Loan Investment

S/N	Years	Frequency	Percentage
1	less than	13	14.4%
2	between	60	66.6%
3	between	12	13.4%
4	between	4	4.3%
5	more than	1	1.1%
	ColumnTotal	90	100%

Source: Field Survey 2013

However, the distribution of the size of loans invested into fishing activity revealed 14.4% of the fisher folks investing less than GH¢500; 66.6% invested between GH¢500-GH¢3000; 13.4% invested between GH¢3001-GH¢5600; whilst 4.3% invested between GH¢5601-GH¢8100. Only 1.1% invested an amount more than GH¢8100. The average amount invested into fishing activity was GH¢2075.37. Comparison of the averages of the amount borrowed (GH¢2423.13) and amount invested (GH¢2075.37) revealed not much difference and as a result, we expect the size of loan invested to influence repayment performance (See table 3.5 above).

Table3.6: Size of Loan

S/N	Size of Loan	Frequency	Percentage
1	less than	31	35%
2	between	47	52%
3	between	11	12%
4	more than	1	1.1%
	ColumnTotal	90	100%
	Average Size of Loan	GH¢2233.37	

Source: Field Survey 2013

The distribution of size of loans repaid was also examined. 35% of the fisher folks were able to repay less than GH¢1000; 52% had repaid between GH¢1000-GH¢5000; 12% were able to repay between GH¢5001GH¢10000; only 1% of the fisher folks were able to repay more than GH¢10000. However, 6.0% of the fisher folks were unable to repay any amount. Repayment structure was basically two types namely installment or bulk repayments. Majority of the fisher folks (92.5%) repaid the loans in installments. Loan repayment periods varied from 1-30 months with majority (28.4%) of the loans repaid between 7-12 months.

3.1 Causes of Credit non-payment
3.1.1 Macroeconomic factors and credit non-payment
In finding out which macro-economic factors would cause Fisher folks to default the credit they have taken from the microfinance institutions, about 90% (n=81) of the respondents agreed that change of government was one of the reasons why Fisher folks default or are unable to pay their credit at the scheduled time. This may be particularly true if the new government pursue tight fiscal policies in order to reduce budget deficit created by the previous administration. When such measures are taken, it reduces the level of economic activity and brings about low consumer confidence in the economy (See table 3.7 below).

Size of loans repaid and repayment structure.
Table 3.8: Macroeconomic factors and credit non-payment

S/N	Factors	SA	A	N	D	SD	Total
1	Change in government	63	18	7	1	1	90
		(70)	(20)	(8)	(1)	(1)	(100)
2	High inflation	44	37	7	1	1	90
		(47)	(39)	(8)	(1)	(1)	(100)

S/N	Factor	SA	A	N	D	SD	Total
3	Royalties agreement (loyalties)	63	20	5	1	1	90
		(70)	(23)	(6)	(1)	(1)	(100)
4	High exchange rate	57	21	7	3	2	90
		(63)	(23)	(8)	(3)	(2)	(100)
5	High import tariffs	44	37	7	1	1	90
		(47)	(39)	(8)	(1)	(1)	(100)
	ColumnTotal	271	133	33	7	6	450

NB: N=90; SA=Strongly agree; A=Agree; N=Neutral; D= Disagree; SD=Strongly disagree
Source: Field Survey 2013

It should also be noted that about 94% (n=85) of the respondents agreed that high inflation rate could also account for Fisher folks not paying their credit. High inflation rate leads to uncertainty in planning thus imparting negatively on business performance. High inflation rate also reflects in rising interest rates which makes credit payment even more difficult (See table 3.8 above).

About 94% (n=85) of the respondents also affirm that high exchange rate could account for Fisher folks defaulting their credits. High exchange rates may affect the cost of production by raising the price of imported raw materials and machinery needed for production. This may erode the provided margin of Fisher folks and weaken their ability to repay their credits (See table 3.8 above).

Besides, 85% of the respondents asserted that high import tariffs may be blamed for credit non-payment. According to them, this could affect the prices of the nets and the outboard motors they use which will adversely increase cost of operation. Only 6% of the respondents surveyed disagreed (See table 3.8 above).

3.1.2 MFI related factors and Credit non-payment
In determining which MFI related factors would cause Fisher folks to default a disbursed credit, about 90% (n=81) of the respondents

agreed that high annual interest rates charged on the credits could account for Fisher folks defaulting (Table 3.9 below). Fisher folks have limited time within which they have to repay the credit, and because this time frame is too short sometimes the investment has not started yielding results thereby making the Fisher folks to default. 90% (n=81) of the respondents agreed that the time of the disbursement or the delaying in the crediting of customers account could explain why Fisher folks default (Table 3.9 below).

About 90% (n=81) of the respondents agreed that sometimes the credit is not adequate for the intended purpose, therefore could not achieve their aim for them to be able to repay the loan as planned. As a result of that, some of the fisher folks relied on other sources that attracted higher interest (See table 3.9 below).

About 90% (n=81) of the respondents agreed that there was no credit payment schedules for the Fisher folks to follow in repaying their credit and this could explain their non-payment, while the remaining 2% disagreed with the statement (See Table 3.10 below). About 90% (n=81) of the respondents agreed that high credit service charges, which includes processing, facility and legal fees, could be one of reasons why Fisher folks default their credits (See Table 3.9 below).

Table 3.9: MFI related factors and Credit non-payment

S/N	Factors	SA	A	N	D	SD	Total
1	High interest rates	63	18	7	1	1	90
		(70)	(20)	(8)	(1)	(1)	(100)
2	Time used in disbursing loans	60	21	7	1	1	90
		(67)	(23)	(8)	(1)	(1)	(100)
3	Inadequate credit	60	21	7	1	1	90
		(67)	(23)	(8)	(1)	(1)	(100)
4	Credit payment schedule	62	19	7	1	1	90

		(69)	(21)	(8)	(1)	(1)	(100)
5	High percentage service charge	63	18	7	1	1	90
		(70)	(20)	(8)	(1)	(1)	(100)
6	Extortion by bank staff	43	35	7	4	1	90
		(48)	(29)	(8)	(4)	(1)	(100)
7	Bank knowledge of use of Credit	38	14	7	30	1	90
		(42)	(16)	(8)	(33)	(1)	(100)
8	Bank regular visits	14	18	7	50	1	90
		(15)	(20)	(8)	(56)	(1)	(100)
	ColumnTotal	403	164	56	89	8	720

NB: N=90; SA=Strongly agree; A=Agree; N=Neutral; D= Disagree; SD=Strongly disagree
Source: Field Survey 2013

To find out how bank staff contributed to the problem of Fisher folks credit non-payment, about 87% (n=78) of the respondents agreed that bank staff extortion from Fisher folks in order to facilitate the credit could result in non-payment, while majority disagree with the statement. About 58% (n=52) of the respondents agreed that bank staff did not know what the credit would be used for, while the remaining 60% disagreed with the statement. 35% (n=32) of the respondents agreed that calls and regular visit from staff of the microfinance institutions could also account for the non-payment of Fisher folks, while 51% of the respondents disagree with the assertion regular could affect non- payment of credit (see table 3.9 above).

3.1.3 Customer Related factors and Credit non-payment

Out of the total, 90% (n=81) of the respondents agreed that poor business performance was a contributing factor, 94.2% (n=85) of the respondents agreed that business failure or closed down was a contributing factor to credit non-payment among Fisher folks, 76% (n=81) of the respondents agreed that most credits are not properly timed and so contributing to their inability to repay, 70% (n=56) of the respondents agreed that rent or royalties linked to their place of operation contributes to their inability to repay their loans (See Table 4 below).

Table 3.10 : Customer Related factors and Credit non-payment

S/N	Factors	SA	A	N	D	SD	Total
1	Poor business performance	42	39	7	1	1	90
		(47)	(43)	(8)	(1)	(1)	(100)
2	Poor timing of credit	42	39	7	1	1	90
		(47)	(43)	(8)	(1)	(1)	(100)
3	Royalties	42	21	7	18	2	90
		(47)	(23)	(8)	(20)	(2)	(100)
4	Diversion of funds for other uses	57	21	7	3	2	90
		(63)	(23)	(8)	(3)	(2)	(100)
5	Domestic problems	42	21	7	18	2	90
		(47)	(23)	(8)	(20)	(2)	(100)
	ColumnTotal	225	141	35	41	8	450

NB: N=90; SA= Strongly agree; A=Agree; N=Neutral; D= Disagree; SD=Strongly disagree
Source: Field Survey 2013

Moreover, 86% (n=78) of the respondents agreed that diversion of credits or using credits

for different purposes other than what was intended for contributes to Fisher folks inability to repay, and 73% (n=63) of the respondents agreed that domestic problems which might include many dependents may account for credit non-payment among Fisher folks (See Table. 4 above).

T-test on Factors that Affect Credit Non payment

Table3.11 Mean and Standard Deviation for Macroeconomic factors One-Sample Statistics

S/N	Factors	N	Mean	Std Deviation	Std Error Mean
1	Change of government	90	3.63	1.665	.221
2	High inflation	90	4.18	2.197	.291
3	High exchange rates	90	3.33	1.816	.241
4	High import duties	90	4.04	1.832	.243

Source: Field Survey 2013

Table 6 Mean and Standard Deviation for Bank Related factors One-Sample Statistics

S/N	Factors	N	Mean	Std	Std Error
1	High interest rates	90	3.39	1.595	.301
2	Disbursement time	90	3.54	2.285	.432
3	Repayment duration	90	3.00	1.610	.304
4	Loan amount	90	3.64	1.393	.263
5	Long processing too	90	3.68	2.109	.399

Source: Field Survey 2013

The result of the paper shows that on the average (M=3.39, SD= 1.595) most of the respondents strongly agreed that high annual interest rate charged on loan contributes to the inability of Fisher folks to repay the credit, on the average (M=3.54, SD=2.285) most of the respondents agreed that time of the disbursement of the credit affects their ability to repay the credit, also, on the average (M=3.00, SD=1.610) most of the respondents agreed that the time for the repayment of the credit was too short thereby affecting the ability to repay (See table 6. above).

Table 7 Rotated Component Matrix (a)

		Components		
S/N	Factors	1	2	3
1	High interest	.741	.017	-.178
2	Time used in	.707	-	.286
3	Inadequate	.686	.392	-223
4	High	-	.876	.184
5	High inflation	.233	.862	-
6	High exchange rate	.135	.147	-.047

Extraction Method: Principal Component Analysis. Rotation Method: Equamax with Kaiser Normalization.
A Rotation converged in 5 iterations.

Scree Plot

Source: SPSS output

Table 8: Cross-tabulation of reasons for Credit Non-payment

S/N	Response	Response		Total
		Agree	Disagree	
1	Interest rates are	81 (90%)	2 (2%)	83
2	Loan	85 (94%)	2 (2%)	87
3	Service	45 (50%)	16 (18%)	61
4	Total	21	20	231

Chi-Square = 34.440, DF = 3, valup - e = 0.000

Decision and Conclusion

At 5% level of significance the paper reject the null hypothesis, since the p -value of 0.000 is less than α-value of 0.05. The paper therefore concludes that, High interest rates, High Service Charge on loans, and inadequate credit do account for non- payment of credit among fisher folks in Ghana.

4.0 CONCLUSION

The following conclusions can be drawn from the paper; First, most respondents who took part in the study agreed that macroeconomic factors contribute largely to the inability of the Fisher folks to repay the credit granted to them by the microfinance institution. This was expected, since factors such as high inflation rate, high exchange rate, and high import duties/tariffs are influenced by the change in government.

Secondly, the paper lends credence to the fact that bank related factors such as high annual interests charged on credits, the time of the disbursement of the credits, time for the repayment of the credits, credit provided to Fisher folks may not be adequate for the purposes for which they were sorted for, no specific structure or schedule for the repayment and high credit service charge as the contributing factor to the inability of the Fisher folks to be unable to pay their credit

The findings from the paper also attest to the fact that customer related factors such as theft or robbery at the business premises, poor business performance which may lead to the closure of business and time of taking the credit may account for credit non-payment.

Based on the conclusions from the paper, the following policy recommendations are provided. First, government should continue to pursue prudent fiscal and monetary policy that will ensure macroeconomic stability and provide the enabling environment for businesses to flourish. Second, the microfinance institution should attempt to reduce their lending rates and other credit related charges and provide technical assistance to businesses.

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A Study of Client Needs and Satisfaction in the Ghanaian Building Industry

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Abstract
Identifying and satisfying the needs of clients is critical for the existence and competitiveness of the construction industry and its practitioners. Methodological approaches to client needs assessment and satisfaction measurement, monitoring and control, and ways of improving client satisfaction level in the Ghanaian building industry are investigated. The study essentially followed the models used by Gyadu-Asiedu (2009) in its investigation partially to test its validity today and to explore new information. The scope of the investigations covers clients of various types and their perception on the performance of consultants. The descriptive survey method was adopted in the study which involved two stages of data gathering. Data obtained from the descriptive survey stage were analysed using the multi-attribute and multiple regression techniques in developing the research models. At the first stage, semi-structured pilot interviews were conducted with a convenience sample of 18 professionals within the target group. Some of the client needs/objectives were as follows: To achieve business expansion and to improve market share. Minimize rental costs in long-term leasehold, resulting from a lease-owned decision analysis and to minimize rental costs. Clients general requirement were also pleasing to look at value for money and freedom from defects on completion. In general, all prospective clients require to be satisfied with the building they undertake particularly in the areas of aesthetics, value for money and to get returns on investments. The research has proposed two validated models for the assessment of construction client needs, and the measurement of client satisfaction in the procurement process. Recommendations were made on ways of improving client satisfaction level in the Ghanaian building industry.

Keyword: Client; Satisfaction; Needs; Assessment; Building Industry

1. INTRODUCTION

The Webster's dictionary defines 'satisfaction' as 'the fulfillment of a need or want'. The concept of customer satisfaction is largely developed in the production sector and the customer service markets, and is regarded as the raison d'etre for companies' existence and operations (Taylor and Baker, 1994). The provision of service or production of a product offered for sale should be aimed at satisfying identified needs of the target customers (Rust and Zahorik, 1994).

The above suggest that the study of client needs and satisfaction is very crucial as current and future prospects in the construction industry depend on the extent to which clients are satisfied with their investment in procurement process. It is therefore disheartening to read about rising spate of client dissatisfaction in the industry. For instance, in the United Kingdom, the NEDO (1974) reports of clients being dissatisfied with their buildings. Further, Bowen et al. (1997) posit that, "the construction industry potentially has a higher proportion of dissatisfied and critical clients than any other industry" (p.1). This agrees with an earlier observation by Kometa et al. (1994) that, "evidence abounds to suggest that clients are largely misunderstood and dissatisfied with the performance of their consultants and contractors" (p. 4333).

Since the concept of client/customer needs assessment and satisfaction measurement are fully developed and operational in the production and consumer services sectors, perhaps it may be worthwhile to adapt them to the construction industry, despite the latter's peculiarities, for potential application in improving client satisfaction levels. An assessment and understanding of clients' real and stated needs, as well as the satisfaction criteria, is imperative to enable service providers tailor their offerings to satisfy both sets of needs alone, as is currently practiced.

Literature Review
Following studies undertaken on the subject area, especially in the production sectors and

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consumer services markets (Suprenant, 1997; Liu and Walker, 1998; Green and Lenard, 1999), the chapter is structured along the pattern of Mbachu (2003) and also adopted by Gyadu-Asiedu (2009) as:

> * Clients in the Building industry
> * Concept of need and needs assessment
> * Concept of satisfaction and satisfaction measurement
> * Factors affecting client's procuring behavior
> * Causes of client dissatisfaction

In our quest to ensure client satisfaction as is being considered –it requires the assessment of a whole perspective of the client of project performance as represented by a number of criteria and indicators. In other words, client satisfaction, if it will have to be considered, should be a declaration by clients after they have considered the achievements of all the criteria and indicators that represent their perspective project performance at the appropriate stage of the project. Not by practitioners or consultants (Gyadu-Asiedu, 2009). This calls for the identification of clients by types or categories based on the different types of clients existing in the construction industry. Gyadu-Asiedu (2009), citing Melville and Gordon, (1983 pp 8-16), identified six kinds of clients. These are: (i) the individual client (ii)the committee client**:** For example**,** sports clubs, tenants associations, charitable or religious organisations; (iii) the company client**:** the Lay and the Informed or Expert; (iv)the local authority client**:** acting for and on behalf of the government; (v)the central government**:** Most of the capital investments in a developing country are undertaken by the central government (Ofori, 1999 &2001); and (vi)nationalized institutions of the government. In another research, Mbachu (2003) categorises clients into two broad bases. One is based on characteristics of the client system: nature of organisational entity, source of project finance, construction industry experience, level of knowledge of the construction industry, frequency of project development, complexity of client organisation, type of business activities, purpose group of buildings mostly procured and procurement interests. He grouped these into three distinct classification based on the nature of clients: public, individual (Private), and Corporation clients.

Rougvie (1991) identifies these as individuals or groups who require purpose-built building projects. Rougvie (1991) note that while individual client may have large degrees of freedom in their decision-making, they are not free from constraints. For instance, if finance is applied for, then, the bank, building society or whoever the financier is, may require that the proposed property be used as security for the loan. This may rule out the worst excesses that the client may wish to incorporate. Otherwise the only constrains that will apply are the normal development functions.

Rougvie (1991) also notes that members of this category of clients may range in size from a sole proprietor to a multi-national conglomerate, and encompass, sometimes within the same company, a wide range of organizational types, functions and objectives. Like the public client, the corporate client system could have a sophisticated approach to development, depending on the corporate size. Turner (1990) observes that where such an organization builds regularly, there is the tendency to find in-house staff with the required project management skills acting as project executives, and who, as single point contact for the organization, are vested with the power to speak and act for the organization. Where such an in-house is not available in large corporation, NEDO report (1998) recommends the appointment of "an independent customer representatives" (p.54) by employing the services of members of professional or trade bodies. However, Rougvie (1991) identifies the problem of the corporate client system similar to that of public client, which is the difficulty in identifying the decision-making body within the organization.

In a related development, Gyadu-Asiedu (2009) provided a summary of clients needs as in Figure 1
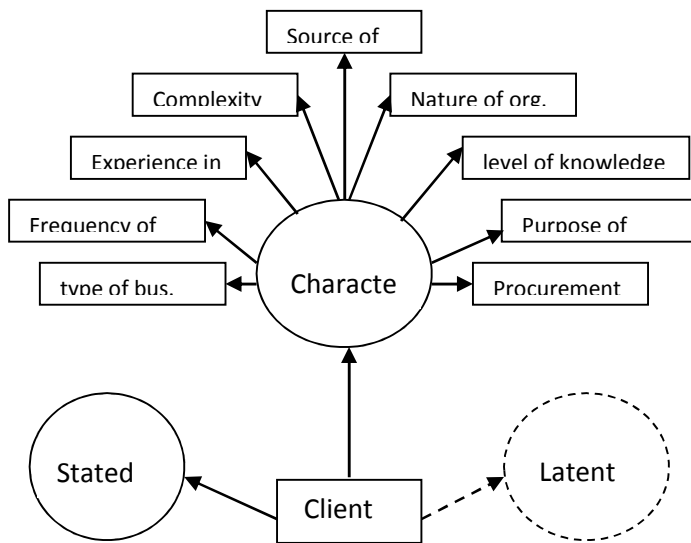
Fig. 1 A Model for Identification of clients according to Needs and Characteristics
(Source: Gyadu-Asiedu, 2009)

From a board perspective, McCabe (1998) sees 'needs' as internal forces that set up some conditions of stress in individuals, thereby motivating them to take actions perceived to reduce the stresses induced" (p.93). this conforms to the dictionary definition of 'needs' as "circumstances requiring some course of action". Other connotations usually associated with 'needs' are requirements' and 'wants'. Kotler (1997) distinguishes between the concept of 'Needs', 'wants' and Demands' by observing that, "human 'need' is a state of deprivation of some basic satisfaction, while 'wants' are desires for specific satisfiers of needs.' Demands', on the other hand, are wants for specific product or services that are backed by an ability and willingness to buy them" (p.9). thus 'wants' translate to 'demands' when backed by purchasing power and willingness to buy. In the context of this study, 'need' connotes identifiable state of deprivation of , or desire for, some basic satisfaction, which the procurement of building project and/or, services can fulfill, when there is an ability and willingness to buy (commission) the procurement process.

The Webster's dictionary defines 'satisfaction' as "the fulfillment of a need or want'. Operationalizing this definition has taken several directions some of which are inconsistent with others. Kotler (1997) states

that, "satisfaction is a person's feelings of pleasure or disappointment resulting from comparing a product's perceived performance (or outcome) in relation to his or her expectation" (p.40). Hempel (1977) also maintain that, "consumer satisfaction is the extent to which expected product or service benefits are realized" (p.7), adding that it reflects a degree of congruence between actual outcomes and expected consequences. Consumer satisfaction can also be defined as the inverse of the difference between the idea and actual combination of attributes (Ptaff, 1977).

2. METHODOLOGY

Target Population

The target population consisted of Owner Occupiers and the professionals of various Government Organisations who, at the time the questionnaire was administered, had properties in the surveyed area.

Sampling Technique

A convenience sample (Zikmund, 1994) of 8 Owner Occupier category and 10 professionals were interviewed in the pilot surveys owing to the poor response rate in the industry (Nkado, 1999).

Census surveys were carried out with the clients, who did not participate at the pilot survey stage, during the questionnaire stage of the study.

The first stage of the research involved the identification and clear definition of the problem to be investigated (the research problem) and the research objectives. A literature review related to the topic area was undertaken at this initial stage. Pilot interviews were subsequently conducted once sufficient insight had been gained from the literature on the subject matter. The data gathered from these interviews was used as constructs for the design of the questionnaire. Questionnaire surveys were used to gather quantitative data for analysis. The final stage of the study included the quantitative data analysis, interpretation of results and statement of the conclusions drawn from the study. Recommendations for further research were made in the light of the research findings.

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Semi-structured interviews were used to generate constructs. These constructs formed the basis for the design of the questionnaire at the quantitative survey stage. The use of semi-structured interviews allowed the researcher to exercise some control over the direction of the interview. This facilitated the speedy collection of vital information within the constraints of scheduled interviews (Saunders et al., 1997).

Guidelines as set out in Saunders et al. (1997) were adhered to during the conduct of the interviews, particularly with respect to approach to questioning, and the avoidance of interviewer / interviewee bias.

All the major construction consultancy organizations in the Sunyani Municipality were targeted as the population for this research. Since their number is not many, questionnaires were sent to twelve (12) of such identifiable organisations. Also ten (10) hardware stores were identified as prominent in the municipality and targeted for this research. Out of these numbers, 9 out of the 12 questionnaires were received from the consultants representing a 75% response rate, whilst 8 out of the 10 questionnaires sent to hardware stores were received representing a response rate of 80%. The responses were further analyzed to determine the background of respondents and the profile of their organisations.

A. Table 1 Clients' General Expectations

Needs/Objectives	Level of importance	
	Weighted mean	Standard Dev.
a. Value for money	3.13	0.70
a. Pleasing to look at	3.25	0.97
b. Freedom from defects on completion	2.33	0.85
c. Delivered on time	2.19	0.81
d. Fit for the purpose	1.89	0.60
e. Supported by worthwhile guarantees	2.25	0.75
f. Reasonable running costs	1.63	0.70
g. Satisfactory durability	1.19	0.39

Table 1 results show that the most important needs/ and objectives for all types of clients in Ghana are "pleasing to look at" and "value for money" These two scored an average response of 3.25 and 3.13 respectively. In the scale definitions these are "important" needs/objectives. These were followed by "freedom from defects on completion", "supported by worthwhile guarantees" and "delivered on time" which regarded as being a little of being of little importance with average response of 2.33, 2.25, 2.19, 1.89 and 1.63 respectively. "Satisfactory durability" on the other hand received an average response of not being important.

For the public client (Government of Ghana) other needs are identified as using projects to contribute to good governance, contribute to national infrastructure and address future infrastructural needs. Tables 2, 3 and 4 shows the distributions.

Table 2 Clients' Contribution to Good governance

Factors	Level of importance	
	Weighted mean	Standard dev.
a. Building a positive image for the government	3.00	0.79
b. Creating job employment	2.44	0.86
c. Regulating the economy	2.31	0.85
d. Improvement in the country's GDP	1.88	0.70
e. To satisfy social needs	1.63	0.86

Table 2 results show that the most important factor to the contribution to good governance for all types of clients in Ghana is "building a positive image for the government"   This scored an average response of 3.00 (important). The rest of the factors "creating job employment", "regulating the economy", "improvement in the country's GDP" and " to satisfy social needs" which regarded as being a little of being of little importance with average response of 2.44, 2.31, 1.88, 1.63 respectively.

Table 3 Contributing to National Infrastructure

Factors	Level of importance	
	Weighted mean	Standard Dev.
a. Adding to national physical infrastructure stocks	3.19	0.52
b. Developing new technical capabilities	2.81	0.81
c. Contributing to other projects	3.25	0.75
d. Contributing to critical fields of national interest	1.88	0.60
e. Investing excess liquidity in infrastructure	1.56	0.70

Table 3 results show that the most important factor to the contribution to national infrastructure for all types of clients in Ghana are "contributing to other projects", "adding to national physical infrastructure stocks" and "developing new technical capabilities". These factors scored an average response of 3.25, 3.19 and 2.81 respectively (important). The rest of the factors "contributing to critical fields of national interest" and "investing excess liquidity in infrastructure", were regarded as being a little of being of little importance with average response of 1.88, 1.56 respectively.

Table 4 Addressing future infrastructural needs

Factors	Level of importance	
	Weighted mean	Standard Dev.
a. Providing housing and infrastructure for increasing population	2.63	0.78
b. Providing housing and infrastructure for future expectations	2.50	0.61
c. Creating incentive for accelerated national growth	2.25	0.75
d. Providing facilities for expanding government activities	1.81	0.95

Table 4 results show that the most important factor to the contribution to addressing futureinfrastructural needs for all types of clients in Ghana are "providing housing and infrastructure for increasing population" and "providing housing and infrastructure for future expectations" . These factors scored an average response of 3.63 and 2.50 respectively (important). The rest of the factors "creating incentive for accelerated national growth" and "providing facilities for expanding government activities", were regarded as being a little of being of little importance with average response of 2.25 and 1.88 respectively.

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In addition, clients also showed their assessment of the services received from the major service providers (consultancies) they have engaged over the years. These results are shown in Tables 5 to 10.

Table 5 Costing services

Services	Level of Importance		Service Performance	Providers'
	Weighted Mean	Stdd Dev.	Weighted Mean	Stdd Dev.
h. Accurate and reliable cost/budget estimates, feasibility /viability and risk assessments	3.00	1.14	3.20	0.81
b. Service efficiency(timely job execution and comprehensiveness of cost information)	2.85	0.91	3.30	0.56
c. Demonstration of competency (expertise and experience) for the job	3.05	0.80	3.10	0.83
d. Ability to foresee and budget reasonably for potential causes of cost escalations	2.40	0.92	3.00	0.89
e. Efficient performance of duties as per terms and conditions of appointment/ engagement	2.55	1.20	2.35	1.15

Table 5 shows that none of the known costing services received an average score close to being very important". Two out of the five criteria however, were adjudged to be important. These are: "demonstration of competency (expertise and experience) for the job" and "accurate and reliable cost/budget estimates, feasibility/viability and risk assessments" in descending order. The remaining three received an average responses that lie between important and of little importance. These are "service efficiency (timely job execution and comprehensiveness of cost information), "efficient performance of duties as per terms and conditions of appointment/engagement" and "ability to foresee and budget reasonable for potential causes of cost escalations".

With regard to the assessment of the performance of the service providers in the same criteria, the results show that client are satisfied in with the performance of four out of the five criteria. The only criteria that received an average response of unsatisfactory was their performance in "efficient performance of duties as per terms and conditions of appointment/engagement"

Table 6 Design (Architectural) Services

Services	Level of Importance		Level of Satisfaction	
	Weighted Mean	Stdd Dev.	Weighted Mean	Stdd Dev.
a. Flexibility in design (to accommodate changes with minimal cost implications)	3.20	0.93	3.00	0.77
b. Optimal, workable and error-free designs & detailing	3.0	0.77	2.95	0.80
c. Delivery to be timely, detailed and comprehensive	3.20	0.81	2.30	0.78
d. Efficient performance of duties as per terms and conditions of appointment/engagement	2.55	0.67	2.75	0.92
e. Aesthetic appeal (beauty in design and concepts)	2.20	0.75	2.85	0.96
f. Design tailored to suit client's budget, yet adequately address client's main needs	2.45	0.92	2.60	0.92

Table 6 shows that none of the known Design (Architectural) Servicesreceived an average score close to being very important". Three out of the six criteria representing half however, were adjudged to be important. These are: "Flexibility in design (to accommodate changes with minimal cost implications)", "Delivery to be timely, detailed and comprehensive"and "Optimal, workable and error-free designs & detailing" in descending order. The remaining three which also represent halve received an average responses that lie between important and of little importance. These are "Efficient performance of duties as per terms and conditions of appointment/engagement, "Design tailored to suit client's budget, yet adequately address client's main needs" and "Aesthetic appeal (beauty in design and concepts)".

With regard to the assessment of the performance of the service providers in the same criteria, the results show that client are satisfied in with the performance of only one out of the six criteria. That is "Flexibility in design (to accommodate changes with minimal cost implications)". The rest of the criteria received an average response of unsatisfactory in their performance.

Table 7 Construction and project management services

Services		Level of Importance		Level of Satisfaction	
		Weighted Mean	**Stdd Dev.**	**Weighted mean**	**Stdd Dev.**
a.	Technical and managerial competences/ experience	2.80	1.03	3.25	0.77
b.	Team work and efficient co-ordination of all the services to achieve desired goals	2.65	0.96	2.95	0.74
c.	Delivery within time, quality and cost targets	2.60	0.92	2.55	0.97
d.	Manage client's changes efficiently (with minimal cost implications)	2.40	1.02	2.45	0.92
e.	Efficient performance of duties as per terms and conditions of appointment/engagement	2.90	1.10	2.40	1.16
f.	Efficient/unbiased communication of project objectives to all parties	2.50	0.92	2.50	1.20

Table 7 shows that none of the known construction and project management servicesreceived an average score close to being very important". Five out of the six criteria, were adjudged to be close to important. These are: "Efficient performance of duties as per terms and conditions of appointment/engagement", "Technical and managerial competences/ experience", "Team work and efficient co-ordination of all the services to achieve desired goals", "Delivery within time, quality and cost targets" and "Efficient/unbiased communication of project objectives to all parties" in descending order. The only one which received an average response of being of little importance is "Manage client's changes efficiently (with minimal cost implications)".

With regard to the assessment of the performance of the service providers in the same criteria, the results show that client are satisfied in with the performance of four out of the six criteria. These are "Technical and managerial competences/ experience", "Team work and efficient co-ordination of all the services to achieve desired goals, "Delivery within time, quality and cost targets and "Efficient/unbiased communication of project objectives to all parties". The rest of the two criteria however received an average response of unsatisfactory in their performance

Table 8 Consulting engineering services

Services	Level of Importance		Level of Satisfaction	
	Weighted Mean	**Stdd Dev.**	**Weighted Mean**	**Stdd Dev.**

a. Safe and economical design	2.90	0.89	2.85	0.85
b. Flexibility in design and construction	3.05	0.59	3.05	0.67
c. Delivery to be timely, detailed and comprehensive of engagement	2.70	0.90	2.70	0.95
d. Efficient performance of duties as per terms and conditions of engagement	2.60	0.92	2.60	0.66
e. Functional and durable design and constructions	2.30	0.71	2.55	0.92
f. Workable and error-free designs & detailing	1.75	0.94	2.55	0.92

Table 8 shows that none of the known construction and project management servicesreceived an average score close to being very important". four out of the six criteria, were adjudged to be close to important. These are: "Sustainability/flexibility in design and construction", "Safe and economical design", "Delivery to be timely, detailed and comprehensive of engagement" and "Efficient performance of duties as per terms and conditions of engagement" in descending order. The other two which received an average response of being of little importance are "Functional and durable design and constructions" and "Workable and error-free designs & detailing".

With regard to the assessment of the performance of the service providers in the same criteria, the results show that client assessed them to be between "satisfaction" and "unsatisfaction" in with the performance of all the six criteria with "flexibility in design and construction" leading.

Table 9 Contractors' service

Services	Level of Importance		Level of Satisfaction	
	Weighted Mean	Stdd Dev.	Weighted Mean	Stdd Dev.
a. Delivery within agreed time, quality and cost targets	2.75	1.09	3.30	0.64
b. Minimize costs (avoid on-site time and material wastages)	2.70	1.05	2.85	0.65
c. Technical and managerial competence	2.55	0.86	2.95	0.86
d. Accommodate client changes in good faith	2.65	0.79	3.00	0.71
e. Efficient co-ordination of the specialist and subcontractors' works	2.50	1.07	2.70	1.05
f. Financial capacity and adequate guarantee against own and subcontractors' defaults	2.42	0.99	2.65	0.85

Table 9 shows that none of the known construction and project management servicesreceived an average score close to being very important". Five out of the six criteria, were adjudged to be close to important. These are: "Delivery within agreed time, quality and cost targets", "Minimize costs (avoid on-site time and material wastages)", "Accommodate client changes in good faith", "Technical and managerial competence" and "Efficient co-ordination of the specialist and subcontractors' works" in descending order. The only one which received an average response of being of little importance is "Financial capacity and adequate guarantee against own and subcontractors' defaults".

With regard to the assessment of the performance of the service providers in the same criteria, the results show that client are between satisfied and unsatisfied in four out of

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the six criteria. The two in which they showed satisfaction has to do with delivery time, cost and quality parameters and also the accommodation of clients' changes.

3.   CONCLUSION

This study was a follow up of an earlier work by Mbachu (2003), South Africa; and Gyadu-Asiedu (2009), Ghana. It provided a further longitudinal dimension of clients' studies. Especially, in the areas of their satisfaction. The results indicates that clients are becoming increasingly demanding in their expectations from service providers and are more focused on what their projects are delivering, especially in the case of the public client. In general, the results show a clear gap in the needs/objective satisfaction, general expectations from service providers and their levels of performance. This problem continues to plaque the industry sponsors. It is the conception of this paper that the core of the problem is the services provided by the consultants. It would seem that they play little premium on the satisfaction of clients, especially, the public client. This emanates from trying to overcome the challenges posed by the process of public construction project procurements as practiced in Ghana. It is recommended that studies be undertaken to reduce the performance gap especially from service providers primarily. This will in the long term help solve the other satisfaction gaps of the clients. Consultants must re-orientate their training to meet the needs of clients and even to help shape the needs of lay and uniformed clients.

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Assessing LPG Usage by Taxi Operators inthe Transport Sub-Sector of Ghana

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Abstract
Liquefied Petroleum Gas (LPG) is one of the alternative fuels that can be used in either spark ignition or auto-ignition engines and it is termed as cleaner energy as a result of its lower carbon contents. In Ghana, LPG has gained credence among taxis and some suggest that LPG consumption is lower than that of petrol and has culminated in its high patronage in the transport sub-sector. The purpose of this research is to assess LPG as to whether the suggestion being raised by taxi operators are indeed true or perhaps it is purely as a result of the price differential. In addition, In addition investigate fuel consumption at different regimes of engine operation. A 1.4litre engine was mounted on a test stand and was converted to run on both LPG and petrol using a switch and the effects of running LPG was investigated on fuel consumption.

Keywords: LPG; Fuel Consumption; Ghana

1. INTRODUCTION

Ghana crude oil reserve is estimated to be 660 million barrels [EIA, 2014]. This is expected to increase as the seismic data available indicates that there are commercial quantities of oil in the Keta basin and other significant locations in the country [EIA, 2014]. Ghana's natural gas reserve is estimated to be between 1.5 Trillion cubic feet and 1.7 trillion cubic feet [GEPC, 2010]. In 2012, Ghana production was 80,000 bbl/dbarrels of crude oil per day and the total import of Natural gas was 29 Bcf in 2011[EIA, 2014]. However,petrol and Liquefied Petroleum Gas (LPG)used in Ghana are all imported [EIA, 2014] and their demand are on the increase due to increasing demand for the commodity in Ghana for transportation.

In Ghana, the fuels that are mainly used in the transport sub-sector are petrol and diesel, however, it can be observed recently that LPG is being patronized largely by taxis. LPG was encouraged to be used mainly for cooking to curb the usage of charcoal and other related wood fuels and by so doing reducing the rate of deforestation and perhaps climate change. To these effects, LPG is greatly subsidized and as a result it is cheaper than petrol and diesel.

Recently, the country experienced serious shortages of LPG and this engendered public debate and two different suggestions were alluded to that: LPG use in vehicles should be banned or remove the subsidies on LPG and, in fact, these suggestions are makeshift measures to curb LPG shortages in Ghana. To ban LPG in

vehicles will only provide some respite but in the long term with population growth which cannot be controlled will definitely increase the demand on LPG. In addition, banning LPG in vehicles will mean the only source of fuel for these taxis will be petrol and it also means that there will be over-reliance on petrol and diesel by transport sub-sector. However, a more holistic approach is to identify the main issues confronting LPG supply in Ghana and this was properly addressed by a report presented by Energy commission [EC, 2011a]. One of the majors issues pointed out was that there were inadequate supply infrastructures including storage, transportation, distribution retail outlets or filling stations. Removing subsidies on LPG will also gainsay the very reason why LPG was promoted and doing so will only spur the use of charcoal and wood fuels that will precipitate the rate of deforestation and hence our ozone layer will deplete quicker.

Upon till now, none of the suggestions has been heeded to, however, the increasing demand for LPG for transportation has led to the government of Ghana to increase the price of the commodity and also had led to the consideration of full cost recovery for the produce since the LPG does not reach the intended targets.

The price of petrol has been on the increase even before the implementation of full cost recovery policy by the Public Utility Regulation Commission (PURC). The price of petrol increased on the average in 2005 from 87.85

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Ghp per kg to 220.97 Ghp per Kg in 2012 [Table 1]. Within the same period, the prices of LPG change from an average of 53.48 Ghp/kg to 131.10 Ghp/kg. These increases from the period of 2005 to 2012 amount to

approximately 152% in the case of petrol, 145% for LPG (including the cost of subsidy) and 148% for LPG with zero government subsidies. Table 1 shows the average prices of petrol and LPG between the periods of 2005 to 2012

Table 1: Average Prices of Petrol and LPG

Year	Petrol, Ghp/kg	LPG, Ghp/Kg Subsidized	LPG, Ghp/kg zero Subsidy
2005	87.85	53.48	57.9
2006	105	68.46	71.21
2007	118.5	83.04	89.22
2008	137.36	97.03	103.21
2009	128.31	73.1	85.78
2010	149.97	83.81	96.49
2011	194.38	105.16	117.84
2012	220.97	131.1	143.78

Apart from the price of LPG which makes them very attractive as replacement fuel for petrol, the higher calorific value of 45.22MJ/kg of LPG compared with that of petrolof 43.11MJ/kg makes LPG much more advantageous to be used in place of petrol. Based on the calorific properties of both fuels, 1 kg of LPG is equivalent to 1.05 kg of petrol. This implies that to obtain the same or equivalent amount of energy, 0.05 kg more of petrol has to be burned.

There is no doubt that national LPG consumption has increased rapidly and in fact, in just a decade LPG consumption rose from about 45 million tonnes in 2000 to about 221 million tonnes in 2009 [EC,2011b and NPA, 2013] accounting for 390% increase and a reduction to 177 million tonnes was realized in 2010 during which there were national shortages in the country. The increase in LPG consumptions is mainly attributed to vehicular fuel-switch from petrol to the LPG [EC, 2010] and cursory survey among taxis done in Koforidua shows that the reason for this shift to LPG is that LPG has a lower consumption than that of petrol.

All the taxis using LPG are converted locally by the so-called road mechanics and a few of them are established. The concerns raised are whether the LPG kits that are installed are done properly since many issues could crop up and some of these issues could include safety of the

installation in the event of accident, and integrity of the devices used which could lead to fire outbreaks. In addition, with the locally converted vehicles it is important to find out whether LPG is used efficiently with minimal waste. This project aims at addressing three mainconcerns which include comparing LPG and petrol which is better in economic terms since some of the taxi operators allege that LPG is better. Fuel consumption will also be investigated and this is done to know if the effect of cost of the fuels is removed from the equation so as to determine the effect of removing subsidies on LPG. A cursory look at the LPG fuel system being used, it was observed that the system has no control system that can vary the amount of LPG entering the engine at different road conditions. As a result, it was intended to replicate same system on a petrol engine in the lab to find out as to whether LPG is being used efficiently in the engine.

2.0 **METHODOLOGY**
2.1 Cost benefit analysis
In order to assess the cost benefit analysis between LPG and petrol, the costs of LPG and petrol were sourced for from National Petroleum Authority (NPA) and in addition properties of LPG and petrol such as densities and calorific values were used in order to have a fair judgment. For the data garnered from NPA it was observed that the data have been reported monthly so averages were calculated

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for to get the yearly results. Density of petrol was used to convert cost of petrol per litre to kilogram so as to compare the cost of petrol and that of LPG.

2.2 Comparing fuel consumption

Initial investigation shows that all the taxis using LPG use carburetors fuel systems which means that fuel and air are premixed along the inlet manifold and there is no fuel injection system. A 1.4litrepetrol engine having a carburetor fuel system was acquired and the LPG kits used by local mechanics were also purchased. In order to have similar system, the method of LPG installation used locally was adopted and it is outlined below.

In order to install an LPG fuel system on a vehicle or test bench, some checks are carried out to ensure that the vehicle is suitable for LPG conversion. The structure of the vehicle must be inspected to check if it is in a good state that allows adequate fitting of the supports of the various elements such as the LPG tank, the evaporator, the high-pressure pipe clamps, etc. The ignition system is also checked for defects since any fault on the components of the ignition system could affect the combustion process of the LPG mixture. The state of charge of the battery is important since this could affect the closing and opening of the evaporator.

A suitable placement for each of the component on the LPG fuel system is considered carefully in order to properly house the fuel system. LPG tank is usually placed in the boot of the vehicle and the pipes to convey the LPG is laid from the outlet of the tank to the inlet of solenoid valve. The solenoid valve is responsible for the opening and discharging of LPG and in addition in the housing of the solenoid valve can be found the fuel cleaner for LPG. Pipes are then laid from the outlet of the solenoid valve to the inlet of the evaporator which is a heat exchanger. The evaporator vaporizes LPG to aid better combustion and to achieve this, hoses are connected from the inlet and outlet of the evaporator to the cooling system of the engine so that the heat generated by the engine is used to vaporize LPG. A hole is drilled in the carburetor in order for the gas coming from the evaporator to be delivered into the inlet

manifold of the engine. In the carburetor the gas and air are mixed before entering the combustion chamber and also the amount of gas and air are controlled purely by pressure drop in the carburetor. To control the amount of gas entering the fuel carburetor, there is a valve on the tank that controls the maximum amount of gas leaving the tank. Tuning process is very critical to the combustion process of the engine so the tuning process is done between the evaporator and the carburetor with a help of a valve installed on the pipe connecting the two components.

2.3 Experimental procedure

To run the engine with the fuels under consideration, the engine was run with petrol for one hour fifteen minutes to attain optimum engine temperature to avoid erroneous results before the experiment was started. Different speeds of the engine were chosen for the sake of analysis and these include idling speed, 1000, 1500, 2000, 2500, 3000 and 3500 rpms. The basis for choosing these speeds is that these speeds depict the different speeds which drivers rev the engine when driving. At each speed, three measurements were taken for both petrol and LPG and when switching from petrol to LPG or LPG topetrolthe engine was run for 15 minutes before a measurement was taken. This was done to ensure that erroneous readings were obviated. To measure the mass of fuel consumed a weighing scale was used and both the LPG and petrol tanks were mounted on the weighing scale to read the different in mass of the tanks.

3.0 RESULTS AND DISCUSSIONS
3.1 Cost benefit analysis

Figure 1 below shows the savings to be made in Ghp/kg if LPG were used instead of petrol as transportation fuel. S1 on Figure 1 shows the savings to be made at historical average LPG and petrol prices considered, S2 represents the savings whenthe heating values of both fuels are considered, S3 represents the savings when the average prices of both fuels are at par and the heating values are considered, and S4 represents the savings when there is zero subsidy on the LPG.

Figure 1 indicates the four scenarios considered will result in savings in Ghp/kg if LPG is used in place of petrol.
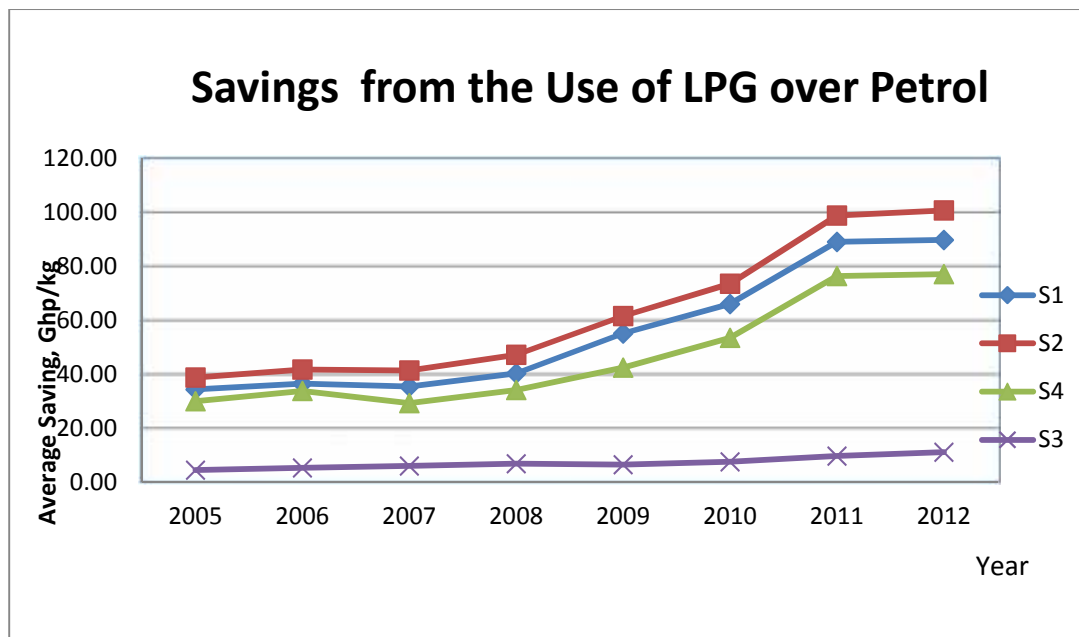
Figure1: Savings from the use of LPG compared to Petrol

It can be observed from Figure 1 that at all the scenarios considered there is always some savings to be made. It thereforemakes logic why taxi operators switch to LPG. S1 and S2 on Figure 1 represent the situation on the ground and these two savings give greater margins on profit when using LPG instead of petrol. To add to this, whenever there is an increase in petrol prices taxi fares are adjusted up irrespective of price increase for LPG. S3 and S4 represent the worst case scenarios effects if government decides not to subsidize LPG fuel used in the transport sub-sector or if LPG and petrol prices are at par.

3.2 Fuel consumption
The set-up was run with petrol and LPG at different engine speeds and the engine speeds chosen depict the different road conditions that can be encountered during driving. The results from the experiment can be categorized into low, medium and high engine speeds and the low engine speeds range from 1000 to 1,500 rpms while medium speeds range from 1500 to 2000 rpms and that of high engine speeds start from 2,500 to 3,500 rpms.

3.2.1 Low engine speeds

Figure 2 shows the results of the experiment at low engine speeds when the engine was run on petrol and LPG. It can be observed that as the speed increases the fuel consumption increases and also the consumption for LPG is higher than that of petrol. At idling speed, it was difficult to run the engine smoothly and as a result the engine was not run at idling speed of the engine, howeverat 1000 rpm, running the engine was successful and it was noted that the consumption of LPG was 11.1% higher than that of petrol as depicted in Fig 3.
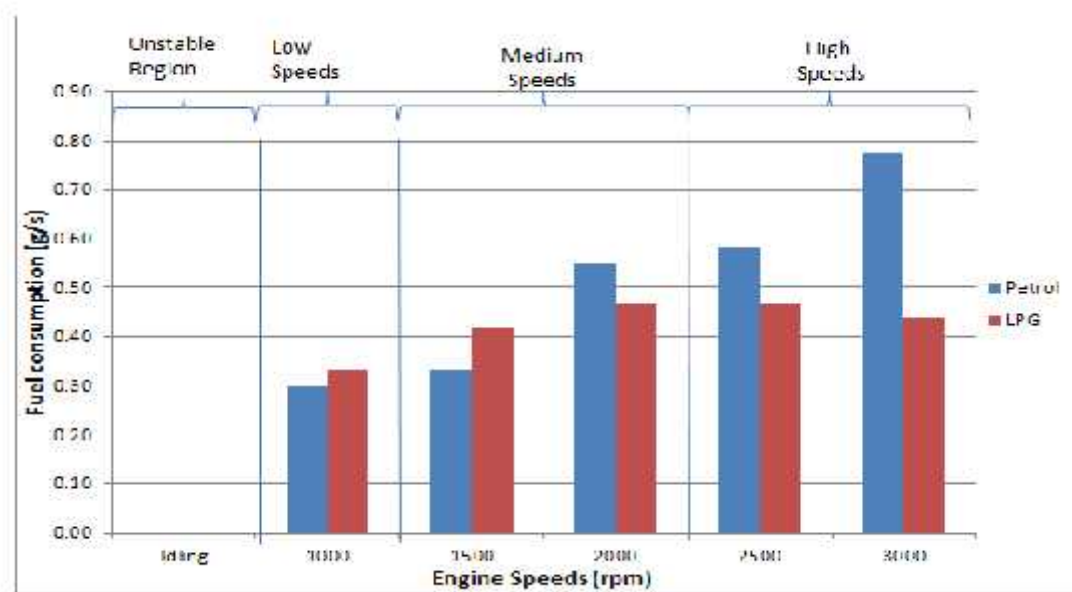
Figure 2: Fuel Consumption of petrol and LPG @ different engine speeds

3.2.2 Medium engine speeds

At 1,500 rpm, it can be observed from Fig 2 that LPG consumption was higher than that of petrol whereas at 2000 rpm engine speed that of petrol was higher that of LPG. These speeds are crucial since they depict the common speeds for town

running and in addition taxis usually operate around these speeds. At 1,500 the consumption of LPG was higher than petrol by 25% which shows that revving engine from low speeds to medium speed of 1,500 made the LPG consumption worse. However, at 2000 rpm engine speed, petrol consumption

was higher than LPG by 15% which shows that LPG consumption was better as shown in Fig 3.

3.2.3 High engine speeds

High engine speeds depict two possible scenarios which include high vehicle speed when trying to accelerate during driving to increase vehicle speed and low vehicle speed whilst climbing uphill which demand a high torque from the engine. It can be observed from Fig 3 that at 2,500 and 3,000 rpms of engine speed petrol consumptions were higher than that of LPG and were 20% and 43% higher than LPG respectively.
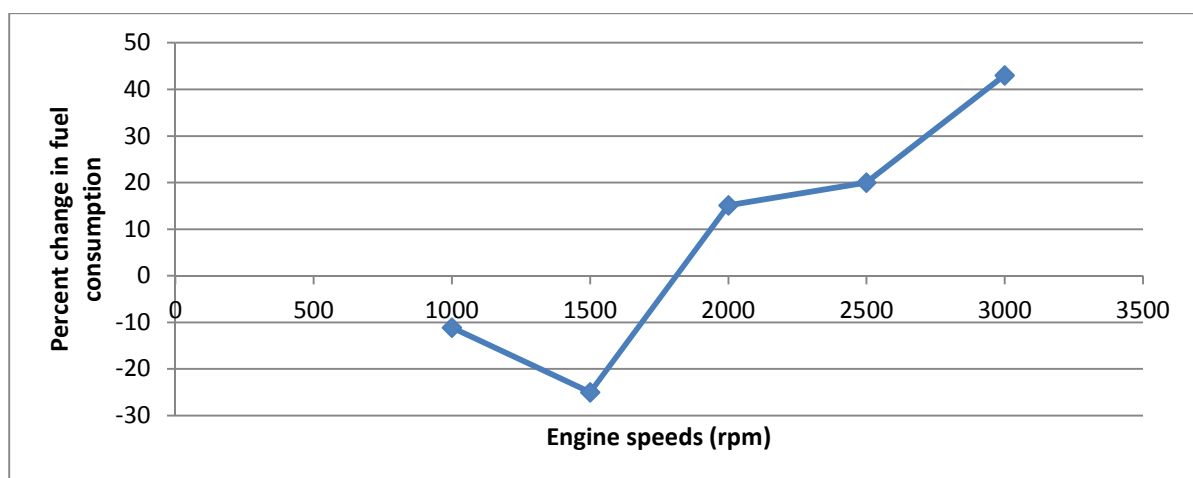
Figure 3: Percentage savings of fuel consumption @ different engine speeds

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It canbe inferred from Figure 2 and Figure 3 that running LPG at low to medium engine speeds is not prudent since it gives a higher consumption compared to petrol. The key component in the LPG fuel system is the vaporizer which evaporates LPG to gaseous form. At low to medium engine speeds the vaporizer is not working properly since its efficiency is dependent on the temperature of the coolant of the engine. However at medium to high engine speeds. The full effect of LPG is realized since the vaporizer is efficient at higher temperatures of the engine coolant. It was observed that all the vaporizers used did not have any temperature monitoring systems in place to check the engine coolant temperature to ensure better efficiency of the vaporizer.

Figure 4: Vaporizers (left-with a temperature sensor and right-without a sensor)
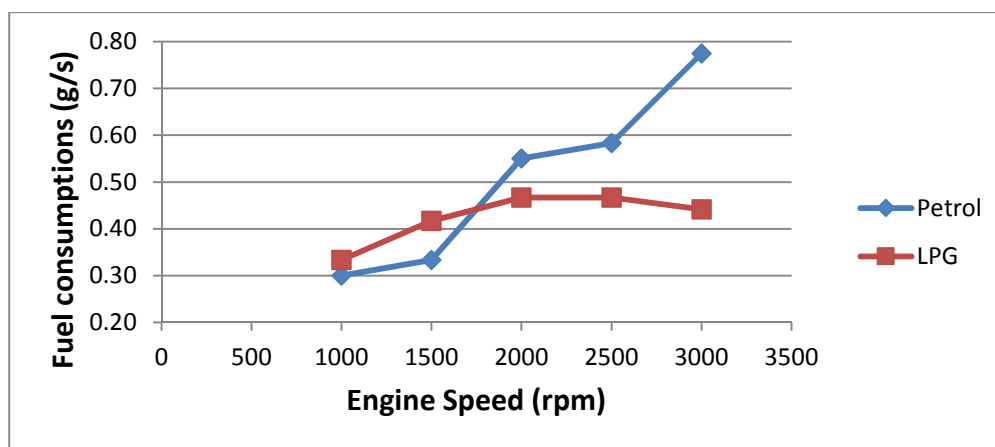
Figure5: Fuel consumptions of petrol and LPG @ different engine speeds

Figure 5 shows fuel consumptions at different engine speeds and it can be observed that at low engine speeds LPG consumption was higher than that of petrol whilst at medium to high engine speeds LPG consumption was lower than that of petrol. Another key observation made was that as the engine speeds increased the petrol consumption kept increasing within engine speeds considered, however for LPG, there was an initial increase at low to medium speeds of the engine and at high engine speeds the consumption stabilized around 0.45 g/s. This meant that the at low to medium engine speeds the maximum fuel intake was controlled by the pressure drop in the carburetor, however at medium to high engine speeds, the maximum fuel intake was controlled by the tuning effect of the valve which is used to control LPG flowrate. It can be said that there is no fuel control system on the LPG fuel system such as electronic control unit for petrol or diesel injection which calculates the amount of fuel to be injected and this can

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seriously affect the usage of LPG in this types of fuel systems which are used in Ghana.

4.   CONCLUSIONS   AND RECOMMENDATIONS

It was found that from historical usage of LPG in transport sub-sector that taxi operators are reaping the maximum profit margins and even if subsidies were removed from transport LPG or the prices of petrol were made same taxi operators using LPG stand to gain. A continual subsidy for LPG used in transport sub-sector is unsustainable since the taxi operators are reaping the maximum profit, however, LI 1592 should be amended and implemented to source funds that can be used to subsidize LPG in Ghana.

Although LPG may be cheaper than petrol, it was found that running engines at low to medium engine speeds was not prudent and usually most operators run their taxis at this range of engine speeds. This could engender

wastage of LPG and at current prices the effect of wastage would not be felt by taxi operators. At high speeds of engine it was found that up to 45% reduction in fuel consumption could be achieved by switching to LPG from petrol and it was realized that the vaporizer was very efficient at high engine speeds. On the basis of current LPG fuel systems used it will be recommended that running engines at low engine speeds should be discouraged.

In all we recommend that testing facilities should be established and a monitoring body through the Engineering Council Bill can be established to monitor all vehicles using LPG as source fuel. This will safeguard all vehicles from improper installation of LPG fuel systems that can lead to explosion. We also recommend that there should be training centres nationwide that will provide the necessary training and in-charge of issuance of certificates to mechanics who do the conversions from petrol to LPG engines.

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Gender Disparities in the Ghana National Health Insurance Claims: An Econometric Analysis

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Abstract
The objective of this study was to find out the gender disparities in Ghana national health insurance claims. In this work, data was collected from the policyholders of the Ghana National Health Insurance Scheme with the help of the National Health Insurance database and the patients' attendance register of the Koforidua Regional Hospital, from 1st January to 31st December 2011. The generalized linear regression (GLR) models and the SPSS version 17.0 were used for the analysis. Among men, the younger people prefer attending hospital for treatment as compared to their adult counterparts. In contrast to women, younger women favor attending hospital for treatment as compared to their adult counterparts. Among men, various levels of income impact greatly on their propensity to make an insurance claim, whereas among women only the highest income level did as compared to lowest income level. Men, who completed senior high school education, were less likely to make an insurance claim as compared to their counterparts with basic or no education. However, it was women who had basic education that preferred using the hospital as compared to their more educated counterparts. It is suggested that the government should consider building more health centers, clinics and cheap-compounds in, at least, every community, to help reduce the travel time in accessing health care.

Keywords: National Health Insurance; Claims; Gender Disparity; Econometric Analysis; Ghana.

1. INTRODUCTION

There have been reports of the relative success of social national health insurance schemes in developing countries including developing countries such as Mexico, Costa Rica and South Korea (Karen & James, 2004). However, Dror and Jacquire (1999), proponents of mutual health insurance schemes, argued that these schemes also have the potential to increase access to health care. Mexico has, since the 1980s, implemented various initiatives to extend the coverage of its social health spending. However, there is some evidence that social/national health insurance alone cannot significantly contribute to increased coverage rates, provide a wider risk pool and hence increase access to health care.

There is equally anecdotal evidence to suggest that poorly designed schemes can have very negative consequences. Studies by Bennett et al (1998), Criel (1998) and Atim (1998) have expressed a similar view and are even less optimistic of community health insurance. They argue that their risks pools are often too small, adverse selection problems are frequent and the schemes are heavily dependent on subsidies, which are most often infrequent and unreliable. Jütting (2003) notes that the schemes that experience managerial and financial difficulties the most are those in the environment of rural and remote areas where unit transaction costs of contracts are often too

insurance scheme to poorer groups of its population (Frenk et al., 2005). Mexico's supposed success has been paraded as part of current global debates and advocacy for social health insurance. Lloyd-Sherlock (2006) noted that the current popularity of social insurance is related to the fact that it fits into the current development paradigm of social protection and risk management, which highlights the vulnerability of poor households to catastrophic health

high. The financial viability of social/national health insurance schemes is also a matter of concern. For example, Mossialos et al. (2000) report that France's social insurance contributions reached an untenable 55% of wage costs and the government had to propose a gradual shift in taxation, which is being implemented.

Argentina was a major focus of externally funded social health insurance schemes. Lloyd-Sherlock (2006) noted that the Argentine reforms are now universally recognized to have failed, with the World Bank viewing the large public sector deficits generated by Argentina's insurance schemes as a major factor in the country's financial collapse in 2001. Jütting (2001) in a study of community schemes in Senegal also noted that community health schemes offer financial protection to those

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otherwise excluded, but he also noted that the poorest of the poor are usually not covered. Such findings raise questions as to the extent to which national or social health insurance can be efficiently and effectively ran to provide adequate health care coverage for all segments of the population and especially for the poorest and most vulnerable.

Ghana with per capita income of about US 400 has struggled over the years with the problem of how to adequately finance public sector health care delivery in the face of severe resource constraints. Before independence, user charges were in place in health facilities. Following independence, health services were made fee-free at all levels. However, over time there were increasing problems with inadequate drugs and supplies. In 1987, the Ghana Ministry of Health introduced significant client out – of – pocket payments at point of service use in the public sector (Annual Report, Dangme West Health Insurance Scheme, 2010); the aim was to recover, at least, 15% of recurrent operating cost. Though out-of-pockets payments at point of service use in the public sector by the client had existed before this time, the amounts paid were minimal and more of a token. The aim of recovering, at least, 15% of recurrent cost was met. Should be state here that before the introduction of the significant client out–of–pocket-payments at point of service, the public sector in 1985, through the Ministry of Health, had already considered the feasibility of health insurance as an alternative to out–of–pocket payment at point service (Annual Report, Dangme West

Health Insurance Scheme, 2010).Consequently, in 1996, the process of designing a health insurance scheme for the non – formal sector in the Dangme West District began (Annual Report Dangme Health Insurance Scheme 2010). A lot of work was put into thinking through the design of the scheme, consulting with community members and district assemblies as well as health providers. The EU provided some financial support for this phase of the work through the London School of Hygiene and through Tropical Medicine (Annual Report, Dangme West DMHIS, 2010). Also built into the design of the scheme was a process of monitoring and evaluation so that the experience gained and lessons learned in the Dangme West district could inform policy makers, health managers and other implements, at large, as well as civil society on the feasibility, so as to provide the best approaches for implementing health insurance in a low income developing country like Ghana. In order to achieve the aim of the study, the binary logit model was employed. The choice of this statistical technique is based on the dichotomous nature of the response variable (whether a policy holder has made claim or not).The data of the study was drawn from the NHIA data base and the hospital records of the Koforidua regional hospital. The remaining part of the paper is organized as follows: section 2 describes the concept of the methods employed in the research. The data, empirical analysis, and results are presented and discussed in section 3; Section 4 provides the concluding remarks as well as recommendations.

2. METHODOLOGY
2.1 Study Area and Source of Data
The eastern region of Ghana has 21 administrative Municipals and Districts with Koforidua as the regional capital. Eastern Region of Ghana has an estimated population of 2,194,508, with 3.1% growth rate. It is the sixth largest region with a land area of 19,323 sq. km., thus representing about 8% of the total land area of the country (Statistical Service, 2011). The region is bounded on the East by the Volta Region, South by Greater Accra region, West by Central Region and on the North by

Ashanti Region. It has the largest number of health facilities in the country. The Koforidua Regional Hospital is a state run referral hospital. The hospital, with about 250 patient beds, is the largest facility in the region which serves both as the first consultation point for patients within its catchment, and as a referral centre for about other 25 primary health centers. These facilities are managed by the Ministry of Health and the Ghana Health Service.

2.2 Data collection and data management
Data used in this study were obtained as primary data from hospital attendance records

at the Koforidua Regional Hospital, from 1st January 2011 to 31st December 2011. Data was

collected from the policyholders of NHIS in Ghana, using the simple random sampling technique with the help of the NHIA database. A total of 4549 policyholders were sampled from the NHIA data base. For this study, the hospital attendance register was used which has patients' age, sex, date of admission and discharge, insurance claim or otherwise, distance, billed charges (i.e. for treatment), marital status, length of stay, number of children, level of education, employment status, cigarette smoking, alcohol drinking, living condition, health status and whether the patient was an outpatient or inpatient. Income

2.3 Model specification, estimation and tests

The mathematical form on which the logistic model is based is defined as follows:

$$f(z) = \frac{1}{1 + e^{-z}} \qquad (1)$$

Where z denotes the values of this function, such that, $-\infty \leq z \leq +\infty$. The relationship between the predictor and response variables is not linear function in logistic regression; instead, the logistic regression function is used, which is the logit transformation of p. To obtain the logistic model from the logistic function, we write z as the linear sum as follows.

$$z = \mathsf{r} + \sum_{i=1}^{k} \mathsf{s}_i x_i \qquad (2)$$

Where x_i are independent variables of interest and α and S_i are constant terms representing unknown parameters and k is the last term. Combining (1) and (2) gives:

$$f(z) = \frac{1}{1 + e^{-\left(\mathsf{r} + \sum_{i=1}^{k} \mathsf{s}_i x_i\right)}}$$

For notational convenience, we will denote the probability statement as simply p(x) where x is a notation for the collection of variables x_1 through x_k. Thus, the logistic model may be written as

$$f(X) = \frac{1}{1 + e^{-\left(\mathsf{r} + \sum_{i=1}^{k} \mathsf{s}_i x_i\right)}} \qquad (3)$$

However, since the above logistic model is non-linear function, the logit transformation would be used to make it linear.

$$Logit(X) = In_e\left(\frac{P(x)}{1 - P(x)}\right) \qquad (4)$$

levels were obtained from the health insurance data base. From the data, the following variables were coded:

Outcome (claim = 1, no claim = 0); length of stay (inpatient=1, outpatient = 0); marital status (married = 1, unmarried = 0); distance to the hospital (distance > 5km) = 1, (distance ≤ 5km) = 0). The distance of 5 km was chosen to reflect travel time of 1 hour on foot. Age, sex, health status, income level, distance, length of stay, number of children, level of education, employment status, cigarette smoking, alcohol drinking, living condition and billed charges were employed as deciding factors.

Where,

$$P(x) = \frac{1}{1 + e^{-\left(\mathsf{r} + \sum_{i=1}^{k} \mathsf{s}_i x_i\right)}}$$

This transformation allows us to compute a number, logit p(x), for an individual with independent variables given by x.

$$\text{Logit } P(x) = \mathsf{r} + \sum_{i=1}^{k} \mathsf{s}_i x_i$$

(5)

Thus, the Logit of p(x) simplifies to the linear sum. The quantity p(x) divided by 1-p(x), whose log value gives the Logit, describes the odds for a policyholder not making a claim, with independent variables specified by x.

$$\frac{P(x)}{1 - P(x)} = \text{Odds for individual X}$$

The goal of logistic regression is to correctly predict the category of outcome for individual cases using the most parsimonious model. To this end, a model is created that includes all predictor variables that are useful in predicting the response variable (Kleinbaum & Klein, 1994).

$$Logit(P(y=1)) = \mathsf{s} + \mathsf{v} + \sum_{i=1}^{k=14} \mathsf{s}_i x_i$$

(6)

Where P is the probability of claim made, the x's are independent variables of interest, α and the β_i are constant term and coefficients respectively representing unknown parameters and ε is the residual term. The coefficients of the model predictors are tested via the hypothesis as follows:

$$H_o: \beta j = 0$$
$$H_i: \beta j \neq 0 j = 1, 2,3,4,5,6,7,8,9,10,11,12,13,14$$

Once a logistic regression model has been fit to a given set of data, the adequacy of the model is examined by overall goodness-of-fit tests and examination of influential observations. One concludes a model fits if the differences between the observed and fitted values are small and if there is no systematic contribution of the differences to the error structure of the model. A goodness-of-fit test that is commonly used to assess the fit of logistic regression models is the Hosmer–Lemeshow test (Hosmer & Lemeshow, 1980). Although appropriate estimation methods which take into account the sampling design in estimating logistic regression model parameters are available in various statistical packages, there is a corresponding absence of design-based goodness-of-fit testing procedures. Due to this noted absence, it has been suggested that goodness-of-fit be examined by first fitting the design-based model, then estimating the probabilities, and subsequently using iid-based tests for goodness-of-fit and applying any findings to the design-based model (Hosmer & Lemeshow, 2000). The hypothesis for model fitness can be measured by the Hosmer and Lemeshow test as follows

H_o: The model fits the data

H_i: The model does not fit the data

3. EMPIRICAL RESULTS

3.1 Descriptive Analysis

Table 3.1 shows the number of observations for the study. The total number of observations for this study was 4549. More than 50% of the people who were sampled were females (56.0%) and the rest (44.0%) were males. The table indicates the frequency of the respondents who made or did not make a claim. Majority of the respondents have made an insurance claim (92.0%), the rest have not made claims in the year (8.0%). The results indicate that majority of the respondents (46.3%) are in the age group of 18-39 years, followed by the age group 40-60 years (19.4%), the rest are in the age groups of 0-17 and 61-100 (19.2% and 15.1%) respectively. The results indicate that majority of the policyholders who made claims are among the working group, aged between 18-39 years (45.2%). The results show that majority of the respondents were unmarried (58.7%) and the rest are married (41.3%).Table 3.1 shows that majority of the policyholders sampled have very good or good health status (65.3%), 24.0% of the policyholders had fair health status and the rest had poor health status (10.7%). Again, majority of the patients that attended hospital are charged bills between GHS1-400 (58.6%), 26.2% of the policyholders that attended hospital were billed between GHS 401-800, the rest were billed GHS 801 or more (9.7%).Majority of the policyholders who were sampled earned incomes between GHS1-1000 (54.0%), 31.4% of the policyholders earned no income and the rest earned GHS1001 or more (14.6%). Majority of the policyholders travel less or equal to 5km to the hospital (51.2%), and the rest travel more than 5km to the hospital. Majority of the sampled policyholders used outpatient services at the hospital (57.2%), and 36.8% used inpatient services and the rest (6.0%) had not used the hospital services in the year. Table 3.1 indicates that majority of the policyholders who were sampled had no child (48.7%), 18.8% had one child, 17.1% had two children and (15.4%) had three children or more. Table 3.1 also shows that more than half of the policyholders had no education or only basic education (62.7%), 15.4% had education up to senior high school, 6.7% of the policyholders had professional qualification and 15.2% had education up to the degree level. 29.9% of the policyholders were full time workers, 23.9% were working part-time, (31.9%) were unemployed and 14.3% were economically inactive. Majority of the policyholders that were sampled had never smoked (66.4%), 19.7% were smokers, and 13.9% were ex-smokers. Majority of the respondents (42.7%) were non drinkers of alcohol, 22.9% were ex-drinkers, 18.9% were regular drinkers and 15.5% were occasional drinkers of alcohol. Majority of the policyholders (58.2%) rent single rooms or double rooms as their living apartment, 22.1% rent flats or self-contained apartments and 19.7% of the policyholders are living in their own houses.

Table 1 Composition of the survey population

Age(Years)	Numbers	%
0-17	873	19.2
18-39	2105	46.3
40-60	884	19.4

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61-100	687	15.1
Sex	**Numbers**	**%**
Male	2002	44.0
Female	2547	56.0
Marital Status	**Numbers**	**%**
Married	1879	41.3
Unmarried	2670	58.7
Health Status	**Numbers**	**%**
Very Good	1165	25.6
Good	1805	39.7
Fair	1092	24.0
Poor	487	10.7
Billed Charges	**Numbers**	**%**
No	250	5.5
GHS 1-400	2666	58.6
GHS 401-800	1191	26.2
GHS 801-1200	246	5.4
GHS 1201-1600	123	2.7
>GHS 1600	73	1.6
Income Level	**Numbers**	**%**
No income	1429	31.4
GHS 1-1000	2456	54.0
GHS 1001-2000	600	13.2
GHS 2001-3000	59	1.3
GHS>3000	5	0.1
Distance	**Numbers**	**%**
>5km	2220	48.8
5km	2329	51.2
Length of Stay	**Numbers**	**%**
Non	273	6.0
Outpatient	2602	57.2
Inpatient	1674	36.8
Number of Children	**Numbers**	**%**
No Child	2215	48.7
1 Child	854	18.8
2 Children	781	17.1
3+ Children	699	15.4
Level of Education	**Numbers**	**%**
No Education	972	21.4
Basic Education	1875	41.4
Senior High School	707	15.5
Professional	307	6.7
Degree	693	15.2
Employment	**Numbers**	**%**
Working full-time	1364	29.9
Working part-time	1089	23.9
Unemployment	1454	31.9
Economically Inactive	642	14.3
Cigarette Smoking	**Numbers**	**%**
Smoker	895	19.7
Ex-Smoker	634	13.9
Never Smoked	3020	66.4
Alcohol Drinking	**Numbers**	**%**
Regular Drinker	864	18.9
Occasional Drinker	702	15.5
Ex-Drinker	1041	22.9

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Non-Drinker	1942	42.7
Living Condition	**Numbers**	**%**
Own House	894	19.7
Rented Flat/Self Contained	1004	22.1
Rented Single Room/Double Room	2651	58.2

Claim	Numbers	%
Yes	4185	92.0

Table 2 Predictor of health insurance claims: comparison between models for men and women

	Male		Female	
	Odds Ratio(95% CI) adjusted for alcohol and cigarette smoking	Odds Ratio (95% C.I.)(fully adjusted)	Odds ratio(95% CI) adjusted for alcohol and cigarette smoking	Odds Ratio (95% C.I.) (Fully Adjusted)
Age				
0-17	1.00	1.00	1.00	1.00
18-39	1.15(0.69-1.93)	1.22(0.81-1.85)	0.49(0.19-1.27)	0.61(0.32-1.19)
40-60	1.14(0.64-2.06)	1.02(0.83-1.36)	0.26(0.10-0.66)	0.57(0.28-1.13)
61-100	1.12(0.71-1.77)	0.80(0.50-1.27)	0.16(0.05-0.44)	0.62(0.30-1.25)
	P=0.891	P=0.540	P=0.208	P=0.457
Marital Status				
Married	1.00	1.00	1.00	1.00
Unmarried	1.03(0.59-1.82)	0.67(0.43-1.06)	0.68(0.41-1.15)	0.70(0.47-1.06)
	P=0.438	P=0.075	P=0.109	P=0.110
Number of Children				
No Child	1.00	1.00	1.00	1.00
1 Child	1.44(0.72-2.88)	1.08(0.66-1.96)	0.75(0.53-1.62)	0.92(0.49-1.71)
2 Children	1.25(0.62-2.57)	2.04(1.28-3.26)	0.77(0.35-1.74)	0.89(0.47-1.69)
3+ Children	1.53(0.74-3.21)	1.98(1.19-3.27)	0.52(0.23-1.20)	0.92(0.47-1.79)
	P=0.612	P=0.560	P=0.361	P=0.989
Income Level				
No Income	1.00	1.00	1.00	1.00
GHS 1-1000	1.14(0.66-1.96)	1.36(0.81-2.31)	1.21(0.81-1.85)	1.43(0.72-2.88)
GHS 1001-2000	2.10(1.10-4.03)	0.89(0.45-1.66)	1.06(0.70-1.62)	1.26(0.62-2.57)
GHS 2001-3000	1.91(1.13-3.25)	1.77(0.99-3.21)	0.81(0.50-1.25)	1.53(0.72-3.20)
GHS>3000	1.01(0.59-3.25)	0.80(0.40-1.60)	0.83(0.51-1.40)	1.52(0.86-2.60)
	P=0.403	P=0.351	P=0.540	P=0.351
Distance				
>5km	1.00	1.00	1.00	1.00
<5km	0.51(0.21-1.16)	0.76(0.54-1.61)	0.81(0.51-1.22)	1.42(0.71-2.81)
	P=0.505	P=0.454	P=0.531	P=0.347
Level Education				
No Educ.	1.00	1.00	1.00	1.00
Basic Educ.	1.20(0.76-1.93)	1.01(0.66-1.52)	1.48(0.97-2.27)	1.06(0.61-1.81)
S.H.S.	0.98(0.58-1.58)	1.91(1.12-3.23)	1.51(0.93-2.38)	0.70(0.42-1.20)
Professional	0.72(0.41-1.26)	1.61(0.85-3.05)	1.18(0.81-1.59)	0.51(0.28-0.91)
Degree	0.80(0.42-1.52)	1.97(1.01-3.90)	1.35(0.91-1.99)	0.31(0.15-0.61)
	P=0.537	P=0.067	P=0.120	P=0.194
Employment Status				
Working Full-Time	1.00	1.00	1.00	1.00
Working Part-Time	1.35(0.86-2.15)	1.51(0.85-2.69)	1.53(0.90-2.62)	1.02(0.55-1.86)

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Unemployed	1.16(0.72-1.82)	0.88(0.50-1.58)	1.10(0.63-1.93)	1.67(0.89-3.07)
Econ. Inactive	1.46(0.87-2.44)	1.81(0.97-3.38)	0.61(0.31-1.20)	1.15(0.60-2.17)
	P=0.402	P=0.352	P=0.440	P=0.136
Living Condition				
Own House	1.00	1.00	1.00	1.00
Rented Flats/Self Contained	1.08(0.67-1.75)	0.77(0.44-1.29)	1.16(0.65-2.15)	1.13(0.58-2.15)
Rented Single/Double Room	2.09(0.66-1.79)	1.22(0.82-1.81)	0.80(0.51-1.25)	0.97(0.63-1.50)
	P=0.571	P=0.324	P=0.538	P=0.924
Cigarette Smoking				
Smoker	1.00	1.00	1.00	1.00
Ex-Smoker		0.73(0.45-1.15)		1.12(0.67-1.52)
Never Smoked		0.37(0.21-0.60)		1.13(0.76-1.65)
		P<0.001		P<0.001
Alcohol Drinking				
Regular Drinker	1.00	1.00	1.00	1.00
Occasional Drinker		0.72(0.46-1.15)		1.01(0.67-1.52)
Ex-Drinker		0.36(0.22-0.60)		1.12(0.76-1.67)
Non-Drinker		0.54(0.32-0.92)		1.02(0.70-1.47)
		P<0.05		P<0.05

Associations with socio-demographic variables were explored using multiple logistic regressions. The first model looked at associations of each major variable (odds ratios) adjusting for cigarette smoking and alcohol drinking which emerged as a strong determinant in univariate analyses. The second model was fully adjusted to disentangle interactions. The dependent variable is the national health insurance claims. Independent variables were self-explanatory. The pattern was similar among men and women. When adjusted for cigarette smoking and alcohol drinking, those living in rented single rooms/double rooms were twice as likely to make national health insurance claims as those in own house. With all variables entered, cigarette smoking and alcohol drinking remained strong determinants. Women reporting no or low income status tended to make more insurance claims. Together both confirm that women have the propensity to make national health insurance claims more than men, according to socio-economic characteristics. The regression model was fully adjusted, with variables entered simultaneously. Less well educated women were more likely to make an insurance claim. Disadvantaged people (younger people, with lower education and people with no income, and among women) were more likely to make an insurance claim.

Table 3 Age Adjusted and Age Unadjusted Odds Ratio Analysis

	Male		Female		Both	
	Age Adjusted OR CI	Age unadjusted OR CI	Age Adjusted OR CI	Age unadjusted OR CI	Age Adjusted OR CI	Age unadjusted OR CI
Age						
0-17		1.00		1.00		1.00
18-39		1.01(0.66-1.54)		1.29(0.97-1.73)		1.07(0.61-1.91)
40-60		0.81(0.43-1.39)		1.09(0.72-0.66)		1.22(0.89-1.65)
61-100		0.94(0.54-1.62)		0.92(0.56-1.61)		1.24(0.83-1.83)
Marital Status						
Married	1.00	1.00	1.00	1.00	1.00	1.00
Unmarried	0.82(0.61-1.10)	0.83(0.62-1.11)	0.99(0.62-1.58)	0.98(0.60-1.56)	1.11(0.67-1.56)	0.57(0.36-0.90)
Number of Children						

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No Child	1.00	1.00	1.00	1.00	1.00	1.00
1 Child	0.58(0.36-0.91)	1.18(0.78-1.77)	0.42(0.08-2.20)	0.73(0.17-3.26)	0.75(0.19-2.97)	0.92(0.47-1.80)
2 Children	0.49(0.26-0.91)	1.12(0.76-1.65)	0.76(0.18-3.23)	0.42(0.08-2.09)	0.72(0.17-3.08)	0.65(0.25-1.71)
3+ Children	0.52(0.26-0.96)	1.01(0.12-4.32)	0.78(0.19-3.23)	0.75(0.18-3.08)	1.35(0.82-2.17)	0.88(0.55-1.40)
Income Level						
No Income	1.00	1.00	1.00	1.00	1.00	1.00
GHS 1-1000	1.41(0.86-2.28)	0.39(0.08-1.95)	0.95(0.14-5.23)	0.40(0.04-3.50)	0.78(0.50-1.23)	0.80(0.36-1.76)
GHS 1001-2000	1.00(0.48-2.02)	0.70(0.16-2.89)	1.21(0.65-2.26)	2.08(0.28-7.32)	1.10(0.68-1.37)	0.57(0.21-1.48)
GHS 2001-3000	0.73(0.27-1.95)	0.71(0.18-2.70)	1.78(0.58-1.06)	0.85(0.57-1.27)	0.78(0.58-1.06)	1.18(0.73-1.90)
GHS>3000	0.82(0.52-1.31)	0.67(0.16-2.82)	1.10(0.47-2.57)	0.82(0.55-1.20)	0.85(0.63-1.15)	0.93(0.58-1.51)
Distance						
>5km	1.00	1.00	1.00	1.00	1.00	1.00
<5km	0.95(0.38-2.41)	2.17(1.40-3.29)	0.71(0.40-1.22)	1.20(0.71-2.04)	0.51(0.26-0.96)	1.57(0.56-4.14)
Level Education						
No Educ.	1.00	1.00	1.00	1.00	1.00	1.00
Basic Educ.	0.85(0.39-1.85)	0.92(0.36-2.31)	0.99(0.40-2.46)	0.90(0.50-1.62)	0.95(0.53-1.71)	2.35(1.46-3.56)
S.H.S.	0.57(0.23-1.51)	1.04(0.30-3.68)	1.06(0.30-3.57)	0.75(0.35-1.60)	0.77(0.37-1.62)	2.09(1.37-3.20)
Professional	1.15(0.73-1.86)	0.71(0.51-1.02)	0.73(0.52-1.04)	0.97(0.75-1.25)	0.96(0.75-1.22)	1.62(0.94-2.77)
Degree	0.90(0.51-1.45)	0.97(0.69-1.35)	1.05(0.77-1.44)	1.25(1.01-1.56)	1.25(1.02-1.55)	0.96(0.71-1.30)
Employment Status						
Working Full-Time	1.00	1.00	1.00	1.00	1.00	1.00
Working Part-Time	2.40(1.50-3.81)	0.99(0.73-1.33)	1.56(0.58-4.17)	0.90(0.63-1.30)	1.10(0.70-1.36)	1.60(1.16-2.21)
Unemployed	2.18(1.44-3.31)	0.94(0.65-1.38)	1.25(0.76-2.11)	1.50(0.57-3.91)	0.28(0.11-0.69)	1.02(0.68-1.52)
Econ. Inactive	1.70(1.00-2.87)	1.26(0.77-2.06)	1.18(0.73-1.90)	1.11(0.71-1.35)	1.36(1.02-1.82)	1.13(0.77-1.68)
Living Condition						
Own House	1.00	1.00	1.00	1.00	1.00	1.00
Rented Flats/Self Contained	1.02(0.70-1.48)	0.81(0.52-1.26)	0.98(0.64-1.50)	1.20(0.71-2.03)	1.22(0.81-1.85)	0.80(0.50-1.27)
Rented Single/Double Room	1.17(0.64-2.14)	1.13(0.59-2.16)	0.76(0.45-1.30)	0.95(0.63-1.42)	1.07(0.70-1.63)	0.85(0.51-1.41)
Cigarette Smoking						
Smoker	1.00	1.00	1.00	1.00	1.00	1.00
Ex-Smoker	1.03(0.59-1.82)	0.68(0.40-1.16)	1.21(0.76-1.94)	0.73(0.42-1.27)	1.36(0.86-2.16)	1.52(0.86-2.70)
Never Smoked	0.67(0.43-1.06)	0.70(47-1.06)	0.98(0.60-1.60)	0.81(0.43-1.51)	1.16(0.73-1.84)	1.47(0.88-2.44)
Alcohol Drinking						
Regular Drinker	1.00	1.00	1.00	1.00	1.00	1.00

Occasional Drinker	0.49(0.26-0.91)	1.22(0.65-2.26)	1.10(0.69-1.38)	2.34(1.46-3.75)	2.40(1.50-3.82)	1.26(0.77-2.07)
Ex-Drinker	0.52(0.27-0.97)	2.08(0.29-7.45)	0.80(0.36-1.77)	2.09(1.37-3.20)	2.18(1.44-3.31)	1.57(0.59-4.18)
Non-Drinker	1.23(0.82-1.82)	1.78(0.98-3.34)	1.26(1.01-1.57)	1.71(0.94-2.77)	1.70(1.00-2.88)	1.25(0.77-2.01)

Among males, health insurance claims was statistically significantly associated with both age and sex in the age adjusted models, and tended to be lower in those living in their own houses and those who earn no income or have lower income. In the age adjusted model, the indicators remained statistically significantly associated with national health insurance claims. Those having no education, basic education and senior high school were clearly strongly more likely to make an insurance claims in the age un-adjusted models. After adjusting for age, the situation remained unchanged except those with professional qualification. Those working full time were less likely to make national health insurance claims; this remained the same after adjusting for age. However, both income and marital status showed weak and inconsistent association with insurance claims in both age un-adjusted and age adjusted models. In both age unadjusted and age adjusted models, health insurance claims was weakly associated with marital status and income. Among males, health insurance claims were inconsistently associated with all the variables except cigarette smoking and alcohol drinking in both age -adjusted and age -unadjusted models.

With reference to females, health insurance claims was consistently associated with all the variables. Women with higher level of education were less likely to make an insurance claim than those who were less educated or have no education. This association remained unchanged after readjusting for the variables. Comparing to males, health insurance was also associated with higher education as degree holders and professionals were less likely to make an insurance claim. Among females, health insurance claims was associated with those with no income or less income; comparing to men, there was a statistically significant association with women. After adjusting for age, all the variables studied remain unchanged.

4. CONCLUSION

The objective was to find out the gender disparities in the Ghana National Health Insurance claims. Among men, the younger people prefer attending hospital for treatment as compared to their adult counterparts. In contrast to women, younger women favor attending hospital for treatment as compared to their adult counterparts. Among men, various levels of income impact greatly on their propensity to make an insurance claim, whereas among women only the highest income level did as compared to lowest income level.

Men in the middle income were as twice as likely to make an insurance claim as compared to their counterparts in the lowest income bracket where as in the upper of men and women, reverse is the case. Interestingly women in the middle to upper levels of income earning rather made less insurance claims compared to the lowest income bracket. However, it only occurred in the highest income level for men, again women with degree and professional qualification made less insurance claims compared to their lowest counterpart. The situation in men did not exist because they were statistically insignificant. This is in clear support of past literature that socio-economic condition affects health insurance claims (Aikins et al.; dale et al., 2012). Recent literature has identified income and production resources as good predictors of quality health (Somkotra, 2013, li et al.., 2007). People living on low incomes have been identified as standing higher risk of suffering serious illness and death than those in upper income brackets; such people with reasonably high saving are less prone to predisposing illnesses.

Men, who completed senior high school education, were less likely to make an insurance claim as compared to their counterparts with basic or no education. However it was women who had basic education that preferred using the hospital as

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compared to their more educated counterparts. Women who completed tertiary education were less likely to make an insurance claim as compared to the non-educated. In the case of women, it was rather those who completed secondary educating that showed similar preference. Again, women who had only primary education were less likely to make an insurance claim as compared to non educated counterparts. It is rather women with no education that showed similar characteristics.

This conforms with existing literature that postulates that out-of-pocket payment system that was introduced as part of the Structural Adjustment Programe was a major hindrance to healthcare utilization. The introduction of the National Health Insurance Scheme in the middle of the last decade sought to bridge the accessibility gaps in terms of affordability; however a lot more need to be done to meet the objective of improved access. The scheme is credited for bringing some improvements to the health indices of the country in terms of life expectancy and infant mortality.

The economically inactive male and female made more insurance claims as compared to their counterparts working full time. Among men, the unemployed also made more insurance claims compared to their counterparts who were fully employed. In contrast, women, who were unemployed, had similar results compared to their counterparts who were fully employed. Among younger men with various levels of health status made more insurance claims as compared to those whose status are very good. Fair and poor health status levels also used more health services in relation to very good health status. In contrast to men, women health status (very bad) made more insurance claims as compared to very good health status.

Following the transition from health services provided free at the point of service, to the introduction of user charges, health insurance is now high on the policy agenda in Ghana. Whilst user charges were introduced primarily as a response to financial sustainability concerns, interest in health insurance is driven more by a concern over income-related inequalities in access to services. However, the widespread introduction of health insurance schemes is motivated primarily by theoretical frameworks, which evolved in the context of wealthy countries. The structure of economy and society in Ghana tends to be very different, for example, in terms of the extent of informal activity, subsistence agriculture, relatively closed traditional communities, and the effective regulation of health professionals.

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Development of Pavement Blocks Using Clay

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Abstract
In Ghana most external paving works are constructed in concrete blocks or slabs. This raises alarm, since the materials used for producing these blocks are of non-renewable resources whose excessive exploitation may lead to its total extinction from the natural environment. This research work was therefore conducted with the aim of using clay as an alternative material for the manufacturing of pavement block. Four different samples of the clay bricks with the blend of other different materials were produced for the purpose of laboratory analysis to determine the compressive strength and durability of the various specimens. They are clay only; clay and sand; clay, sand and cement; and clay, cement and quarry dust. Data obtained was analyzed using bar chart and graphs.The research showed that the burnt "clay only" samples recorded the highest average compressive strength value of 3.62 N/mm², followed by the "clay + sand" samples with an average strength of 2.73 N/mm². "Clay + sand + cement" and "clay + cement + quarry dust" samples had 2.43 N/mm² and 1.73 N/mm² for respectively.Clay only sample is recommended for minor walkways.

Keywords: Clay; Pavement; Samples; Compressive Strength.

1. INTRODUCTION

Clay based material is one of the materials that has been widely used in construction materials instead of wood, sand, concrete and other waste materials. This material is a major constituent in clay brick, clay tiles and clay roofing tiles due to its wide-ranging properties, high resistance to atmospheric condition, geochemical purity, and easy access to its deposits near the earth's surface and low price (Konta et al., 1995 cited Ummi Kalsum, Mashitah and Badorul 2008).

Before World War II, the traditional pavement surface course in many areas of Western Europe was the rectangular clay brick (Sharp and Armstrong, 1985). Clay pavers have been around for a very long time and the fact that some are still in use in the United Kingdom and France, which were first laid over four hundred years ago. They are used in driveways and pavements today and their installation is essentially the same as the concrete blocks that have taken over the bulk of the market since the 1980s (Driveway Expert Inc., 2008).

However, the Ghanaian construction industry since the colonial era had used concrete pavement blocks, slabs and stones until now without much preference to an alternative material such as clay to serve the same purpose. It has been reported by Kirkendale (1960) that clay reserves are estimated to be 278 million cubic yards in the country cited Geological Survey Department of Building and Road Research Institute (BRRI). These deposits are widespread throughout Ghana and are located close enough to population centres to be used in brick manufacturing. Records available indicate that, clay deposits are in all the regions in Ghana.

According to Kirkendale (1960) clay products are maintenance free and need not be painted or plastered. In view of the high cost of imported cement in Ghana, and the abundance of indigenous clays, the cost difference should be even more striking; comparative costs excluding maintenance have been made.

Clay pavement blocks serve the same purpose as other pavement block. The key difference between clay and concrete pavement blocks, apart from the cost, is the natural colour. The colour of a clay pavement is not affected by exposure to the weather elements; the same cannot be said of concrete pavers (Driveway Expert Inc., 2008).

In view of the above benefits being enjoyed by countries using clay pavers, there is the need to research into its manufacturing and possibly, introducing it into the Ghanaian construction industry.

Aim

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This study is therefore aimed at experimenting into an alternative material for the production of pavement block by the use of clay.

Objectives
- ❖ To prepare pavement bricks sample using clay;
- ❖ To test for the strength and durability of clay pavement blocks;
- ❖ To recommend a sample clay pavement to be used in the construction industry.

Significance of the Study
This paper would inform players of the industry particularly material developers, policy makers to be innovative with the development of pavement blocks by the use of alternative building materials. The construction industry would change from traditional practices to the use of new techniques of constructing pavement works.

Literature Review
Definitions Of Clay
Cowan and Smith (1998) defines clay as a finer grained soil produce either by the decomposition of rock, or as a sedimentary deposit. It consists of hydrated silicates of aluminium with various impurities, and is in part colloidal. Clay is also defined as a fine-grained earthenware material which contains

Collection of Clay Soil
Mfensi is a town located in the Ashanti Region of Ghana, precisely on the Kumasi-Sunyani road. Mfensi is well known for its production of clay bricks and various forms of earthen ware products. For the purpose of manufacturing pavement brick samples, the researchers collected clay soil from Mfensi.

Moulding of Pavement Samples
The following tools were used the manufacturing of the clay pavers:
Mould box, Shovel, Wooden platform, Foam and Compacting bar.
Aside clay which is the main raw material used for the production, other locally available materials were also added to the mix designs for moulding of different samples. The materials used in addition to clay were sand, cement, and quarry dust.

clay minerals, and is plastic and cohesive (Obeng & Atiemo, 2005).

Areas in Ghana with Clay Deposit
Clay deposits are available in almost every part of the country. Some of the areas with deposits have been recorded in the Table 1 below.
Table 1 Regions with clay deposits in Ghana
Source: (Mining portal of Ghana, 2006)

REGIONS	CLAY DEPOSITS/ OCCURRENCES
Upper East	Gambibigo, Sumbrungu, Tono, Sobole.
Northern	Koblimahago, Kpaliga, Nyankpala, Kukuo, Yepei.
Brong Ahafo	Sunsan Valley, Tanoso, Adentia.
Ashanti	Asokwa, Afari, Mpasatia, Mfensi.
Eastern	Asuoya, Framase, Asamankese, Abomosu, Akim Awisa, Adawso, Okwenya, Kibi.
Western	Teleku-Bokazo, Aluku
Central	Abonku, Ochiso.

2. METHODOLOGY
2.1 Research Procedure
The experiment and laboratory analysis work was conducted using the following procedure
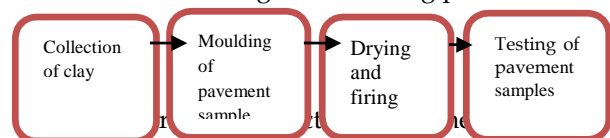
ten minutes by the researchers since it was already kneaded and made semi-plastic from

the source of clay for some days. The mould box was oiled to be made ready to receive the semi-plastic clay. The clay was filled into the box by hand in three layers. Each layer was well compacted to remove pockets of air that might have been trapped in the brick. The fair face finish of the brick was achieved by placing a flat plate covered with a black polythene sheet on top of the final layer to level and to finish it. Thirty samples were produced.

Clay and Sand

The mix design used for this particular brick sample was 2½:1, thus, two and half parts of clay and one part of sand. The clay material was firstly kneaded for some minutes and the right proportion of the sand added in smaller quantities until a uniform mix was attained. It was then moulded. The surface finish of this sample was achieved by sprinkling water on the surface and using a flat plate to level off the top.

Clay , Sand and Cement

The ratio used for this brick sample was 2 : 1 : ½. That is, two parts of clay to one part of sand and half part of cement . The sand was firstly mixed with the kneaded clay before the introduction of the cement into the mix. The addition of cement called for a water cement ratio of 0.7 in the mix in oder to achieve a thorough and uniform mix which was semi-plastic; made ready for moulding. Water was then used on the inner faces of the mould box to ensure easy removal of brick from the box. It was moulded and smoothly finished.

Clay, Cement and Quarry Dust

The mix ratio used to mould this sample was 3 : 1 : ½, thus, three parts of clay to one part of quarry dust to half part of cement. The mixing aspect of this sample was the most difficult among the rest of the mix designs due to the particle size of the quarry dust. Eventually, a thorough and uniform mix was attained after spending close to an hour of mixing by hand. The uniformly mixed material was then filled into the mould box and well compacted to remove trapped air from the brick sample. A plate covered with the black polythene sheet was used to finish the surface of the brick which produce a nice finish.

Drying of Green Bricks

The manufactured brick samples were spaced out in an open shed to allow natural air under normal atmospheric conditions for evaporation from the samples for a period of six days. After the sixth day, the samples were transported to the Building Technology Department Workshop for storage and ready for firing.

Firing of Moulded Bricks Sample

After air drying of the bricks samples, a number of them were sent to the Building Technology Department Laboratory for firing in an electrical oven. The bricks were fired for 24 hours at a temperature of 250°c (limit of electric oven). The firing brought

changes in the weight of the bricks, its colour and dimension.

Fig. 1 Fired pavement brick samples

Crushing Test

The testing of the hardened pavers was conducted on the 7th, 21st, and 28th day respectively using a compression testing machine. The samples were placed between steel bearing plates on a compression machine. The samples were wiped off from grit and placed centrally with load applied steadily to destruction and the maximum failure load reached was recorded

Fig.2 Pictures taken during the crushing test

The result gathered from the test is recorded inTable 2 below.

Table 2 Compressive strength results from 7 to 28 days

SAMPLES	DENSITY (kg/ m³)		DENSITY (kg/ m³)		COMPRESSIVE STRENGTH(N/ mm²)		COMPRESSIVE STRENGTH(N/m m²	
	7 days		21 days		7 days		21 days	
	burnt	Un-burnt	Burnt	Un-burnt	burnt	Un-burnt	burnt	Un-burnt
Clay	1775.1	1632.65	1743.1	1630.61	3.67	2.48	3.80	2.25
clay + sand	1824.28	1824.28	1820.00	1810.16	2.90	1.69	2.73	1.97
clay + sand + cement	1673.7	1467.71	1673.0	1470.12	3.06	2.15	2.66	2.19
clay + cement + quarry dust	1474.97	-	1466.91	-	1.75	1.20	1.70	1.21
	DENSITY (kg/ m³)						**COMPRESSIVE STRENGTH(N/m m²)**	
	28 days						28 days	
Clay	1743.1	1630.61					3.62	2.19
clay + sand	1820.00	1810.16					2.73	1.97
clay + sand + cement	1673.0	1470.12					2.43	2.09
clay +cement + quarry dust	1466.91	-					1.73	1.21

3.   DISCUSSION OF TEST RESULTS

By the 28th day, the burnt "clay only" samples recorded the highest average compressive strength value of 3.62 N/mm², followed by the "clay + sand" samples with an average strength of 2.73 N/mm² with 2.43 N/mm² and 1.73 N/mm² for "clay + sand + cement" and "clay + cement + quarry dust" samples respectively as shown in fig.3 below.

Moreover, the un-burnt "clay only" samples recorded the highest average compressive strength value of 2.19 N/mm², followed by the "clay + sand" samples with an average strength of 1.97 N/mm² with 2.09 N/mm² and 1.21 N/mm² for "clay + sand + cement" and "clay + cement + quarry dust" samples respectively as shown in fig.3 below.

Compressive strength goes on reducing as percentage of sludge increases in bricks. This agrees with Jahagirdar, et al. (2013) as sludge contains less silica content as compared to base material. Firing temperature of 250°C and firing period of 28 days gave a good compressive strength with same percentage of sludge in the bricks. Thus, the compressive strength reduces when more materials are added to the clay pavers. This made the burnt 'clay only' samples to achieve the highest compressive strength of 3.62 N/mm². As per the IS code classification (Bureau of Indian Standard, 1992) compressive strength requirement is 3.5 N/mm². This strength is the standard for soft areas or minor walkways.
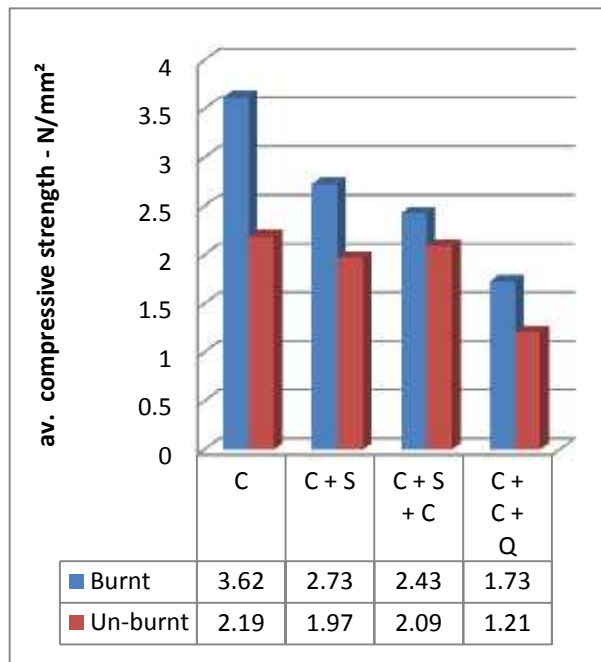
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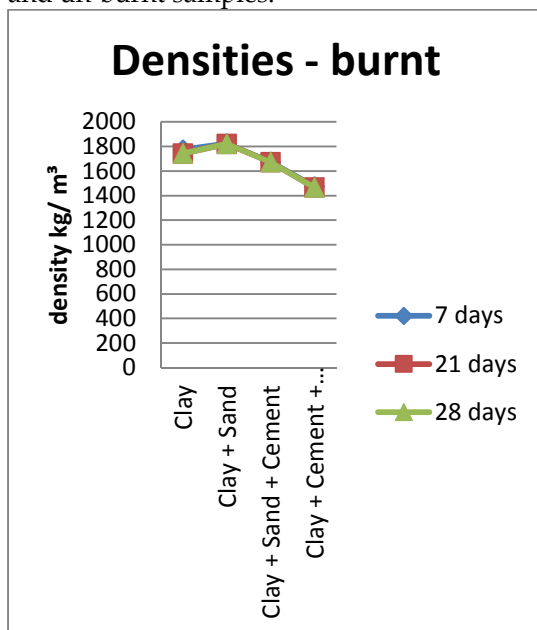Fig.3 Average compressive strength for burnt and un-burnt samples.
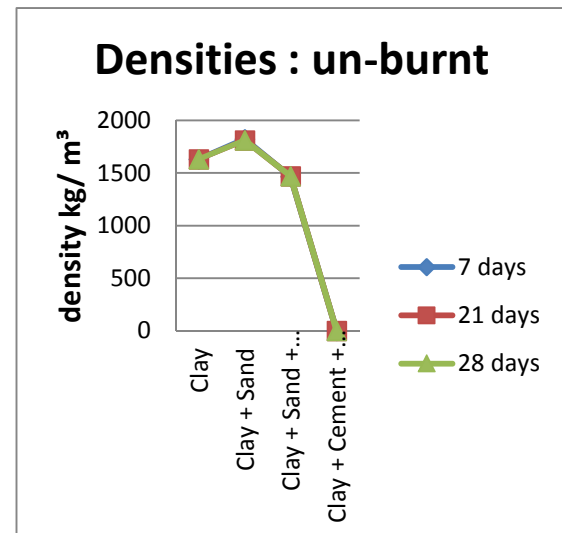

Fig.4 Densities for burnt samples

Fig.5 Densities for un-burnt samples

The densities of the samples produced were also reduced because of the drying and firing of the bricks. By the 28th day, the burnt bricks densities of all the samples were higher than the un-burnt samples because of burning of organic matter present in the pavers and also due to large number of voids created in the body of the bricks.

4.   CONCLUSION

The experimental nature of this paper has massively improved and increased our knowledge and understanding about the production of clay pavement blocks. Clay deposits are in almost every region of the country. Clay pavers can serve the same purpose of concrete block. It is readily available and less expensive. Its maintenance is also less. The laboratory analysis was carried out on the pavement bricks produced.

Four different samples of the clay brick with different materials were produced. The first sample was clay only. The second sample was clay and sand with a mix ratio of (2½ : 1). The third sample which was produced was clay, sand and cement (2 : 1 : ½). Finally a sample of clay, cement and quarry dust was also produced with a mix ratio of (3 : 1 : ½). Clay has the property of blending with different materials.

With respect to the strength and durability of the samples produced, the burnt "clay only" samples recorded the highest average compressive strength value of 3.62 N/mm², followed by the "clay + sand" samples with an

average strength of 2.73 N/mm² with 2.43 N/mm² and 1.73 N/mm² for "clay + sand + cement" and "clay + cement + quarry dust" samples respectively.

 Moreover, the un-burnt "clay only" samples recorded the highest average compressive strength value of 2.19 N/mm², followed by the "clay + sand" samples with an average strength of 1.97 N/mm² with 2.09 N/mm² and 1.21 N/mm² for "clay + sand + cement" and "clay + cement + quarry dust" samples respectively.

Recommendation

The study reveals that, clay is a good material that can be used to produce pavement bricks which will satisfy the same purpose as concrete pavement bricks. The "clay only" samples used for this research produced the highest compressive strength of 3.62 N/mm² which is good comparing it with International Standard code classification of 3.5 N/mm². It is also is lower for hard areas of compressive strength of 17.5 N/mm² and above (Bureau of Indian Standard, 1992), (Construction terms, 2014). The "clay only" sample is therefore recommended for minor walkways.

In view of this, the government and all other stakeholders in the construction industry need to direct their attention to do more research work on clay as an alternative raw material in the production of pavement blocks in the Ghanaian construction industry.

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Analysis of Vehicular Type as a Risk Factor of Road Accidents' Fatality in Ghana

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Abstract
The occurrence of road accident in Ghana is known to be the second major cause of death after malaria and it is reported that there is an average of 1909 people who are killed by road accidents annually. This paper employed the negative binomial regression to fit a model to the secondary data collected from 2001-2010, to ascertain the significance or otherwise of vehicular type to road accidents' fatality in Ghana. The negative binomial regression model was fitted into the data using R statistical package which applies the Akaike information criterion (AIC) for the best model selection.It was observed from the results that in general the number of people killed in road accidents gradually increases with time. The type of vehicle involved in road accident significantly influences the fatality of the accident and determines whether one would be killed or survived in the accident. The results also showed that buses killed most people in accidents, followed by saloon cars.

Keywords: Ghana; Road Traffic Accidents; Fatality; Negative Binomial Regression

1.   INTRODUCTION

The occurrence of vvehicular accidents in Ghana has become one of the growing concerns to most Ghanaians in recent times. This is as a result of the tremendous toll road accidents have on human lives, properties and the environment. Media reports reveal that, there is a high incidence of road accidents in Ghana, when compared with other developing countries. In 2001, Ghana was ranked as the second highest road accident-prone nation among six West African countries with 73 deaths per 1000 accidents, (Akongbota, 2011). The World Health Organization (WHO) ranked road accidents as the 9th major cause of death among the first 20 major causes of death in Ghana and advised that given the rate at which the number is increasing, if nothing is done about it, road accident will be the first major cause of death in the country by 2025. The report further reveals that Traffic Accident Deaths in Ghana is 2.7% of total deaths in the Country (WHO, 2011).

According to, statistics for the year 2009 released by the Building and Road Research Institute of Ghana there were 12,299 road accidents for the year 2009, (Afukaar et al. (2009)). There were a total of 18,496 casualties with 2,237 of them losing their lives, while 6,242 sustained serious injuries. This reveals that there was an average of 6 deaths every day in Ghana through road accidents and the people killed were those in the age group that largely constitute the work force. According to Ghana's National Road Safety Commission's provisional data on the road accidents in Ghana from January to April, 2013, there were 4,526 number of road accidents which killed 694 people. This number in a raw sense seems to be smaller than the number in 2012 which was 4,702 accidents that killed 745 people for the same period. However, a further analysis of the data shows that on the average the same numbers of people were killed by road accidents. (National Road Safety Commission, 2013). Boamah (2013) found that in 2011, there were 2,330 road accidents bringing it to an average of 7 accidents per day across the country. In 2012, by November ending, 13,535 crashes were recorded and over 2,069 deaths in Ghana. In December 2012 alone, 246 people died and 1,260 were injured in car accidents, (www.VibeGhana.com, 2013). Unfortunately, vehicular accidents are not peculiar to Ghana alone. For example, Heidi (2006) reported that 1.2 million people in the world lose their lives through road accidents every year. This number has risen to 1.3 million people who lose their lives globally every year and between 20 and 50 million people sustain various forms of injuries annually as a result of road accidents. The most affected of these consequences of road accidents are the people in the age bracket

of 15 and 29. Road accidents cost the world an amount of US$518 billion annually. It is estimated that if nothing is done globally to curtail the rampant nature of road accidents and most especially the causes of deaths of casualties before they are sent to hospitals then by the year 2020, 1.9 million people will be killed by road accidents in the world, (World Health Organization, 2011). A research conducted by Salim and Salimah (2005) also indicated that road accident were the ninth major cause of death in low-middle income countries and predicted that road accident was going to be the third major cause of deaths in these countries by 2020 if the trend of vehicular accident was to be allowed to continue.

1.2   Causes of Road Accident

Many researchers have come out with the causes, effects and recommendations in respect of vehicular accidents in Ghana and elsewhere. For instance, Ayeboo (2009), identified that the numerous accidents on our road networks have been linked to various causes which include over speeding, drink driving, wrong over taking, poor road network and the rickety vehicles which ply on our roads. Furthermore, the National Road Safety Commission (NRSC, 2007) has identified over twenty causes of road accidents in Ghana which include unnecessary speeding, lack of proper judgment of drivers, inadequate experience, carelessness, recklessness, intoxication, over loading, machine failure, dazzling and defective light, boredom, unwillingness to alight from motion objects (vehicles, motor cycles, human being and uncontrolled animals), skid and road surface defect, level crossing and obstruction. Other factors are inadequate enforcement of road laws and traffic regulations, use of mobile phones when driving; failure to buckle the seat belt and corruption. According to the Commission, the major cause of road accidents in Ghana is over speeding. This accounts for 60% of car crashes in the country, (National Road Safety Commission, 2011).

1.3   Causes of Death in Road Accidents

The cause of death of casualties has been associated with many factors such as secondary collision, failure of drivers and vehicle occupants to put on seat belt and riders failing to put on their helmet, Afukaar et al (2009).Studies have shown that sleep related accidents tend to be more severe and as such most people are killed (Homes and Reyner, 1995; Strohl et al, 1998, Allan et al., 1995). In a research conducted in North Carolina, sleep related accident was found to be the most severe accidents category among all other types of road accidents, Allan et al.. (1995). Also, Zomer (1990) identified that the number of casualties in sleep related road accidents is 50% higher than all accidents. It had three times the fatalities and doubles the seriously injured as compared with non-sleeping related road accidents.

The age of the vehicle involved in an accident cannot be ruled out of the contributors when one is assessing the cause of death of casualties in road accidents. Broughton (2007) identified that when two vehicles collide, the driver and occupants of the older vehicle are usually at more risk of being killed than those in the newer vehicle. In that study (Broughton, 2007), it was estimated that the mean risk of death of drivers of vehicles which were registered in 2000 to 2003 was less than half of the risk for the drivers of vehicles which were registered in 1998 to 1999, Broughton (2007). The size of a vehicle has also been found to contribute to the death of road users in traffic crashes. From the findings of Broughton (2007) in his study into road accidents data from 2001 to 2005, it was revealed that the driver casualty rate increases with the size of the other vehicle in collision. Broughton (2007) concluded that for the past 30 years, the weight and size of vehicles have been improved by 30% yet the number of casualties' deaths have not decreased in accordance with that. The fact still remains that people especially the youth, end up relying so much on the strength of their vehicles and take undue risk and that young drivers and young passengers die more in road traffic crashes than their older counterparts (Broughton, 2007). Drink-driving is another factor which was identified by Clarke et al (2007) as a contributor to death of casualties in road accidents. The reason for this could be linked to the inability of the drunk driver to control the vehicle as a result of sleeping, Zomer et al.. (1990).

1.4.   Road Accident Models.

The fatality rate over the years has been used to compare road accident incidence in a large number of countries. Fatality rate is defined as the number of deaths which occurred through road accidents with respect to some measure of

the use of the road system. However, Jacobs (1980) suggested that the measure employed cannot be used to compare accident fatality rates of different countries since the countries may vary in terms of population and total vehicles which ply their roads. He then proposed a model which assessed the relationship between fatalities, population and motorization of the country. This model supported the Smeed formula (Smeed, 1938; 1968) for international comparisons of accident fatalities. Smeed in 1938 used accident data from different countries and proposed the formula

$$\frac{D}{N} = 0.0003 \left(\frac{N}{P}\right)^{-0.67},$$

where D is annual number of fatalities from road accidents, N is number of vehicles in use and P is the population. This model was confirmed in 1968, (Smeed, 1968). Silyanov (1973) used the idea of Smeed and modeled accident data from different countries and had similar results as that of Smeed except that there were some variations in the constant terms in the models. In all these models none of the researchers made an attempt of using the model to predict accident fatalities in the countries concerned but as basis for only comparison. However, Andreassen (1985) raised serious objection to the use of death per vehicles licensed in order to make international comparison of road accident fatalities because it was found out that the two parameters were not linearly related over time. He then came out with a general formula

$$D = \text{constant} * N^{m_1} * P^{m_2},$$

which could also be used to predict the number of deaths in road accidents. In this formula, D is the number of deaths in road accidents, N is number of vehicles in use, P is the population of the country and m_1, m_2 are variables of interest. The difficulty in applying the equation by Andreassen (1985) is how to determine the constant term and the indices which might vary from country to country. Also, time series analysis was used by Mekky (1985) to study the effect of a rapid increase in the motorization levels on the rate of fatalities in some developing countries. Salifu (2004) has developed a forecasting model for traffic crashes for unsignalised urban junctions. Afukaar and Debrah (2007) have also model traffic crashes for signalized urban junctions in

Ghana and Ackaah (2011) has modeled traffic crashes on rural highways in the Ashanti region. This study attempts to ascertain the significance of vehicular type effect on road accidents fatality in Ghana using the Negative binomial regression model.

2. METHODOLOGY
2.1   Model Formulation
The data for this research was secondary data obtained from the Building and Road Research Institute of the Council for Scientific and Industrial Research, Ghana. The data was originally collected using accident report form by the Motor Traffic and Transport Unit of the Ghana Police Service. This study considered accident data for ten year period from 2001 to 2010. It consists of the number of people who were killed by road accidents for every year as the response variable, the year and the type of vehicle involved in the accident as the explanatory variables. Since road accident cases are considered as count data, a negative binomial regression model was adopted to verify the significance of vehicular type contribution to road accident's fatality. To ascertain the significance of vehicular contribution to road accident's fatality in Ghana, this study specify a Negative Binomial regression for the data.

The Negative Binomial regression model is a special form of the generalized linear model frame work for count data (Agretsi, 2007). The negative binomial regression model is an extended form of the Poisson regression model to cater for over/under dispersion which is very common in count data such as road accidents. The Poisson model assumes that the mean of the count data equates the variance (Agretsi, 2007). This assumption is most likely to be violated by accident data due to the presence of spatial clusters or other sources of autocorrelation (Trivedi et al.. 1998). The negative binomial has an extra parameter which accounts for the extra-Poisson Variation in the data (Dean and Lawless, 1989).

The negative binomial distribution has a probability mass function with a response variable Y given as (Jong an Heller, 2008)

$$P(Y = y) = \frac{\Gamma(y + 1/r)}{\Gamma(y+1)(\Gamma(1/r)} \left(\frac{1}{1+r\}}\right)^{1/r} \left(\frac{r\}}{1+r\}}\right)^y$$

(1)

where Γ is gamma function. In equation (1), λ is the mean, α is referred to as the dispersion parameter and the variance is given by $\lambda + \alpha\lambda^2$. The negative binomial distribution approximates to Poisson distribution when $\alpha = 0$. Thus, $\lim_{\alpha \to 0}(\lambda + \alpha\lambda^2) = \lambda$. Hence the expected value of the response variable Y of the negative binomial regression model converges to

$$\log(\lambda) = X \beta$$

(2)

where X and β are vectors of predictors and their coefficients respectively. In the negative binomial regression model as in any generalized linear model, model selection can be performed using an information criterion such as the Akaike Information Criterion. The coefficients of the predictors in the model are estimated by the maximum likelihood method and the evaluation of the model follows the usual generalized linear models.

3.   RESULTS AND DISCUSSION

There were 114,770 road accidents which occurred in Ghana from 2001 to 2010 which killed 19,088 people. This shows that on the average, 11,477 road accidents occurred every year and 1,909 lives were lost through these accidents.

3.1   Annual Distribution of People Killed by Road Accidents in Ghana.

Figure 1 shows the time in years for which accidents that killed the people occurred. It also presents the total number of people killed in road accident annually from 2001-2010.
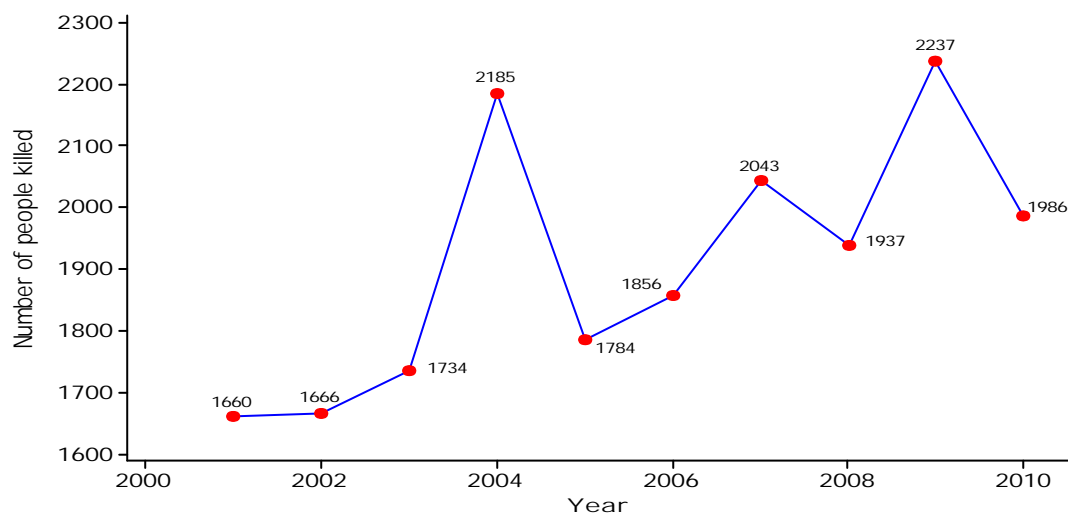

Figure 1. A line graph illustrating the average number of people killed by road accident in Ghana from 2001 t0 2010 for various age groupings.

It is evident from figure 1 that the number of people killed by road accidents in Ghana increased gradually from 1,660 in 2001 to 1734 in 2003 and rose sharply to 2,184 in 2004. This number of people killed by road accidents in 2004 dropped tremendously to 1784 in 2005. The number started rising again and by the end of 2007, the number of people killed by road accidents had risen to 2043. It then dropped again to 1,937 in 2008 and by the end of 2009, the number of people killed by road accident in Ghana had jumped to 2,239 which fell by the close of 2010 to 1986. In spite of the rising and falling nature of the number of people who were killed by road accidents in Ghana for the years under review, it is obvious that in general, there is rising trend in the number of people killed by road accidents in Ghana as the years go by. This observation supports what Odoom (2010) stated in his publication that as years go by, the number of vehicle in Ghana will be increasing and the number of traffic accident increases accordingly and as such the number of people who are likely to be killed in road accidents will also increase.

3.2   Type of Vehicle that Killed People in Road Accidents in Ghana.

The type of vehicle involved in road accident cannot be ruled out as a contributory factor to the number of people who are killed in that

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accident. The type of vehicle involved in the road accident which killed the people, the number of people killed by the type of vehicle, the percentage number of people killed and the

average number of people killed by type of vehicle for every year are presented in the Table 1.

Table 1 The number of people who were killed by road accidents through different types of vehicles in Ghana from 2001 to 2010.

Vehicle type	Total number of people killed	Percentage killed	Ave killed
Car	5,527	29.2063	553
Goods vehicle	3,675	19.41978	368
Bus/mini bus	5,650	29.85627	565
motor cycle	1,495	7.900021	150
Pick up	1,033	5.458677	103
Cycle	979	5.173325	98
Others	565	2.985627	57

From Table 1, it could be seen that Bus/Mini bus killed 5,650 people from 2001 to 2010 which constitute 29.9% of the total number of people killed via road accident in the same period. This was followed closely by cars which killed 5,527 representing 29.2% of those who were killed by road accidents. Goods vehicle was the third on the list of type of vehicles which killed most people in accidents with 3,675 people who were killed for the ten year period. This figure represents 19.4 % of the total deaths through road accidents in Ghana from 2001 to 2010. The type of vehicle which killed the least number of people for the years under consideration is represented by other types of vehicles. Only

565 people were killed by other type of vehicles such as tractor, bulldozer, tipper, mixer and loading box which constitute just 3% of the total number of people killed by various types of vehicles through road accidents.

3.3 Negative Binomial Model Specification

The negative binomial regression model was fitted the data using R statistical package which applies the Akaike information criterion (AIC) for the best model selection. The best model was selected based on AICs of the various models and the dispersion parameters were as illustrated in table 2.

Table 2 Goodness of Fit Test for Negative Binomial Regression

Assessment parameter	Negative Binomial Regression Model
Null Deviance	988.852
Degree of Freedom	69
Residual Deviance	66.666
Degrees of Freedom	54
Dispersion Parameter	1.234556
AIC	769.1

Looking at the results presented in Table 2, it is clear that the negative binomial regression model is the best model which fit the vehicular

type data since the dispersion is 1.23 and the AIC is 769.1 in the negative Binomial model. Table 3 summarizes the maximum likelihood estimates of the parameters in the model. The

coefficients for all the variables are estimated in relation to the base levelsfor vehicle type 1 (cars) in2001. To ascertain the significance of the various variables in the model, likelihood ratio test was conducted based on their P-value.

Table 3 The Parameter Estimates of Negative Binomial Regression Model for Number of People who were Killed by Different Types of Vehicles in Road Accident from 2001-2010 in Ghana

Coefficient	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	6.07980	0.11210	54.237	< 2e-16
Veh.type2	-0.39209	0.10169	-3.856	0.000115
Veh.type3	0.02487	0.10123	0.246	0.805906
Veh.type4	-1.36794	0.10388	-13.169	< 2e-16
Veh.type5	-1.67558	0.10512	-15.940	< 2e-16
Veh.type6	-1.72659	0.10536	-16.387	< 2e-16
Veh.type7	-2.31388	0.10919	-21.191	< 2e-16
year2002	-0.04041	0.12883	-0.314	0.753797
year2003	0.05038	0.12843	0.392	0.694892
year2004	0.27526	0.12758	2.158	0.030955
year2005	0.13912	0.12808	1.086	0.277370
year2006	0.21209	0.12780	1.660	0.097011
year2007	0.32977	0.12739	2.589	0.009635
year2008	0.34928	0.12733	2.743	0.006086
year2009	0.43932	0.12705	3.458	0.000544
year2010	0.53288	0.12678	4.203	2.63e-05

R package takes the first category in a data as the base level by default and as such Veh.type1 (cars) and the year 2001 were picked as the base levels for comparison in the analysis of the parameter estimates in the negative binomial regression model. The intercept was found to be 6.07980 which was very significant at 95% significant level with p-value of < 2e-16 following a Pearson Chi-square χ^2 distribution with 54 degrees of freedom as shown in table 2 above. With the exception of veh.type3 (bus/mini bus) which was not significantly different from the cars in the model, the rest of the vehicles were all significantly smaller than the base level in the model at 5% α-level for every year. For instance, veh.type2 (goods vehicle) was found to have parameter estimate of -0.39209 less than the logarithm of the expected number of people who were killed by cars for every year. It could also be said from table 3 that the expected number of people who were killed by veh.type7 (others) was $e^{-2.31388} = 0.09887686$ times less than that of cars for every year. Table 3 further reveals that the expected number of people who were killed by different types of vehicles for the years 2002, 2003, 2005 and 2006 were not significantly different from 2001 for all types of vehicles in the model giving that the year 2001 is the base level. 2010 was found to be the year which had most people killed by road accident for all types of vehicles in Ghana. It was found that 2010 had $e^{0.53288} = 1.703832$ times more than the expected number of people killed in 2001 for all types of vehicles in Ghana. The model for the above table is presented in equation 3.

$$\log(\text{mean\_killed}) = 6.07980 - 0.39209v_1 + 0.02487v_2 - 1.36794v_3 - 1.67558v_4 - 1.72659v_5 -$$
$$2.31388v_6 - 0.04041Y_1 + 0.05038Y_2 + 0.27526Y_3 + 0.13912Y_4 + 0.21209Y_5 +$$
$$0.32977Y_6 + 0.34928Y_7 + 0.43932Y_8 + 0.53288Y_9 \tag{3}$$

where $v_1, v_2, \cdots, v_6$ represent Veh.type2 (Goods vehicle), Veh.type3 (Bus/mini bus),…, Veh.type6 (others) respectively and $Y_1, Y_2, \cdots, Y_6$, denotes 2002,2003,…,2010 in that order.

4. CONCLUSION

Road accidents have been a lifelong phenomenon which leads to loss of lives of Ghanaians. The goal of this paperisto ascertain the significance of the risk of the type of vehicle involved in the fatality of the accidents in Ghana using Negative binomial regression model. Within the period from 2001 to 2010, there were a total of 114,770 road accidents which killed 19,088 people in Ghana. Also it was found that road accidents' fatality increases with time in that there was 53% logarithmic increase from 2001 to 2010. In the investigation of the number of people who are killed in different types of vehicles through road accidents, there was a significant contribution of vehicle type to road accident fatality in Ghana.

It was identified that buses and mini buses killed more people in road accidents than the other types of vehicles. This is due to the fact that the parameter estimate for mini buses was positive 0.02487 and the rest of the vehicles have negative estimates (see table 3). The model also confirmed this through the parameter estimates for the various types of vehicles. It was observed from the model that bus/mini bus was 1.025182 times more than the base level for every year, while the rest of the vehicles were all less than the base number of people killed by cars. Since the type of vehicle involved in the accident affects the number of people expected to be killed, drivers of vehicles such as cars and buses should be given special training to be able to avoid preventable accidents. Education on road accidents should also be intensified especially among drivers. Finally, institutions that enforce road traffic regulations should do well to apply the law to the letter so that all perpetrators of traffic offences are brought to book to deter others from repeating such offences.

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Higher Education and Development in Ghana: Development Outcomes, and Policy

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Abstract
The role of higher education in economic and social development remains controversial in many developing countries. The demand for university education in Ghana is growing faster than the resources that go into producing graduates because of their contributions to knowledge and research needed for development, as well as benefits associated with advance knowledge and skills required for positions in government and businesses. However, adverse macroeconomic conditions and increased competition for scarce public funds have reduced government's capacity to expand higher education to meet the high demand. This paper addresses the contributions of higher education to sustainable development outcomes, and addresses the challenge of preserving or improving higher education quality amidst a compressed education budget. The development outcomes are estimated by means of simulation based on cross country data. The findings indicate that different levels of education affect development outcomes differently, but higher education may be more important in economic growth, life expectancy and other development outcomes. However, expansion of higher education should not be at the expense of secondary education, since growth in enrollment in secondary education reveals indirect feedbacks including improved enrollment in higher education and economic growth. Furthermore, private universities respond efficiently to changing demand, and thus increase educational opportunities with little or no additional public costs. Therefore, government can encourage the development of private universities to complement public universities as a means of expanding higher education for sustainable development. The findings have implications for development policy in Ghana.

Keywords: Higher Education; Secondary Education; Private Universities; Economic Growth; Economic Development and Investment

1. INTRODUCTION

Ghana is changing from being just agricultural dependent nation to service,and to conceptual, and knowledge-based education vital for sustainable development; therefore, academics must help to produce labor skills that will close this gap. However, with the rising rate of Ghana's population, and an increase in secondary school graduates each year, many qualified students do not gain admission in the public universities due to lack of space and resources. Gross enrollment rates (GER) in 2011 at the primary, secondary, and tertiary levels are 106, 57, and 12 respectively (UNESCO Institute of statistics, 2011).

Following the birth of "human capital" theory by Schultz, Mincer, Friedman, and Becker in the mid-twentieth century, the importance of education in economic development is acknowledged in the development literature (Psacharopoulos, 2002; Appiah& McMahon, 2002; McMahon, 2002 among others). Most of these literaturehas stressed the complementary relationship between human capital and physical capital, noting how human capital externalities can affect economic growth. .Apart from its contribution to sustained economic development, education, like health, is a consumption good whose acquisition directly contributes to people's well-being. For this reason, the United Nations Development Programme (UNDP) uses education as one of the components of its Human Development Index (HDI). Motivated in part by this observation, findings from several studies focusing on higher education and national development suggest that higher education is a key to delivering the knowledge requirements for economic development (McMahon &Oketch 2010; Keller, 2006; and Hanushek&kimko, 2000; UN University, 2011

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among others). These studies have shown that sustainable development in any economy depends on the availability of skilled labor force whose contributionto increased labor productivity and long-term economic growth are essential for poverty reduction.In many African countries, the role of higher education in development remainsuncertainsince it is seen by some people see higher education as something good to have, but not necessary a preparationtowards development outcomes.In addition to knowing the effects of education on economic development, it may be necessary for governments in Africa to know what levels of education (primary, secondary, or tertiary) are for a particular development outcome.

Despite the benefits of investment in higher education to individuals and the nation as a whole, the sector is in crisis throughout the world, and especially in Africa. Given the importance of education in Ghana, the government spends a lot of resources to provide it. But are the resources that go into the various levels of education efficient? Why is higher education so sought after? These are some of the questions that need to be addressed.

Ghana, like many developing countries areoften inefficiently subsidizing the tuition and living expenses of students from high income families who do not need such financial aid. The award of financial aid is inequitable in the sense that taxes are borne by all citizens, but it is the poor who are largely excluded from higher education. There is a need for financial aid policy that will ensure that qualified students from lower income families are not left out.First, it is necessary to address the types of returns to investment in education. There are two types of such returns classified as "monetary" and "non-monetary".

To my knowledge, this paper appears to be the first to consider the contributions of private universities in Ghana on a wide variety of sustainable development outcomes, including monetary and non-monetary benefits, as well as the indirect effects of higher education on development outcomes. The contribution to the literature goes a long way to address the challenges of preserving and improving higher education quality amidst a compressed education budget, as well ashigher education

resource recovery in Ghana.The findings of this paper suggest that more investment in higher education may be justified because of the strong link between higher education participation rates and larger developmentimpacts;however, the effects of education on development outcomes differ according to the level of education, such asprimary, secondary or tertiary.The rest of the paper is as follows: 2. Theoretical framework and methodology, 3.Results of the study, 4.Discussion, and 5.Conclusion.

2. Theoretical framework and Methodology

It is important to make some theoretical distinctions to understand how the effects of education will be measured, as well as the time lags in the dynamic process. These are the monetary and non-monetary effects from investment in education, as well as private benefits and externalities. The framework of this analysis is the established dynamic view of economic development process, which includes a flow of new research in endogenous growth theory with empirical tests that focuses on investment in education as the key means for dissemination of new technologies and new knowledge that can be used productively (Lucas, 1988). The formation of such human capital sets the stage for future growth because it extends from one generation to another.

2.1 Monetary benefits of education.

Monetary benefits of education consist of private and public benefits. Private monetary benefits have economic significance because of productivity of graduates, who are well compensated in the labor market. The private benefits for individuals are well established, and include better employment prospects, higher salaries, and a greater ability to save and invest. These benefits may result in better health and improved quality of life. Social or Public monetary benefits can in part be explained by university's contribution to economic growth through increased employment rates, as well as increased tax revenues that benefit society as a whole (Appiah, 2013).

2.2 Non-monetary benefits from education.

These are the net education impacts on development goals that improve the quality of life in addition to the earnings benefits because they are generated as the individual uses his or

her human capital during non-labor market hours spent at home or in the community. Per capita income is controlled to avoid overlapping the earnings benefits, so as to measure only the indirect contribution of education to the non-market benefits such as longevity and better health, which are partially due to the purchase of better health care services, and also the ability to access information on good health habits.

2.3 Private benefits vs. externalities. The distinction between the private benefits of education to the individual and the externalities or indirect effects that spill over to benefit society and future generations are usually underrated. These public benefits for example, knowledge are benefits to others due to the education of prior generations, but often taken for granted when one makes private investment decisions.   In such cases, government policies can potentially remedy market failure and raise economic well-being. This is referred to as "public goods", (Mankiw, 2007; Romer, 1990) because they are "non-excludable and non-rivalrous" benefitsshared equally by society.

We measure the indirect effects in regressions that contain lags, and therefore can generate a time path in simulations, but there are other methods. Education policy change has short-term impacts that set the stage for future growth and development, as well as long-term impacts which are deliberately traced. Lucas (1988) expresses economic output as a function of human capital used on the job, physical capital and the average level of education in the society.

Firm's Production Function:

$$Y = f \left(\mu H, N, K \right) H^{\alpha} \tag{1}$$

Differentiating this production function implies output is a function of the rate of investment in human capital as measured either by investment in education, a flow, relative to per capita income or by enrollment rates, which are also a flow of additions to the human capital stock by the term μH, raw unimproved labor, N, and physical capital, K in Eq. 1. Outside the inputs internal to the firm is the level of human capital knowledge in the society created by education, H^{α}, which also contributes to the productivity of the firm. The public effects of education and their feedbacks on the economic growth process are made explicit here, because they are the specific non-monetary society effects of education, of which some are externalities on growth that will be traced. The equations in the model are too extensive and detailed to discuss here, but have been published in Appiah and McMahon (2002). The simplified representation of the model:

Per Capita Economic Growth: $GN = \beta_1 GER_{-20} + \beta_{i2} GDIG_{i-10} + \beta_3 POPGR + \mu_1$ (2)

Development Goals: $GDIG_i = \alpha_{i1} GER_{-20} + \alpha_{i2} GN_{-20} + \alpha_{i3} GDIG_{j-20} + \mu_2 \qquad i \neq j$ (3)

where GN=Growth of per capita GDP in real terns; GER_{-20} =Gross enrollment rates for primary, secondary and tertiary lagged 15-20 years or more. The lags allow time to graduation and time for graduates to learn on the job. $GDIG_{i-10}$ is development outcomes lagged 10 years or more. $GDIG_1$ represents the rate of investment in physical capital as a percent of income from household production as derived from Lucas (1988).   Other development outcomes ($GDIG_{i's}$) in Equation 2 are the indirect effects of education, such as better health on productivity, which contributes to economic growth and also other non-monetary development outcomes like poverty reduction (Aref, 2011, Chaudhry, Malik, Hassan, and Faridi, 2010). POPGR is the effects of population growth on per capita income. In Ghana and most of Africa universal secondary education has not been reached hence rapid population growth contributing to falling per capita income. The μ's are the disturbances less significant in determining economic growth and development outcomes.

3. RESULTS

The net impacts of education on specific types of non-monetary social benefits are summarized below. They are benefits that accrue to society as a whole, that are not directly related to economic, fiscal or labor market effects. The simulations were run for 40 years to isolate the net effects of one particular policy change under defined conditions.The estimates show the net education impacts after 40 years that result from an increase of two

percent of per capita income invested in education. There are lags of 10, 15, or 20 years in gross enrollments representing gross investment in education in each equation. These lags are because it takes time for students to graduate, and still more time before they have an impact on their communities. First,

education's net marginal product as it relates to each outcome is estimated, which are the direct effects based on cross-country data. For each development outcome there is a control for per capita income to remove the indirect market effects of education.

Table 3.1 Estimates of Education Impacts on Sustainable Development Goals
Simulations of Outcomes Over 3 Years

Development Goal Affected by Education	Percent Change in Outcome After 35 Years	Basis for Estimate (after a 2% per capita GDP increase in education investment)
Economic Growth	10% increase in GNP growth	Improvement in per capita income
Tertiary Education	20% increase in enrollment	Continued to grow
Better Health	Positive health effect	Micro-regressions. Secondary education reduces infant mortality rates
Lower Population Growth	Increased by 0.04% and stabilized thereafter	Fertility rate falls, longevity increases-Stabilize population
Democratization	33% increase in democracy (on a scale of 8 the Freedom House Index was up from 6 to 8, the top limit)	2% of per capita GDP raises gross enrollment rates by about 30 percentage points
Political Stability	Increased by 3%	Increased by 3% &continued to increase thereafter
Environmental Effects		Deforestation falls as indirect
Deforestation	Deforestation falls by 0.5%	effects of education, reduce poverty and population growth thus increase economic growth
Water Pollution	Water pollution falls by 7.6%	Water pollution falls as indirect effects of education increases economic growth
Reduced Inequality	8% reduction in GINIcoeff.	Education helps the Poor
Reduction in Poverty Rate	Poverty falls by 15%	Partially private benefit

4. DISCUSSION

The simulations based on the regressions show that total education enrollment rates in tertiary education institutions would also increase with this increased investment. In Ghana they are estimated to double by 20 years. These enrollment rates will continue to grow because they do not hit the universal enrollment ceiling at the tertiary level as they do at the secondary level, and because after universal secondary school education is achieved much of the new funding would be diverted to the tertiary level.

a.   **Economic growth**.

The impacts of secondary and university enrollment rates have positive economic growth with the education policy change; however, higher education show larger impact. The findings are consistent with earlier studies (Gyimah-Brempong, Paddison, and Mitiku, 2006;Baldwin and Borrell, 2008; and Gyimah-Brempong, 2010). Keller (2006) also finds per capita growth in the developed countries significantly related to increases in secondary and higher education (including Community Colleges) enrollments ten years earlier. Racharan (2002) also finds a link between education, fertility, and growth. Additional major benefit of higher education is from

research that contributes to the stock of new knowledge, which in turn promotes development. It is well established that education in general promotes economic growth and development, but it is higher education that has been associated with increased ability by society to adapt to and use new technology.

4.2 Better health. Infant mortality is an important health index of economic development also known to be significantly affected by education. Ghana's infant mortality rate between 1995 and 2010 was 61 deaths per 1,000 live births compared to 90.5 for the Sub-Saharan Africa (SSA) average is among the lowest in the SSA region. The high proportion of poverty rate coupled with the inadequate education they receive may in part explain the higher infant mortality in SSA countries. Education at all levels improves better health through lower infant mortality and maternal mortality rates (Appiah and McMahon, 2002). Increased primary and secondary enrollment of females improves health, lowers infant mortality rate, and increase life expectancy. These effects on better health increase net population growth rates. University education however, does not only improve the graduates own health and that of their children, but help the reduction of infectious diseases to others, which benefits the public at large as extensively surveyed in Grossman and Kaestner (1997). Also the findings in Gyimah-Brempong (2010) show a high correlation between curative health outcomes like tuberculosis with tertiary education than with primary and secondary education.

b.   **Lower population growth**. Lower population growth rates are a public benefit because they reduce a country's financial burden and resources (physical capital and human capital) from population growth pressures. The reduction of the financial pressure will enable Ghana to improve in school quality, which over time will improve the labor quality and help to stimulate per capita growth and development. The simulation result shows that the net effects of lower infant mortality rates, increased life expectancy, and improved better health, all combined increase net population growth rate. However, the lower fertility effect from education begins to dominate the better health

effects from education as more females complete secondary school plus increase enrollment in universities, thereby stabilizing population growth.These findings are consistent with those found in Appiah and McMahon (2002) among others.

4.4 Democratization.   Universal secondary education or higher education fosters democracy, human rights and political stability. The democratization index by Freedom House (2009) ranges from 1 to 8 with 1 being the lowest and 8 the highest. As shown in the simulation result in Table 1, the net effect on democratization index of increased investment in higher education reaches the top limit (8), within 25 years. This is consistent with the findings in Barro (1999), and also inAppiah and McMahon (2002) where increased investment in secondary education alone led to a 36% increase in the democratization index after 40 years.Similar conclusions were made in a press release by the former UN Secretary General, Kofi Annan, which disclosed that university is the primary tool for Africa's development in the new century (UNIS, 2000). Addressing a wide range of benefits that higher education can provide, he emphasized on the development of African expertise that can enhance the analysis of African problems, and strengthen domestic institutions that can also aid the practice of good governance, conflict resolution, and respect for human rights.

1.5   Political stability. Political stability is significant in attracting domestic and foreign investments. These in turn are important to economic growth in Ghana. Stability as measured by the International Country Risk Guide is greater with higher levels of per capita income, as well as with higher secondary and university enrollments after a 20 year lag accompanied   with   democratization   as evidenced in Table 1. The simulation results show that Ghana's political stabilitywill improve by about 3% in the medium term (2035) after the increased investment in higher education.

1.6   Environmental effects. The effects of education on environment (deforestation and water pollution) are indirect through the reduction of population growth and reduction of poverty.   After controlling for income,

McMahon (2002) traced the direct and indirect effects of education on environmental quality. He concludes that more education tends to demand clean environment which is direct effect, but "higher education further reduces fertility and population growth rates that are destructive to forests, wildlife, and water purity". Deforestation and wildlife destruction are very serious problems in many African countries as a result of high population growth rates. However, there are positive feedback effects from increased education enrollment through economic growth and lower population growth, but only after a lag of 25 years or more. Consistent with Appiah and McMahon (2002), the results show that the indirect effects of higher education through reduction of poverty and population growth rates, and increase in economic growth are estimated to reduce forest destruction by 0.5% percentage point. Water pollution is also a major problem in countries with high illiteracy rates. More education has indirect effects on water pollution through reduction of population growth and poverty rates. After controlling for per capita income from higher education, then the effects of lower population growth, reduced poverty, and democratization significantly reduce water pollution as shown in Table 1. It can therefore be concluded that education contributes to environmental sustainability, but only indirectly and only after a lag of about 20 years. However, at what level of education leads to a significant reduction in pollution rate is not clear.

1.7   Reduction in poverty.   Education policy change on reducing poverty as measured by the proportion of population living on less than $1 a day is partly due to economic growth that is an indirect effect of the expansion of access to good quality education, and partly as a direct effect from education. Resources invested in education may not result in a decrease in poverty for several years, but as the poor's human capitals improve they begin to reap the benefits from increased earnings and household production. Higher education can therefore make a significant contribution to the reduction of poverty by conferring skills and knowledge that increase the productivity of individual's labor, and thereby increase the individual's access to the job market. The caution is that higher education policies can be such that they increase poverty and inequality,

when there is no need-based financial aid. Some students who get admission to public universities are those who could afford university education without government support, where a larger proportion of those graduates emigrate (Hagopian et. al, 2005 and Aghion et.al 2005). If more of these are done the effects of the new education effort on reducing poverty cannot be expected to occur and may even be negative. With lags, the simulation results for Ghana indicate that poverty is reduced by 15% in the medium term by the extension of secondary education and perhaps higher education to all students, and are consistent with those found in earlier studies including Appiah and McMahon (2002), and Smith and Appiah (1997). Sen (1997) also found out that policies geared towards expansion of education for the poor have positive effects on the reduction of both poverty and income inequality, as well as on better health.

1.8   Inequality in income distribution. Inequality in income distribution as measured by GINI coefficient responds to human capital development policies as evidenced in Appiah and McMahon (2002) among others. Studies haveshown that the poorest countries usually have high inequality in income distribution as a result of low educational attainment (World Bank, 2002) However, inequality in income distribution can be reduced if students have access to quality secondary education, and perhaps tertiary education that can potentially strengthen their labor market opportunities. For this to succeed, provision of financial aid to poor students must be made to help reduce school dropouts, and increased enrollments in secondary schools and universities. With the education policy change, the GINI coefficient in Ghana reduces by 8% after 35 years. Although the inequality in Ghana is still high, the magnitude without the policy change is much higher.

1.9   Challenges in Ghana's higher education. In many countries throughout the world, higher education is considered a public good, therefore heavily dependent on the government, where the government is the CEO of higher education institutions.   Ghana's higher educational system historically follows the pattern of their former colonizers, the British. Ghanaians are entitled to free university education. Until recently, the

government of Ghana was the main provider of higher education—thus the control and supervision of university activities was the responsibility of the government. The problems encountered include higher education heavily dependence on government funds, making it difficult to improve quality as education budgets and per student expenditures are compressed. In response to the high demand for university graduates in our labor market, access to higher education for all qualified students has also increased. But access to public universities generally remains elitist with majority of students coming from wealthier families. The per student expenditure in higher education in countries like Malaysia and the United States are much higher than that of Ghana, but such expenses are not all borne by the government. Rather, they are borne by the government and the individual student and/or their families. Ghana, like many developing countries can no longer afford to waste resources even less by inefficiently subsidizing the tuition and living expenses of students from high income families who do not need such aid. The award of aid is inequitable in the sense that taxes are borne by all citizens, but it is the poor who are largely excluded from higher education.

5. CONCLUSION

This paper uses micro data for Ghana to investigate the effects of education on several development outcomes including income growth, health, population growth, environmental effects, democratization, and poverty reduction in Ghana. **This paper does not suggest that education is the only, or the major cause of economic development. There are other contributing factors, and this paper attempts to bring out the marginal effects of education on sustainable development outcomes.**

Conclusions drawn here about the potential of higher education to affect economic growth and development outcomes are recognized in many studies including Gyimah-Brempong, 2010, Bloom et al, 2005, and McMahon 2002 among others. But the findings in some of the studies show that different levels of education affect income growth and development outcomes differently. Controlling for a per capita income, we find that higher education attainment has significant positive impacts on all development outcomes in Ghana. Most of the education impacts on development goals

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are externalities and with lags. But the effect of higher education on income growth is much larger than the effects of lower levels of education; while lower levels of education have stronger impacts on preventive health than tertiary education. As university graduates move into the labor force, they have acquired human capital skills that they can use not only on the jobs, but also in their homes and communities throughout their life-cycle. The offspring of these graduates are healthier and better educated, and as the cycle continues, the society benefits from development outcomes such as better public health and reduced poverty. All these contribute to dissemination of new knowledge and higher productivity in the country.

Some of the challenges addressed in the study include leaving out many qualified students from higher education, because they could not get admission in the public universities, and cannot afford private universities. We recommend a need-based financial aid for able students from the lower income families' so that they are not squeezed out. Higher education reforms policies for mobilizing greater private financing for higher education through cost-sharing and the promotion of private universities can help Ghana free up some of the public resources needed to improve access and quality at the primary and secondary levels.

Policy Implications

The above findings suggest that increasing higher education enrollments may be important in promoting improvement in a country's ability to maximize economic growth and sustainable development. Therefore, government can encourage the development of private universities to complement public universities without imposing an unsustainable financial burden on the government budget. This can potentially broaden access to higher education to meet the increasing demand. Moreover, there is greater quality within private universities because of their affiliation to public universities that mentor them. Thus, private universities can make positive contributions to society through higher income tax revenue from high-paying jobs. Therefore government must embark on policies including program evaluation instruments, technical assistance for curriculum development and institution

management, and provide merit of need-based financial aids to both private and public universities for able students from the lower income families' so that they are not squeezed out. Furthermore, thegovernment should provide subsidies in the form of staff in government service to teach in private universities. This would help to reduce the operation costs, as well as to enhance the quality of university education. The government shouldsupplement private universities research funds through direct monetary research grants that can stimulate research and development in private universities.

Recommendations forImprovingSustainable Development:

(1) In order to ensure that there is critical mass of skilled labor on the job market that could contribute significantly to sustainable development, there should be a link between thehigher education sector and the labor market.

(2) The government should award research grants to both public and private universities. This would ensure that researchers would relate results to local conditions and disseminate results through industries and agricultural extensions. Moreover, this would help to improve the research training of graduate students.

(3) The government should make available to the Ministry of Education a copy of the national survey data, which contain information on education outcomes, earnings, employment, unemployment, costs and benefits of different types and levels of education. It is envisaged that this would assist the Ministry to balance competing demands from the education sector, and plan for efficiency in education's contribution to sustainable development.

(4) There should be monitoring of the labor market, which would include a continuing program of tracer studies, where studies could be used for policy adjustments.

(5) Private universities play an important role in the provision of education at the tertiary level. Thus a national survey, similar to that done for public tertiary institutions should be carried out on private tertiary institutions.

(6) The government should set a higher priority on the expansion in secondary education. High quality secondary education is not just a preparation for higher education, but it is also

useful as a preparation for the workplace and will lead to improved development outcomes in Ghana.

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Enzyme Applications in the Beverage and the Edible Oil Industries – A Review

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Abstract
Enzymes are organic catalysts, which play a major role in biological systems. The native enzymes present in food speed up biochemical reactions to bring about desirable or undesirable changes. These may lead to desirable or undesirable colour, flavour or textural changes in food. Sometimes, the desirable effects may take place not as fast as required and therefore exogenous enzymes can be added to enhance the rate of these biochemical reactions. In cases where the effects are not wanted, exogenous enzymes may be utilized to counteract them. Lack of understanding or poor understanding of the role of both the native and exogenous enzymes in food and how they influence food quality can ultimately lead to rejection of food products by the consumer. Thus,a study on enzymes should be a matter of importance to the food processor in order to derive maximum benefits from them. Against this background, this review took a look at some enzymes used in various food processing industries, the role they play, how they influence food processing, and their effect on food quality.

Keywords: Enzymes; Food; Quality; Desirable; Biochemical Reactions

1 INTRODUCTION

Interest in enzymes as industrial materials for processing has increased. The world production of enzymes is estimated at more than 10,000 tons per year (Hassan and Richter, 2002). The world-wide sales of enzymes in 1998 alone were over $1.5 billion, and the projected annual growth rate of the feed enzyme is 25% (OECD, 1998). The food industry alone uses over 55 different enzyme products in food processing (van Oort, 2010). Economically, the application of enzymes in the food industry is known to make better use of raw materials, increase yield and reduce process cost (Uhlig, 1998). It is reported that enzyme-based processing industries reduced their operating cost by 9-90%, saving energy and raw materials (OECD, 2001). The utilization of enzymes in food production is considered more environmentally-friendly than the traditional chemical-based technology because their by-products are more biodegradable (van Oort, 2010).

The activity of - endogenous enzymes may be beneficial or detrimental to food quality. The beneficial effects may be furtherenhanced by exogenous enzymes. Also, the bad effects can be controlled by exogenous enzymes. The application of enzymes in food has to be well understood by the food processor to derive maximum benefits. Poor understanding /lack of understanding of role of enzymes in food processing may affect quality and demand.

Enzymes are highly specific catalysts required for many biochemical reactions which go on in living organisms. They can however, be used as catalysts outside living cells (Buchholz et al., 2005), and as such can be added to foods during processing, to bring about desired characteristics, including changes in the functional properties of food, removal of toxic constituents, and production of new ingredients (Whitaker, 1996). Due to their specificity in the reactions they catalyze, enzymes produce less side reactions and by-products: therefore they give more quality products. Enzymes allow mild processing conditions which preserves valuable attributes of foods and food components (van Oort, 2010). They work by lowering the activation energy of the reaction. As a result, they speed up reactions 10^3 to 10^{11} times that of non- enzyme catalyzed reactions, and 10^8 to 10^{20} times that of uncatalyzed reactions (Whitaker, 1996), and even reactions that may not take place can be made to proceed under the influence of enzymes (van Oort, 2010).
There are different types of enzymes which play specific roles in the food industry. Among

these are proteases, pectinases, xylanases, peptidases, amylases, lipases, amyloglucosidases and polyphenol oxidases. Enzymes have applications in the industries such as beverage, meat, dairy, bakery products, cereal, edible oil, etc.

Due to the crucial roles enzymes play in food processing, this review highlighted - some enzymes used in various food processing industries, how they influence food processing, and their effect on food quality.

1.2 Enzyme applications in the beverage industry

1.2.1 Wine industry

Winemaking relies on biochemical, chemical and microbial transformations, through the help of enzymes found in grapes, yeast and lactic acid bacteria (Jackson, 2008). These transformations are usually incomplete due to the inhibitory effect of typical winemaking conditions such as high sugars and ethanol concentrations, low pH and high polyphenol concentrations (Ugliano, 2009). Exogenous enzymes with higher efficacy are therefore added to achieve the desired biochemical transformation. Enzymes are utilized in winemaking for clarification, decolourization, dealcoholization, enhancement of flavour development, improvement in anthocyanin extraction (Jackson, 2008; Ugliano, 2009) and filtration enhancement (Ribereau-Gayon et al., 2006).

During fermentation, grapes are crushed, and the hydrolytic enzymes released during the process facilitate the liberation or extraction of nutrients, flavorants and other constituents from the pulp, skin and seeds. Pectic enzymes also attack the pectin in grapes and further aids in the release of cellular constituents into the must (Jackson, 2008). Pectins are known to act as protective colloids which cause clarification and stabilization problems in wines (Feuillat, 1987; Jackson, 2008). This problem happens because pectin forms a gel and retains water, and this prevents phenolic compounds and aromas from diffusing into the must during fermentation. When grapes are crushed their pectin, makingthem forms a viscous solution which makes juice extraction, clarification and filtrattion difficult (Bruchmann and Fauveau,

2010). Therefore, in addition to the native pectolytic enzymes, exogenous ones are added to the must to reduce viscosity, enhance the extraction process and to aid filtration (Ribereau-Gayon et al., 2006; Jackson, 2008). Pectinases break down pectin in grapes to increase free run juice yield, facilitate clarification and pressing, increasing aroma and polyphenol concentrations (Bruchmann and Fauveau, 2010). Pectinases have been used in wine to cause a drastic reduction in pectin viscosity, compared with the control (Rodriguez-Nogales et al., 2008). The addition of pectolytic enzymes to the crushed grapes helps speed up the breakdown of the cell wall, thus increasing anthocyanin extraction and colour development (Revilla and González-San José, 2003). In grapes that have high pectin content the use of pectolytic enzymes reduces processing time, increases yield of must and wine (Berta 1991).

Glucan is a high molecular weight polysaccharide produced by grapes infected with Botrytis cinerea. This type of polysaccharide is made up of glucose units joined together by β-1,3 on the main chain with β-1,6-D- glycosidic bonds on the branches. The presence of glucan in must and wine makes filtration and clarification difficult because it clogs filters (Ribereau-Gayon et al., 1980). Many authors have reported the successful utilization of exogenous glucanase to enhance the filterability of wines(Villetaz, 1987).Glucanase application led to a significantly higher filtrate volume of wine, compared to the control (Humbert-Goffard et al., 2004). How is the yeast autolysis associated with wine production?In sparkling wine ageing, yeast autolysis occurs, where the degradation of the yeast cells happen, for its contents to be released into the wine, and thus influencing the sensory properties and biological stability of the wine. (Charpentier and Feuillat, 1993).Natural autolysis occurs slowly (Martínez-Rodríguez and Pueyo (2009),and this may be speeded up by using glucanase preparations (Jackson, 2008).

[explain red and white wine in order to put the information on white wine in context.]Red wine production involves alcoholic fermentation of musts in the presence of solids such as the skin and seeds while in white wine production it is the grape juice which is usually

fermented (Ribereau-Gayon et al., 2006b). Though oxidation under controlled conditions could enhance and stabilize red wine colour, exposure to oxygen generally has negative effect on white wine quality (Singleton, 2000). Oxidative browning is therefore a problem in white wines.Anthocyanin is known to be involved in white wine browning. As a result it may be necessary to have it removed from white wine to prevent discoloration and to confer oxidative stability (Jackson, 2008).This can be done by adding the enzyme, anthocyanase before or after fermentation. By removing the sugar moiety from anthocyanins, they become less soluble and thus enhancing precipitation during fermentation (Jackson, 2008). The fungal polyphenol oxidase, laccase can also be used to prevent browning in wine. It is reported that laccase application in red wine led to the reduction of the phenolic compound responsible for the must antioxidant properties,however, in the case of white must, even though laccase reduced the total phenol to a greater extent, the antioxidant potential was slightly affected (Minussi et al,, 2007). This finding shows that in the white wine, laccase application conferred a greater colour oxidative stability, and thus reducing the tendency for browning. Another study has also reported reduced browning in rosé wine with the application of polyphenol oxidase (Gómez et al., 1995). This treatment also gave a better colour quality.

There is a growing market for low-alcohol wines (Jackson, 2008), probably due to the concerns about the dangers of alcohol, economic and quality issues (Kutyna et al., 2010).Therefore some authors have suggested some methods of reducing the alcoholic content of wine. Among the methods are dealcoholization after fermentation (Jackson, 2008), use of yeast strain with the ability to divert more fermentation by-products to glycerol production (de Barros Lopes et al., 20032002) and the use of commercial enzymes (Villettaz, 1987). In the enzymatic process, two enzymes are applied. These are glucose oxidase and peroxidise (Pickering et al., 1988). In the process, glucose oxidase oxidizes glucose to gluconic acidand hydrogen peroxide.The gluconic acid cannot be fermented by yeast.The peroxidase then destroys the hydrogen peroxide produced. When this happens the alcohol production then becomes dependent on

the fructose present, thus reducing the final alcoholic concentration of wine. The optimum conditions of enzyme concentration, sparging, mixing rate, aeration and temperature, resulted in 87% conversion of glucose to gluconic acidPickering et al., 1998). The reduced glucose level indicates that the alcohol potential of the wine produced from this grape must/juice would be low.

In grapes, some flavour compounds may be bound to glycosides, and these can be released by breaking this bondby the glycosidases in grapes, yeast or lactic acid bacteria (Ugliano, 2009). However, the glycosidase activities of grapes, yeast and lactic acid bacteria are limited. In order to enhance the release of glycosidically-bound volatile compounds, exogenous enzyme preparation with glycosidase activities is added to the grape must during winemaking. Günata et al. (1993) have noted that addition of enzymatic preparation produces higher concentrations of different classes of volatile compounds, particularly monoterpene alcohols, monoterpene polyols, norisoprenoids and benzenoids.

1.2.2 Fruit juice industry

In the fruit juice processing industry, juice extraction and clarification pose major challenges. One challenge is as a result of pectin, which contributes to the juice viscosity and turbidity (Urlaub, 2002).

In the enzymatic clarification of juice, the cost of the enzyme, heating and time are important. In order to get the best out of the process, response methodology is employed. A response surface methodology has been used to obtain the optimum conditions necessary for clarifying banana (Musa sapientum cv Berangan) juice, using commercial pectinolytic and amylolytic enzymes at concentrations, 0.01-0.1% in the temperature range, 30-50 °C and time range, 30-120 min. The optimum conditions were 43.2 °C, 0.084% and 80 min for temperature, enzyme concentration and incubation time (Lee et al., 2006). A commercial pectinase with mainly transeliminase, polygalacturonase, and pectinesterase activity, as well as small amounts of hemicellulase and cellulase had been used to clarify sapodilla fruits (Achras sapota), in a response surface

methodology with the enzyme concentration range, 0.03-0.10%, temperature range, 30-50°C and time range, 30-120 min (Sin et al., 2006). In the study, the conditions for the juice to be considered optimum were minimum turbidity, minimum absorbance (maximum clarity), minimum viscosity and maximum lightness value (L). The results indicated that the optimum juice was achieved with the conditions, 0.1% enzyme concentration at 40 °C for 120 min. Liew Abdullah et al. (2007) have also optimized the conditions for producing carambola fruit (Averrhoa carambola L.) juice, using a commercial pectolytic enzyme. The commercial enzyme had the following activities: endo-polygalacturonase, endo-pectinylase, pectin esterase, β-galactosidase, chitinase and transgalactosidase. The authors reported the optimum conditions for the enzymatic clarification as 0.1% enzyme concentration at 30°C for 20 min. Different fruits have different types and amount of pectic substances, therefore enzymatic clarification is bound to produce different optimum conditions. The application of the commercial pectinolytic enzyme, Pectinex 3XL in the clarification of passion fruit juice had been studied, and the results showed that the enzymatic treatment produced a significantly higher viscosity reduction, compared with the control (Domingues et al., 20122012). Interesting results on alternative enzyme application in filtration have been reported. Alternate use of protease (Enzeco) and pectinase (Pectinex Smash®) in cherry juice clarification was studied, and the results obtained showed that the turbidity measurement of the juice reduced significantly immediately after addition of the protease, but slightly after the pectinase addition. However, when the two enzymes were applied to the juice during 14 days of cold stabilization, the pectinase gave effective reduction of turbidity but the protease showed little effect on turbidity (Pinelo et al., 2010).

Sweeteners are very important ingredient in the fruit juice industry. The production of high-fructose corn syrup helps to provide the industry with large quantities of sweeteners. This is estimated as ~100 billion tons/year (Whitaker, 1996). High-fructose corn syrup is produced through the application of a series of commercial enzymes. It is produced by adding α-amylase to starch which has been heated to

105°C, and this produces dextrins of degree of polymerization 10-12. Glucoamylase is then added to the dextrin to produce glucose. Immobilized glucose isomerase is then added to glucose to produce approximately equimolar concentrations of glucose and fructose. Starch hydrolysis and isomerization of glucose performed chemically would give lower yields, high cost, unwanted byproducts and more waste acids (Buchholz et al., 2005). Chen et al. (1986) reported the production of high- fructose syrup from sweet potato, using both acid and enzymatic hydrolysis. The enzymatic hydrolysis was carried out by using α-amylase obtained from Bacillus subtilis, glucoamylase isolated from Rhizopus delemar. They found out that the saccharose obtained from the enzymatic hydrolysis experienced less browning, compared with the one from the acid hydrolysis. The study concluded that the enzymatic hydrolysate was more suitable for the production of high fructose syrup.

The glucose derived from starch can be isomerized to fructose, and this gives greater sweetness-to the syrup formed, and is commonly used in many food and beverage products; e.g. as a sweetener and an enhancer of citrus flavour (Synowiecki, 2007). He also noted that fructose is the sweetest tasting of all the carbohydrates and is suitable for the formulation of low-calorie products having reduced sucrose content, or as a sweetener for diabetics because it can be metabolized without insulin. The use of fructose syrup as an additive to some baked products results in desirable browning developed as a result of Maillard reactions, and in addition, fructose acts as a crystallization inhibitor which keeps sucrose in solution, thus producing a cookie that retains its soft texture during storage (Synowiecki, 2007).

1.2.3 Enzyme application in edible oil extraction

Extraction of edible oil can be assisted by enzymes to increase yield and improve oil quality. Many authors have reported enzyme-assisted extraction of edible oils. The effect of proteases on the aqueous extraction of oil and protein was reported (Rosenthal et al., 2001). The enzymatic treatment resulted in significant increase in oil yield from 27.8 to 66.2% and significant increase in protein yield from 41.8 to

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58.7% over the control, when heat-treated soybean flour or when non-heat-treated flour with large particle size was used for extraction. However, the results showed that extraction of oil and protein from non-heat treated flour with enzymes generally decreased the yields slightly. This underscores the need to supply the right temperature requirement for optimum performance of the enzyme. Sharma and Gupta (2006) have reported the effect of prior ultrasonic pre-treatment on aqueous enzymatic oil extraction from almond and apricot seeds. The study revealed that the ultrasonic treatment at a power of 70 W for 2 min prior to almond oil extraction resulted in 95% (v/v) oil yield, within extraction time of 6 h, compared to a yield of 75% by the aqueous enzymatic extraction only (using commercial preparation of three proteases) within 18 h. The use of enzymes in extraction of extruded soybean flakes and de-emulsification of emulsion formed during enzymatic oil extraction has been reported (Wu et al., 2009). Three of the four proteases used in the study, Protex 51FP, Protex 6X and Protex 7L gave 90% oil recovery, whereas Protex 50FP gave similar oil yield as the control (without enzymatic treatment). Though different proteases may give similar yields, others may also give different results. The study also investigated the use of two enzymes, phospholipase A2 (LysoMax™) and a protease (Protex 51FP) to destabilize emulsions formed during the enzymatic oil extraction, and at enzyme concentration level 0.2%, the protease and phospholipase gave 88 and 47% of free oil recovery respectively from the oil left in the emulsion after the initial enzymatic extraction. Enzymatic extraction of oil from borage seeds and the effect of the extraction on antioxidant properties of the resulting defatted meal has been investigated (Soto et al., 2008). The study showed that the defatted meal obtained from enzymatic borage oil extraction had antioxidant content three-fold more than that from the non-enzymatic treatment. The enzymatic treatment enhanced the value of the defatted borage meal. Passos et al. (2009) have optimized the conditions for enzymatic extraction of oil from grape seed (Vitis vinifera L.). Enzyme mixture of cellulase, xylanase and pectinase was used for the extraction, and under the optimum conditions of time, temperature, particle size and enzyme concentration, the extraction yield obtained

was 13.7%, representing 106% increment over the non-enzymatic extraction. The enzymatic treatment led to improved extraction efficiency. In another study, the application of enzymatic pre-treatment (cell wall degrading enzyme mixture of cellulase, protease, xylanase and pectinase) prior to supercritical extraction of oil from grape seed (Vitis vinifera L.), though gave a higher yield of 16.5% represented only 44% increment over the untreated sample (Passos et al., 2009).

2 CONCLUSION

The review took a look at the use of exogenous enzymes in beverage and the edible oil industries. It can be seen from the review that there is a wide range of enzymes with varied applications in the various sectors of the food industry. Also the review has revealed the critical roles enzymes play in the food processing industry. In some instances they can be used to correct unwanted effects in food, but they can also be used to directly enhance food quality. Food processors need to have a better understanding of the activities of endogenous food enzymes, how to enhance their activities or suppress them with the aid of exogenous enzymes. The future direction of food enzymes should be to assess the nutritional and chemical composition of the processed food which has been subjected to enzymatic treatment.

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An Assessment of Risk Management as a Means of Achieving Supply Chain Flexibility in the Non-Traditional Sector in Ghana

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Abstract
This study assessed the relevance of risk management asa means of achieving supply chain flexibility in the non-traditional sector in Ghana. The reasons for the investigationsare that, , there are problems associated withthe transportation of pineapple products to the international market. There are potential risks recognised by the study; the major external pineapples supply chain risks are: delays in shipment , weather conditions, high fuel price, and global financial crisis. Also from the findings, major internal pineapples supply chain risks identified are: power curtailments, financial obstacles, damages and accidents, capacity problems, bureaucratic documentation procedures, delays in pick-ups, and labour strike. In all 20 exporters were contacted. The researchers employed a mix methodology approach, that is, the use of questionnaires, interview, and observation. Based on the findings the study recommends that; adequate attention is given to the cost of the transport, that is, the government should provide transport facilities for either for pineapple farmers or pineapple exportersto help reduce the risk of damage of goods from the farms to the port. Government can also so give more affordable loans to the needy producer and exporter to improve on the condition of transport facilities.. Also, the bureaucratic processes that exporters go through before exporting the goods through the ports and other financial institutions should be reviewed. Flexible procedures should be implemented by decentralising the process.

Keywords: Supply Chain; Non-Traditional Export; Risk Management; Supply Chain Risk

1.0 INTRODUCTION

The declining performance of main traditional export commodities dominated to a greater percentage by cocoa since 1980's compelled Ghana to look for other alternatives to diversify the export base because the economy could no longer be sustained solely on these commoditiesand this led to perishables to be elevated of traditional export products to meet international standards. Horticultural exports have grown dramatically over the past decade, experiencing a growth rate of 7% (UNCTAD, 2009), and has the potential to grow further.

In addition, the growth of export of perishable food items can also be attributed to Ghana's trade liberalization policies which have made it possible to expand trade with the international world in the past decade. Takane (2004) observed that the increase in perishable export is attributed to Ghana's adoption of the Structural Adjustment Program (SAP) and other policy changes towards trade liberalization which in turn have increased the participation efforts of the private sector on horticultural activities.

Moreover, there is growing demand for fresh fruits and vegetables by European consumers, especially during the winters. Due to improved technology such as irrigation schemes and modern farming techniques, Ghana has been able to take advantage of the European customers' growing demand. This is because, the use of modern technology has improved farming activities and doubled production output beyond the demands of the local markets; moving Ghana into being a food-surplus country (Tetteh, 2006).

Based on the above, it should be clear to all those who are concerned that, the increase in doing business with the international world calls for a critical look at the transportation system ofdeveloping countries, especially where perishables are concerned. Long, (2009) indicates that "transportation is the central issue of logistics" and that transportation consists of physical movements and storage. This results from the fact that there are some storage functions during the physical movement of goods. The time critical nature of perishables requires a complementary role by the two functions to achieve reliability. This study will therefore look at the factors in transportation where flexibility can be introduced to enhance transportation

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reliability. Hence the focus of the study is based on the perishables supply chain from Ghana into the international market.

As pertains in most developing countries, Ghana is no exception when it comes to transportation infrastructure. Ghana's road network in general is woefully inadequate, especially in areas where perishables are produced. Major highways especially those linking the Tema port are congested and poorly maintained. Most of the main and feeder roads leading to food producing areas are in very deplorable states (GEPC, 2010).

The means of water transport is through the Volta Lake whose water level has been falling to the extent where part of the lake has not been navigable. With this, ferries are unable to reach landing bridges. Rail lines are not well developed to reach the regions where perishables are produced. Ghana has only two ports, situated in Tema and Takoradi. Tema is the bigger of the two and is the principal import and export port of containerised goods. Takoradi is the main port of bulk goods (Rønnevik, 2009). Tema is referred to as a traffic junction due to the fact that it is faced with capacity and efficiency problems. There is also lack of coordination between the port and land transport (i.e. road and railway).

1.1 Problem Statement

Based on background presentation, it is evident that perishables exportation has potential to grow even further. This is due to the fact that the global demand for perishables like pineapple, banana and mango is still growing (UNCTAD, 2008). For Ghana to be able to effectively satisfy that international demand, effective risk management measures is the key requirement that needs to be put in place so as to prolong the short shelf lives of products at the market. On the other hand, the present conditions of transport infrastructure in Ghana poses some challenges in the attainability of delivery reliability, hence causing pineapple products to get rot before getting the final destination. In this light, there is a need to introduce effective risk management measures as a critical element in addressing transportation challenges.

It is rather unfortunate that the pineapple industry in Ghana is still in its infant stage and very little is known about its high economic potentials and prospects to become the leading

non-traditional product. Many efforts have been instituted to expand exports in general by diversifying export products through non-traditional export products including pineapples (Daily Graphic, 2011). In all these concerns, it is important to undertake a survey to specifically identify the supply chain risk in the non-traditional sector and find risk management strategies to reduce theses risk, hence the research is important.

This study aims at assessing the relevance of risk management as a means of achieving supply chain flexibility of non-traditional export sector in Ghana.However, the specific objectives of the study are to;

1. Identify the supply chain risk faced by pineapple exportersin the Eastern Region of Ghana.
2. Assess the effects of the supply chain risk on pineapple exporters in the Eastern Region of Ghana.
3. Determine the value added by each farmer, exporter, and processor along the pineapple value chain in the Eastern Region of Ghana.
4. Identify and rank the constraints faced by pineapple exporters in the EasternRegion of Ghana.

2.0 METHODOLOGY

The study investigates the challenges facing pineapple exporters by conducting a constraints analysis. Thus, the study also assessed the level of value added at each stage of the supply chain by adopting a value addition assessment. Moreover, the descriptive research method was used for the purpose of reducing cost and time. Nonetheless, it was very difficult to rule out alternative explanations and especially infer causations. Thus, this study used the descriptive approach.

The study partially used quantitative research methods because this permitted a flexible and iterative approach in data collection. During data gathering the choice and design of the methods was constantly modified, based on ongoing analysis. The target population included various respondents from pineapple export businesses which include pineapple exporters, pineapple farmers and the Ghana Export Promotion Council (GNPC).

There are over one hundred pineapple exporters and producers in Ghana. But for the

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purpose of this study the researchers concentrated on the major pineapple exporters and producers who are based in the Eastern and Greater Accra regions in Ghana (Oboum, Akuapim North and South) in Ghana. In all twenty-five (25) respondents were contacted which consisted of Twenty (20) pineapple exporters, and five (5) Top management officials of GEPC.

The Kendall's concordance analysis was used to test for the agreement of the rankings by the respondents on the constraints the exporters face in the supply chain. The analyses were however presented in the form of graphs such as bar charts and pie charts for simpler discussion of issues. To conclude, the proposed hypothesis was tested using the responses from staff of GEPC, and pineapple farmers/exporters. These responses were tested using the percentages analysis which enabled the researchers to examine the extent to which risk management can increase market value of pineapple exportation in Ghana. This was done by considering the responses from all the stakeholders involved in which the independent variable (risk management) yields a prediction for the dependent variable (supply chain flexibility).

3.0 Results
This section illustrates the data collected and the analysis; the study used both close and open ended questions. The Exporters responded to the questions and the names of the companies are attached to appendix B.
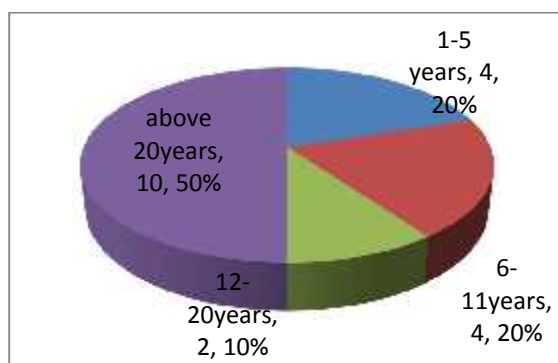
Figure 4.1: Age of Pineapple Exporting Business
Source: Field Survey, 2014

Four (4) exporters have been in the export business for about five years. These exporters are relatively new in the business and therefore lack the required expertise to manage their

businesses. (4) Exporters confirmed they have been in business for about eleven years. Two (2) exporters said they have been in the business for about twenty years. The rest of the 10 have been in the supply chain for more than 20 years.
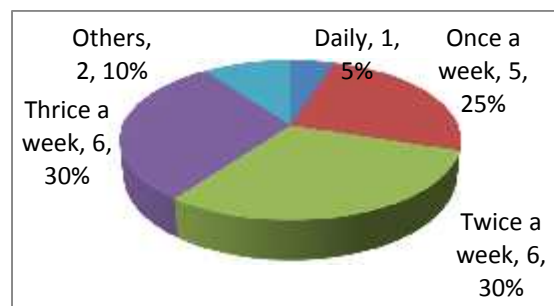
Figure 4.2: Transporting Goods from farm to the Port

Source: Field Survey, 2014

From Figure 4.2, above only 1 exporter acknowledged that, they transport goods to the port daily. 5 exporters transport goods to the port once a week. 6 exporters transport goods to the port once a week. 6 exporters transport goods to the port twice a week. 2 exporters transport goods to the port once a week.
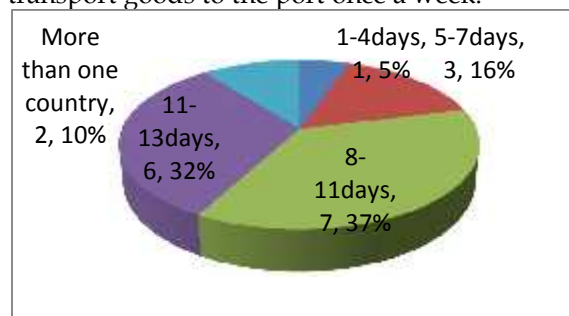
Figure 4.3: Duration of Transporting Goods to their Destination
Source: Field Survey, 2014

Figure 4.3 shows data on how long it takes exporters to transport goods abroad; only 1 exporter acknowledged that, it takes between1-4daysfor goods to get to their destination. 3 exporters said it takes between 5-7days to transport goods to their destination. 7 exporters said it takes between 8-11days transport goods to their destination. 6 exporters said it takes between 12-13days transport goods to their destination. The rest of the 2exporters transport goods to the port once a week.

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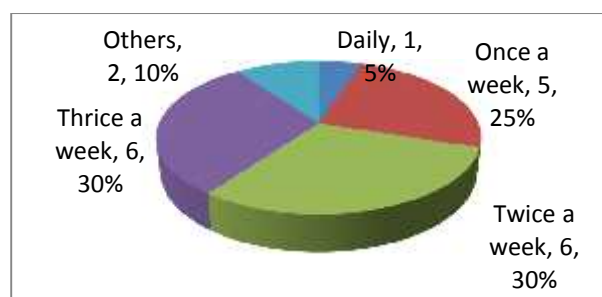
Source: Field Survey, 2014
Figure 4.4 Number of Times Exporters send goods Abroad

4.1.1 Challenges Pineapple Exporters Face in the Inland Face of Transport

It was established that, all the twenty (20) exporters strongly agreed that, they faced various forms of challenges in the export business. Some of the problems they mentioned were as follows:

- Insufficient funds to promote their business in terms of transport and storage;
- Poor transport infrastructure
- Unreliability of local transport agencies.

4.1.2 Challenges Pineapple Exporters face when goods get to their destination

It was established that, all the twenty (20) exporters strongly agreed that, they faced various forms of challenges in the export business when goods get to their destination. Some of the problems they mentioned were as follows:

- Lack of control over the international supply chain price;
- Product rejection by the customer abroad due to the nature of our roads and storage facilities, which causes a lot of debt to the exporter; and
- Inability of Ghanaian farmers to produce enough of the MD2 variety to meet the supply chain demand.

From the results above,it is revealed that, there is presence of flexibility to some extent with

Figure 4.4 shows, how often exporters transport goods to the port; 1exporter acknowledged that, they transport goods to the port daily. 5exporters transport goods to the port once a week. 6exporters transport goods to the port once a week. 6exporters transport goods to the port twice a week. The rest of the respondents transport goods to the port once a week (See, Figure 4.3).

regards to the internal and external elements, which have positive influence on the performance of this supply chain.

4.1.3 Supply chain risks

There are potential risks in the pineapple supply chain. It was revealed that, the major external pineapples supply chain risks are the result of delays in ship/plane, and associate with weather conditions, high fuel price, and global financial crisis. The study also identifies that: power curtailments, financial obstacles, damages and accidents, capacity problems, bureaucratic documentation procedures, poses serious challenges.

4.1.4 Sensitivity Analysis for Pineapple Farmers in the Eastern Region

Sensitivity levels differ for the different costs/revenue items across the Eastern Region (Table 4.2). However, in general, revenue is the most sensitive parameter while cost of tools and consumables is less sensitive parameter in Eastern Region.

Planting cost with 9.83%, certification with 15.35%, other costs with 16.26%, harvesting cost with 19.24% and costs of tools and consumables with 27.51% being the least sensitive for production in the Eastern Region (Table 4.2). Further, the same cash flow discounted at 1.65% and 1.70% gave NPVs of GH¢ 27.87 and GH¢ -7.93 respectively, yielding an IRR of 1.69%.

Table 4.1: Value Added by Actors in GH¢ (per tonne of pineapple fruits)

S/N		Farmer	Retailer of fresh pineapple	Processor (Fresh)	Processor (Juice)
1	Primary raw material	50	184	990	300
2	Total cost	82	281	2394	894

3	Total value added	32	97	1404	594
4	Value added per tone	32	81	425	527
5	Total revenue	154	350	2990	16400
6	Total value added per day	0.08	11.57	60.71	75.29

Source: Field Survey 2014

Table 4.2: Sensitivity Analysis for Pineapple Farmers in the Eastern Region

S/N	Activity/Transaction	Discounted cashflow (GH¢)	Sensitivity/ Switching value (%)	Rank
1	Certification	122.04	1535	7
2	Land Preparation	289.07	426	4
3	Planting materials	419.69	131	4
4	Planting	44.82	983	6
5	Maintenance	49.64	435	5
6	Harvesting	23.3	1924	9
7	Tools and consumables	12.39	2751	10
8	Other costs	18.57	1626	8
9	Total cost of production	651.11	65	2
10	Revenue	948.13	33	1
11	NPV = 1,873.00	-1587	1438	1770

Source: Field Survey 2014

On the whole the drying processor incurs the highest cost per tonne (GH¢14051.00) and hence sellsat a higher price to obtain a value of GH¢ 16400.00 torecover cost and make some profit to remain in business compared to the slicing and then pineapple juice processor.Among the fresh fruit retailers, the retailers of the Eastern Region add more value (GH¢81.00) per tonne of fresh pineapple fruits than the retailers of the other Region.

4.1.2 Results of the Value Addition Analysis
Table 4.1 shows the estimates of the value added by the various actors (farmers, retailers and processors in the Eastern Region). The standard unit here is a tonne of fresh pineapple for each actor. The results reveal that the processor adds the highest value (GH¢).The farmer of the Eastern Regiondoes not add much value to fresh pineapple fruit (GH¢32.00).

On a daily basis, the drying processor adds the highest value (GH¢ 75.29) followed by the slicing (GH¢ 66.00). The results revealed that in the Eastern Region (GH¢ 11.57), the retailer difficulty in accessing labour, higher weed competition, difficulty in accessing farm land, inadequate tractor, bad weather conditions, no premiums paid (GH¢ 0.08).

The turn over period of the pineapple farmer per tonne of fruits is about 14 months compared to a week or organic production technology. The processor invests more in quality control and assurance and hence adding more value per unit cost. The varieties cultivated by the farmers have high water content and slicing. An investigation on a pineapple dry processing business in South Africa revealed that the return per unit of fruit is 50% compared to that in Ghana of about 17%. The factory in South Africa is using the queen

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Victoria pineapple variety which has low water content and hence better for dry processing compared to varieties in Ghana with high water content.

4.1.3 RESULTS OF THE CONSTRAINT ANALYSIS

The study also identified and ranked the constraints of organic pineapple production in the Eastern Region of Ghana. The study revealed that constraint followed by:lack of access to cash credit, no premiums paid for pineapple irrigation fruits, higher post -harvest losses, unreliable market, difficulty in return per unit cost for processing into juice than dry and technology hence better accessing labour, inadequate organic production, bad weather condition, difficulty in accessing farm lands, less access to extension services, pest and diseases and inadequate access to tractor services.

Table 4.3 below shows the agreement among the rankings in Table 4.3. The three different rankings (i.e., all farmers, the Eastern Region) are all significant as indicated by the asymptotic significance values (i.e., $p < 0.01$).

Table 4.3: Ranking of Constraints faced by Pineapple Farmers of Eastern Region

S/N	Constraints	All pineapple farmers Mean Rank	Mean	Pineapple farmers in Mean Rank	Mean
1	Pest and Diseases	6.66	6	10.20	11
2	No premiums paid for certified Fruits	5.81	5	2.94	3
3	Inadequate organic production technology	8.68	11	6.80	7
4	Unreliable market	4.88	3	5.18	5
5	High post-harvest losses	7.92	9	4.76	4
6	Inadequate extension services	8.68	12	8.68	10
7	Difficulty in accessing labour	5.77	4	5.85	6
8	High post-harvest losses	7.92	9	4.76	4
9	Inadequate extension services	8.68	12	8.68	10
10	Difficulty in accessing labour	5.77	4	5.85	6
11	Bad weather conditions	7.09	8	8.04	8
12	Difficulty in accessing farm land	6.78	7	8.50	9
13	High weed competition	4.74	2	2.43	1
14	Lack of access to cash credit	2.83	1	2.90	2
15	Inadequate access to tractor services	8.16	10	11.72	12

Source: Field Survey 2014

4.2.4. Test of Hypothesis Using the Chi- Square

H_0: $-5.991 \leq X \geq 5.991$

Table 4.4 Chi-square presentation

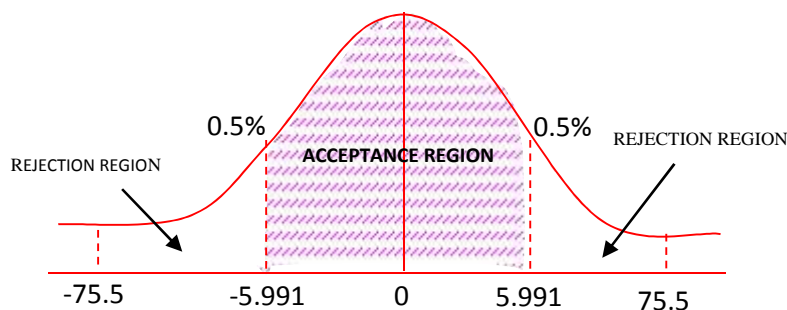| S/N Response	Respondents' stance		
	Agree	Disagr	Total
1 Reduced cost of	15	5	20
2 Reduces supply chain	12	8	20
3 Help maintain	16	4	20
4 Standards	43	17	60

Source: Field Survey 2014

Test statistic = $\sum(O - E)^2 / E$ where O= observed value, E= expected value $\sum$= sum Expected value = Row total x Column total/ Observed total

Table 4.2.4. Calculation for chi-square

S/N	0	E	O – E	(O – E)²	(O –E)²/E
1	15	20 x 15 / 60 = 5.0	10.00 100.00		20.00

2	12	20 x 12 / 60 = 4.0	8.00 64.00	16.00
3	16	20 x 16 / 60 = 5.5	10.50 110.20	20.00
4	5	20 x 5 / 60 = 1.6	4.40 19.30	12.00
5	8	20 x 8 / 60 = 2.6	5.40 29.10	2.00
6	4	20 x 4 / 60 = 1.3	2.70 7.20	5.50

| 7 | 15 | 20 x 15 / 60 = 5.0 10.00 100.00 | 20.00 |

$$\sum = 75.5$$
T- calculated

Degree of freedom = (Row – 1)(Column –1)
= (2 -1) (3 – 1)
= 1 x 2
= 2
(α, df) where α = significance level and df = degree of freedom
Therefore, (0.05, 2)
= 5.991 ⟶ T- critical

Figure 4.1. Normal distribution curve

Decision and Conclusion

At 5% level of significance the study reject the null hypothesis, since the p -value of 5.992 is greater than α-value of 0.05. The study therefore concludes that "risk management has helpedachieve supply chain flexibility of non-traditional export in Ghana"

4.DISCUSSION

This part discusses various supply chain risks that originate beyond the boundaries of pineapple supply chain. These risks cannot be controlled or avoided by supply chain actors; they can only adjust to these risks or put in place contingency plans. Based on the findings, major external pineapples supply chain risks are: delays in ship/plane, weather conditions, high fuel price, and global financial crisis.
It is our view that if the risks under discussion are properly managed or adequate contingency plans are put in place, supply chain flexibility will be greatly enhanced. Cooperation to a large extent is favourable in dealing with problems collectively. However, this is not always the case as different actors may be pursuing different individual and group interests.

The provision of transport infrastructure (roads, air ports and seaports) has remained the sole responsibility of government thereby exposing the supply chain to limited number of transport modes. This situation has resulted in a restriction on the number of modes available. Demand for storage facilities at the international phase of the transportation is necessary to maintain the quality demanded by the international consumer. Even though it takes several days (sea) and hours (air), to reach the international destinations, the presence of cooling systems on the modes makes it possible to prolong post-harvest shelf life for the products. Thus the presences of such cooling systems present a form of flexibility in the supply chain.
On the other hand, when there are delays or cancellation of ship/plane arrival it results in extra costs for the exporter to bring the product back to the local supply chain, this situation consequently reduces his contribution margin. The flexibility regarding this situation at the port has been enhanced through the port authority's initiatives to rent out storage

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facilities to Sea Pineapple Exporters of Ghana (SPEG) and other Exporters' Associations.

5.CONCLUSION

The conclusion of discussions of findings; there is evidence of the presence of reliability in this supply chain to some extent. These are especially prominent in connection with reliability elements such as reduction in product deterioration; shorten lead time, and customer satisfaction. However to achieve higher reliability other elements like maximizing profits and increasing delivery frequency need to be addressed. The means of dealing with these essentials will be advanced in our recommendations in the next study.

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Mathematics as a Tool for Enhancing Competitiveness and Employability of Vocational Training Institutions in Ghana

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Abstract
The study sought to investigate the effectiveness of restructuring the Mathematics content and curriculum into the Vocational Institutions to enhance competence-based skills and employability of the graduates in Ghana. The seemingly low level of Mathematical competence and skills of these graduates have hampered their chances of competing favourably with their counterparts from the senior high schools and the technical institutes in accessing higher education and securing good jobs. This study randomly sampled 400 students from four Vocational Training Institutes in the Upper East and Central Regions of Ghana, whose poor geographical locations and low economic viabilities render them highly disadvantaged. The findings showed that students were willing to study Mathematics and any restructuring of the Mathematics curriculum would be of immerse benefits to the country. Therefore, for research, technology and innovation to serve as the bedrock for sustainable development in Ghana, it was recommended that the Government of Ghana, through the Ministry of Education and the bodies responsible for the Vocational Education and Training Institutions should reconsider the mathematics-based courses to enhance favourable competitiveness and employability of those graduates.

Keywords: Mathematics; Employability; Job; Skills;Tools

1.0 Technical and Vocational Education and Training System in Ghana

The African Union(AU--2014) opines that the Technical and Vocational Education and Training(TVET) systems in Africa differ from country to country and are delivered at technical institutes, vocational centres, polytechnics, universities, enterprises, and apprenticeship training centres. In West Africa, traditional apprenticeship offers the largest opportunity for the acquisition of employable skills in the informal sector. In Ghana, the informal sector accounts for more than 90 percent of all skills training.

The UN Educational, Scientific and Cultural Organization (UNESCO- 2014) and National Vocational Training Institutes (NVTI--2009) observe that the TVET system in Ghana is even provided through several ministries; with the Ministries of Education and Employment and Labour Relations being the most prominent. Bortei-Doku Aryeetey, Doh and Andoh (2011)gives the statistics of both the public and private TVET institutions recorded by the Ministry of Education, as 27% Integrated Community Centres for Employable Skills, 21% Ghana Education Service (GES) Technical Institutes, 19% NVTI centres, 16% Community Development Centres, 10% Social Welfare Centres, 6% Leadership Training Institutes, 1% Opportunities Industrialization Centres and 1% Agricultural Training Institutes.

1.1 Goals of the Vocational Training Programmes in Ghana

Bortei-Doku Aryeetey, Doh and Andoh (2011) agree that the Government of Ghana established a legal framework for TVET and formed the Council for Technical and Vocational Education and Training (COTVET) in 2006 to co-coordinate, formulate national policies and oversee all aspects of TVET in the country. The COTVET has also formed three sub-committees for industry advisory, qualifications/quality assurance and traditional apprenticeship. While the different ministries are responsible for implementing the policies within their TVET institutions, the overall goals of the Council are to ensure that the unemployed particularly, the youth, Junior High School (JHS), Senior High School (SHS), secondary technical schools or technical institutes are given competitive, employable and entrepreneurial skills nationally and globally within the formal and informal sectors. The SHS and technical school graduates can opt progress to universities and polytechnics or apprenticeships including those who not get these schools. However, no such opportunities have been accorded to the vocational school graduates.

1.2 Programme Requirements of Vocational Training Institutions in Ghana

The Ministry of Education, Youth and Sports (MoEYS--2004); MOEYS (2007); and, Anarfi and Appiah (2012) opine that the JHS programme is the basic entry requirements which equip students to move into the diversified system of SHS comprising options in Vocational, Technical, Agricultural and General Education or simply two parallel streams of the SHS and TVET or an apprenticeship scheme. All the JHS students offer Mathematics alongside English Language, Social Studies and Integrated Science as core subjects. These core courses are continued to the SHS, technical institutes and beyond. It is however, regrettable that the vocational school students do not offer core Mathematics (Amedorme & Fiagbe, 2013).

1.3 Examinations and Certifications of Vocational Training Institutions in Ghana

Kitaev, Glover, Melomey, Coleman and Kaluba (2003), and NVTI (2010) observe that the vocational institutions hold three types examinations administered by the Ghana Education Service, NVTI and Social Welfare examinations. The NVTI operates under the Ministry of Employment and Labour Relations to provide demand-driven employable skills and enhance the income generating capacities of all students through competency-based Apprenticeship, Master craftsmanship, Testing, Certification and Career Development. The National Trade Test Committee is in charge of curriculum development and examination for the students of vocational schools. It provides the Grade 1 Certificate, the Grade 2 Certificate and the National Craftsman Certificate (NCC). Each candidate then receives a performance grade in Distinction, Credit, Pass, Referred or Fail. Even though students may perform creditably well, they cannot progress to any higher institution just because they did not write Mathematics.

1.4 Challenges and Prospects of Vocational Training Programmes in Ghana

According to Ghana News Agency (2008),Mr. George Aboagye Okyere, the Head of Monitoring and Supervision Department of NVTI,observes thatabout60% of the vocational institutions are operating below the required standards. Also, Kitaev, Glover, Melomey, Coleman and Kaluba (2003) and, Fu and Tu(2013) also bemoan the fragmented, uncoordinated and inconsistent TVET

legislation that has plagued the vocational institutions. TVET institutions may choose to register with the GES, the General Department of Registration, the Ghana National Association of Private Schools, the NVTI, the District Assemblies, the Ministry of Works and Housing, Ministry of Local Government or any other bodies. The majority of private TVET institutions has however, registered with the GES and uses the standard NVTI curriculum. Bortei-Doku Aryeetey, Doh and Andoh (2011), and The AU (2014) bemoan that TVET is perceived across Africa as a route for those who are not able to function within an academic setting.

In order to stem the tide, stakeholders need to inculcate TVET with modern science, mathematics and technology to wipe out negative perceptions, enhance sustainable development and provide linkages to higher education and the labour market.

Therefore, for research, technology and innovation to serve as the bedrock for sustainable development in Ghana, it was incumbent that the Government of Ghana, through the Ministry of Education and other stakeholders should consider restructuring the mathematics-based skills to enhance the competitiveness and employability of vocational graduates in this globally competitive labour environment.

2. RESEARCH METHODOLOGY

The study randomly selected 400 students from two regions of the country—2 public and 2 private. A structured questionnaire for the study, consisting mainly of a five-point rating scale, ranging from (a) to (e) was employed in the data collection. The decision on the sample size was taken based on economic viability of the two regions. The choice of regions was discussed thoroughly to represent the profiles of the poor prevailing conditions of these vocational institutions.

Principals or representatives of the four institutions were contacted and briefed on the contents of the questionnaire. The Principals in turn briefed the students on how to complete the questionnaire carefully. Copies of the questionnaire were then distributed to the students to answer and return them to the Principals' offices for delivery.

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The researchers implored the SPSS software for the data processing and reporting of the findings. The software was used in vetting and coding of the completed questionnaire. Charts and none parametric data analysis were the main tools of analyses. The charts were used to visualize gender and aim of studying Mathematics in these vocational institutions. The nonparametric Binomial tests, the Runs tests based on the central tendencies and the Chi-square Analysis of Variance (NOVA) based on gender as independent variable were implored.

3.0 RESULTS
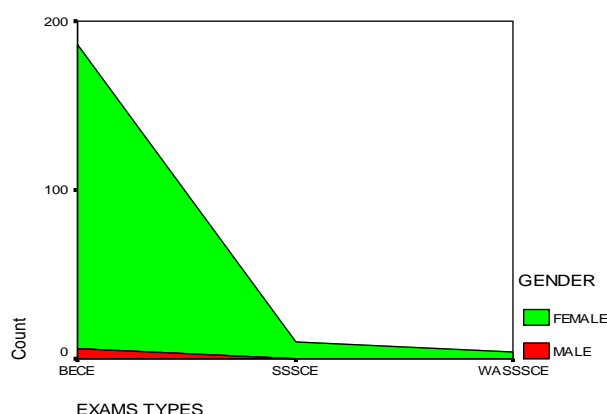
Figure 1: Examinations Students Ever Wrote Before Pursuing Programmes
Figure 1 shows the qualifications of the participants by gender in four vocational institutions. The results showed that females formed the majority of the vocational students across the three types of examinations conducted at the pre-tertiary levels.The data revealed that majority of the students at the vocational institutions completed JHS and hold

BECE certificates. As mathematics is compulsory subject at the JHS, it suggests that these students possess the required mathematical knowledge that will enable them pursue courses involving mathematics at higher level. There is no point in exempting them from pursuing and writing mathematics examinations to enhance their competitiveness just like their colleagues at senior high school.
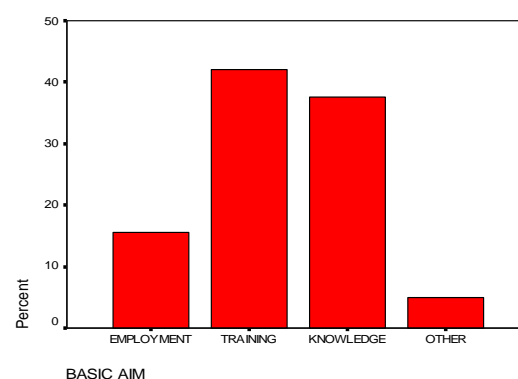
Figure 2: Aim of Pursuing Vocational Programmes

Figure 2 shows the basic aims of the students in pursuing the vocational programmes in the four vocational institutions. It was observed the majority of the vocational students came from those who attend their institutions for the purpose of acquiring professional training and academic knowledge. Employment came so closed to these two aims.This means the students also preconceived their vocational training to mean liberal general education. Since they have established this deep rooted aim for pursuing the vocational programme, it is incumbent upon policy makers to adequately satisfy them.

3.1 Binomial Tests on Binary Responses Based on Z Approximation
Table 1: Binomial Descriptive Statistics of the Binary Responses

Responses	Number	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
Gender	308	1.70	0.46	1	2	1.00	2.00	2.00
Work History	308	1.84	0.37	1	2	2.00	2.00	2.00
Maths Exams	308	1.00	0.00	1	1	1.00	1.00	1.00
Study Maths	308	1.15	0.35	1	2	1.00	1.00	1.00
Willing to Train	308	1.07	0.26	1	2	1.00	1.00	1.00

Table 1 displays four items that contained two options in their rating scales. It was observed the majority of the vocational students were unanimous in their responses to in terms of gender, work history, examinations, previous learning of mathematics and willing to learn mathematics. Categorically, the students were more than willing to study and write mathematics in the vocational institutions. There is therefore, no point in denying these students the opportunity to study and write mathematics examinations.

Table 2: Binomial Test of Significance of the Four Binary Responses

Responses		Category	Number	Observed Prop.	Test Prop.	Asymp. Sig. (2-tailed)
Gender	Group 1	Female	216	0.70	0.50	0.000
	Group 2	Male	92	0.300		
	Total		308	1.00		
Work History	Group 1	Yes	50	0.16	0.50	0.000
	Group 2	No	258	0.84		
	Total		308	1.00		
Maths Exams	Group 1	Yes	308	1.00	0.50	0.000
	Total		308	1.00		
Study Maths	Group 1	Yes	263	0.85	0.50	0.000
	Group 2	No	45	0.15		
	Total		308	1.00		
Willing to Train	Group 1	Yes	285	0.93	0.50	0.000
	Group 2	No	23	0.07		
	Total		**308**	**1.00**		

Table 2 shows the Binomial test of significance of the four binary responses. With the test proportion of 0.50, the test was significant at 5%. These tests indicate that the gender, work history, mathematics examinations, mathematics studied and willingness were very important in determining the progress of the students.

Table 7: Chi-Square Descriptive Statistics of the Four Non-Binary Responses

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles 25th	50th (Median)	75th
Level Completed	308	2.01	0.33	1	3	2.00	2.00	2.00
Basic Aim	308	2.25	0.89	1	4	2.00	2.00	3.00
Nonbasic Aim	308	2.64	1.08	1	4	2.00	3.00	4.00
Area of Maths	308	2.70	1.40	1	5	1.00	3.00	4.00

Table 7 showed the chi-square describes of four aspects considered in the study. The results revealed consistency with Table 3 results. It was observed over 75% of the students completed JHS. Their basic aim was to get basic training and knowledge necessary for pursuing higher levels od education. About 25%, 50% and 75% liked Algebra, Trigonometry and Statistics respectively.

The table 7a to 7d above subdivides the chi-square analysis of the four items. We have observed that 7a have 0 cells (.0%) expected frequencies less than 5 with the minimum expected cell frequency being 102.7; 7b and 7c have 0 cells (.0%) expected frequencies less than 5 with the minimum expected cell frequency being 77.0. and 7d have 0 cells (.0%) expected frequencies less than 5 with the minimum expected cell frequency is 61.6.

Table 8: Chi-square Test Statistics

	Level Completed	Basic Aim	Non Basic Aim	Area of Maths
Chi-Square	428.909	67.481	8.649	143.721
Degree of freedom	2	3	3	4
Asymp. Sig.	0.000	0.000	0.034	0.000

The Table 8 above shows the Chi-square tests of significance. The tests were unanimously significant with regards to the level completed before pursuing the vocational programme, basic aim for the training, non-basic aim and areas of Mathematics students liked. These four factors were very important in explaining the circumstances surrounding the students' education and training in the vocational institutions.

4.0 DISCUSSIONS

The study revealed that majority of vocational students completed Junior High Schools in Ghana and obtained BECE. Interestingly, in Ghana BECE is the same requirement for entry into senior high schools, technical secondary school and technical institutes. It is therefore uncertain why vocational students are not offering mathematics or writing the same examinations with their counterparts from the Senior High Schools. This constraints graduates from these vocational institutions from advancing in their education into the universities and polytechnics (Boateng, 2012).

The findings also showed that the top most priorities of the students were to get education and training. This major purpose is not different from their counterparts who opt for general education. They appear to perceive vocational education in similar vein as general liberal education. Once this comparison has been made, coupled with their unceasing interest, restructuring mathematics might not be a misplaced priority.

Though majority of the students unanimously indicated that they had no work experience, they were willing to study mathematics at the tertiary levels.To ensure uniform and sustainable development, it would be prudent to give this category of students the privilege to progress to these tertiary levels.

5.0   CONCLUSION   AND RECOMMENDATIONS

In conclusion, the findings revealed that every vocational student would benefit a lot from any restructuring of the Mathematics content in those vocational institutions to reflect the exigency of the times. We therefore recommend that for research, technology and innovation to serve as the bedrock for sustainable development in Ghana, the Government of Ghana and other stakeholders should consider restructure Mathematics to enhance the competitiveness and employability of those graduates.

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Table 7a: Level Completed

	Observed Number	Expected Number	Residual

PRIMARY	16	102.7	-86.7
JHS	274	102.7	171.3
SHS	18	102.7	-84.7
Total	**308**		

Table 7b: Basic Aim

	Observed Number	Expected Number	Residual
Employment	72	77.0	-5.0
Training	108	77.0	31.0
Knowledge	108	77.0	31.0
Other	20	77.0	-57.0
Total	**308**		

Table 7c: Nonbasic Aim

	Observed Number	Expected Number	Residual
Failure	62	77.0	-15.0
Non Selection	69	77.0	-8.0
No Money	96	77.0	19.0
Other	81	77.0	4.0
Total	**308**		

Table 7d: Area of Maths

	Observed Number	Expected Number	Residual
Algebra	104	61.6	42.4
Geometry	33	61.6	-28.6
Trigonometry	36	61.6	-25.6
Statistics	120	61.6	58.4
Other	15	61.6	-46.6
Total	**308**		

Effect of Inter-row Spacingon *Jenguma* Soyabean Yield Components and Yield

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Abstract
The study focused on effect of the different inter-row spacing on the yield components and yield of Jengumasoyabean. The experiment was carried out on a 0.2 ha plot at Nyankpala in Northern Region of Ghana. A Randomised Complete Block Design (RCBD) was used in the study in which four inter-row spacing (45 cm, 60 cm, 65 cm and 75 cm) were used. Plant population at establishment, population at harvest, plant population loss, weed biomass, number of pods per plant, number of seeds per pod, one thousand seed weight and grain yield were evaluated.The results from ANOVA showed that the narrow spacing had the highest plant population with low weed intensity. Grain yield correlated positively and significantly with plant population at establishment and plant population at harvest. The 45 cm inter-row spacing gave the highest grain yield. This study indicates that farmers can reduce the inter-row spacing required to produce Jengumasoyabean, without negatively impacting yield, at least in the study area.

Keywords: Jenguma soyabean; Weight; Spacing; Biomass; Yield.

1. INTRODUCTION

Soyabean (Glycine max (L.) Merrill) is an important global legume crop that grows in the tropical, subtropical and temperate climates. Soyabean belongs to the large botanical family, Leguminosae, in the subfamily Papilionideae. Soyabean is not as well-known to farmers in Ghana compared with cowpea. Further, it has received little attention from farmers. Although few people in Ghana have acquired the taste of soyabean as a basic component of their diet, relatively large quantities are imported yearly to support the poultry and pig industry as high protein supplement in mixed rations. Soyabean is an important oil crop with high protein content. The seed has high protein content of about 40 % compared with 18 % for fish and beef (Abbey et al., 2001).

Ghana's current production of is about 15,000 metric tons of soyabean grain annually (MoFA and CSIR, 2005), but total domestic demand for cooking oil, seasoning and animal feed cake is estimated at nearly 30,000 metric tons per year (African Development Foundation-ADF, 2004). Despite the numerous benefits of the soyabean, the grain yield per unit area is low in Ghana, an average of 1.3 tons per hectare (Tweneboah, 2000). That of Africa is an average of 1.1 tons per hectare (International Institute of Tropical Agriculture-IITA, 2009). However, Italy,

Argentina, USA and Brazil produce 3.32, 2.31, 2.30 and 2.00 tons per hectare on the average respectively (Norman et al., 1995). Reasons attributing to the low yields of soyabean in Ghana include low plant population per hectare for various cultivars of the crop, pod shattering, poor germination due to rapid loss of seed viability, poor nodulation and drought stress among others (Addo-Quaye et al., 1993). The low plant population is due to inadequate information on specific inter-row spacing to get optimum plant population for the various soyabean varieties cultivated locally.

Available research data on soyabean planting systems give a broad range of 60-75cm inter-row spacing and 5-10cm intra-row spacing, giving an average of 19,750 plants ha-1 (MoFA and CSIR, 2005). This spacing is irrespective of factors such as the maturity group, growth habit, soil condition and vegetation zone. This makes choice of optimal population densities among early and medium maturity soyabean varieties difficult for farmers. Generally, legume seed yield is a function of plants per unit area, pods per plant, number of seeds per pod and weight per seed. Late harvesting of soyabeans leads to low or fluctuating yields by shattering of the pods. Through research and extension committee linkage farmers have requested solutions be explored. Therefore, in

November 2003 SARI developed the Jengumasoyabean which has a maturity period of 110 days, 40 % protein and 20 % oil. The Jengumasoyabean variety is high yielding (2.5-3 bags per hectare), field resistance to pod shattering and a killer to the striga weed that hinders crops yields. The aim of this paper was to determine the effect of inter-row spacing on Jengumasoyabean yield components and yield under field conditions.

1.2.5 Thousand seed weight (g)

The weight of the seeds from the 50 plants previously taken to determine the yield parameters were added to obtain the total seed weight per plot and converted to hectares.

1.2.6 Grain weight (kg/ha)

The whole plant was harvested, pods were threshed and the seeds weighed. The weight of the seeds from the 50 plants previously taken to determine the yield parameters were added to obtain the total seed weight per plot and converted to hectares.

3 Data analysis

The data collected was subjected to analysis of variance (ANOVA) using STATISTIX software. The significant treatment means were compared using the Tukey HSD method of mean comparison. Where the treatments were not significant, the standard errors were computed.

4 RESULTS

4.1 Weed intensity at 2 WAP

The weed intensity at 2 WAP was not significantly different among all the treatments. However, there were only numerical variations in the means showing an increasing trend from inter-row spacing of 45 – 75 cm (Table 1).

Table 1: Weed intensity at 2WAP for different plant spacing

Spacing(cm)	WI (gWD/m²)
45	27.80
60	29.63
65	36.13
75	42.18

1.4.2   Plant population and losses

Statistically, there was no significant difference (p>0.05) in plant stand both at establishment and at harvest (Table 2). The population loss did not also show any significant difference (p>0.05). However, inter-row spacing at 45 cm gave more plants in all the three parameters measured. The lowest figures were observed at inter-row spacing at 75 cm for plant population at establishment, harvest and population loss.

2.   METHODOLOGY

The experiment was carried out at Nyankpala, about 16 km West of Tamale. Nyankpala lies in the Guinea Savannah agro-ecological zone of Ghana. The area has an average annual rainfall of 1022 mm. The soil is moderately drained loam and free from concretions. Common weeds found in the area include Digitariagayana, Commelinabenghalensis, Commelinadiffusa, Cyperusrotundus, Elusineindica, and Brachiariaalata.

2.2.1   Experimental design

A Randomised Complete Block Design (RCBD) was used. The Jengumasoyabean variety released by the Savannah Agricultural Research Institute (SARI) of the Council for Scientific and Industrial Research (CSIR) in 2003 was used for the experiment. The crop was planted (from May-July 2013) on the field at four different inter-row spacing in three replications. Inter-row spacing used included 45 cm, 60 cm, 65 cm and 75 cm. An attempt was made to drill the seed at 5 cm within rows but with little success.

2.2.2   Weed control

Weeding was done at 3 weeks after planting (WAP) by hoeing and hand picking. During the experiment, no fertilizer or pesticide was applied to the crops.

2.2.3   Data collection

The data collected include date of planting, date of emergence, date of flowering and date of maturity. Other parameters included weed intensity 2WAP plant population at establishment (2 WAP), plant population at harvest, yield parameters.

2.2.4   Pods per plant and seeds per plant

Fifty (50) plants were picked from each plot, the pods weredetached from the stalk, counted and divided by fifty (50) to get the average pods per plant. Seeds from all the pods were counted and divided by the number of pods to get the average seeds per plant.

Table 2: Plant population at establishment, harvest and losses

Spacing (cm)	Population at establishment	Population at harvest	Population Loss
45	199061	199000	60.7
60	158716	158667	49.6
65	132048	132000	48.0
75	108727	108667	60.7
GrandMean	149888	149583	54.8
Sed	29100	29428	42.9

4.3 Grain yield parameters

The results showed that there was no significant difference ($p > 0.05$) in the number of pods per plant among the treatments. However, inter-row spacing of 65 cm and 75 cm gave the highest number of pods per plant and the lowest number of pods per plant was recorded at a spacing of 65 cm (Table 3). There was no significant difference in the number of seeds per pod. However, inter-row spacing treatments of 75 cm had the highest number of seeds per pod.

The results obtained from the experiment showed that there was no significant difference ($p > 0.05$) in the thousand seed weight at all the inter-row spacing (Table 3). The lowest seed weight recorded at inter-row spacing of 45 cm and the highest at 75 cm. The highest grain yield was obtained at inter-row spacing of 45 cm and the lowest at 60 cm. However, there was no significant difference ($p > 0.05$) in the yield among all the inter-row spacing.

Table 3: Plant population at establishment, harvest and losses

Spacing (cm)	Mean Pods/plant	Mean Seeds/plant	1000 Seed Weight (g)	Grain yield (kgha⁻¹)
45	36.1	1.7	120.6	1575
60	30.7	1.6	123.6	1125
65	39.7	1.7	123.6	1136
75	39.3	1.9	159.5	1308
GrandMean	36.4	1.7	131.8	1286
Sed	8.00	0.2	25.5	219.9

4.4 Correlation analysis

The results obtained from the study showed that there was no significant correlation ($p > 0.05$) between the grain yield (GYLD) on one hand and the number of pods per plant (NPPP), number of seeds per pod (NSPP) and thousand weight (TSWT) as shown in Table 5. However, there was significant difference ($p > 0.05$) between the grain

yield and plant population at establishment (PPEST) and plant population at harvest (PPHVT). Grain yield did not also show a significant correlation ($p > 0.05$) with weed intensity at 2 WAP. The correlation between the grain yield and weed intensity at 2 WAP was

negative. Thousand seed weight and number of pods per plant also gave negative correlation.

Table 4: Pearson correlation of grain yield and other parameters

	GRYLD	NPDSPP	NSDSPP	PLOSS	PPEST
NPDDSPP	-0.3146				
p-value	0.3192				
NSDSPP	0.3959	-0.5353			
	0.2027	0.0729			
PLOSS	0.3341	-0.2176	0.5797		
	0.2885	0.4968	0.0482		
PPEST	0.7585	-0.4516	-0.0197	0.0895	
	0.0042	0.1405	0.9517	0.7820	
PPHVT	0.7556	-O.4452	-0.0950	-0.0950	0.9999
	0.0045	0.1469	0.9356	0.7691	0.0000
TSDWT	-0.1618	-0.0437	0.4278	0.1246	-0.4685
	0.6154	0.8927	0.61654	0.6996	0.1245

5 DISCUSSIONS

5.1 Spacing and weed control

All the treatments showed no significant difference (p>0.05) in terms of weed biomass. The results indicated that at 2 weeks after planting, inter-row spacing treatment of 45 cm showed the lowest weed intensity by recording the least weed biomass. This was followed closely by inter-row treatment of 60 cm (Table 1). This shows that closer spacing in soyabean production have low weed problems, as there is serious competition of plants against weeds for growth factors. Kwarteng and Towler (1994) reported that closer spacing provides adequate competition against weed once the crop has established. Weed intensity was highest at inter-row spacing treatment of 75 cm. This may be attributed to less competition of plant against weeds for growth factors, and also the plant canopy did not completely cover weeds during the vegetative growth phase to suppress weed growth in treatment 75 cm.

1.5.2 Spacing and yield parameters

The results showed that there were more pods per plant at inter-row spacing treatment of 75 cm and 65 cm than 45 cm and 60 cm. Treatments with wider spacing had plants that branched and flowered well and eventually gave more pods per plants although statistically, there was no significant difference (p>0.05) among the treatments (Table 3). Despite the higher number of pods per plants observed on plants grown at wider row-widths, the number of seeds per pod did not significantly different in all the treatments (Table 3).

The results showed that seeds in wider spacing generally weighed higher than those planted closely, and there was no significant difference (p>0.05) among all the treatments. The higher number of pods per plant, seeds per pod and thousand seed weight observed in the crop grown at a spacing of 75 cm did translate into superior grain yield over the crop grown at a spacing of 45 cm (Table 3). Although there was no significant difference (p>0.05) in the grain yield among all the inter-row spacing, at wider spacing grain yield was lower than at 45 cm spacing.

The high grain yield observed in the 75 cm may be due to the prolific branching and flowering during the vegetative and reproductive growth phases that led to more pods per plant and therefore influencing yield. The comparatively higher yield at 45 cm than at 75 cm was principally because the former had more plants ha^{-1} that the latter. This is justified by strong correlation (r = 076, p = 0.004) between the plant population at harvest and grain yield (Table 4). There was lower weed competition against

plants at 45 cm inter-row spacing than 75 cm spacing (Table 1). These findings are similar to a study by Crabtee and Rupp, 1980) who reported that a minimum population of 250,000 plants ha-1 is necessary in a less weedy environment if higher yield is to be obtained.

6 CONCLUSION

Comparatively, there were more plants at 45 cm spacing which decreased as the spacing increased. There was also weak correlation between the number of pods per plant, seeds per pod and thousand seed weight on one hand and grain yield on the other. Additionally, there was strong correlation (r = 0.76, p = 0.004) between plant population at harvest and grain yield, making plant population a strong determinant of grain yield of Jengumasoyabean. Therefore, inter-row spacing of 45 cm can be recommended for jengumasoyabean farmers for high productivity in the Nyankpala area.

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The Impact of Microfinance on Women Empowerment in Ghana
(A Case of Sinapi Aba Trust, Sunyani)

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Abstract
The empowerment of women is also the basis for transforming lives at the household level and in the wider society. In this regard, the delivery of microfinance is one of the approaches to the empowerment of women. The study sought to identify and review the role of microfinance in the empowerment of women economically, socially and politically. It recognizes the multidimensional nature of empowerment as a process involving personal, social, economic and political dimensions. The research was conducted at the Sinapi Aba Trust (SAT), Sunyani. The researchers used both qualitative and quantitative methods to obtain a reliable data. Data were derived from a questionnaire survey of a number of fifty (50) sampled women clients of the SAT. Convenient sampling method was used. The study established that improved access to microfinance has been able to empower women economically. Although the results vary, the study indicated that the income and saving levels of the majority of the clients have increased after the delivery of microfinance. Encouraging results have also been shown in the enhancement of the women's of self-confidence with respect to the capability to work on their own and improve their lives. On the other hand, there is no indication of an enhancement in the decision making power of women and in their political empowerment as reflected in respect for their legal rights, ownership of household assets and holding of political positions.

Keywords: Microfinance; Women; empowerment; SAT.

1. INTRODUCTION
In September 2000, 189 heads of states and governments gathered at the United Nations in New York at the Millennium Summit and adopted what become known as the Millennium Development Goals (MDGs) and Targets. The MDG three (3) seeks to promote gender equality and empower women. (UN Summit 2000). Economic empowerment is one means for reducing poverty and inequality, and to promote economic growth. Therefore, it is a key for achieving gender equality.

Notwithstanding women's limited participation in wage employment and the formal sector, they are largely represented in the Micro and small enterprises and informal sector and play an important role in the economies of Africa (Economic Commission for Africa, 2012). In Ghana one of the means of empowering women is through the activities of Micro Finance.
Microfinance is the provision of financial services to low income poor and very poor self-employed people (Otero, 1999). Microfinance contributes to women's empowerment, especially in economic terms, by offering women the opportunity to use their skills and talents to earn a living. Microfinance for women also correlates with better health and nutrition for themselves and their households. However, women sometimes face constraints, like the double burden of running a business while bearing responsibility for the majority of caring tasks. It can also happen that husbands use their wives' microfinance money that women are not free to spend the money they earn, or that women are not involved in decision-making at various levels (Majoor&Manders, 2009).
Several microfinance support programs have observed improvements in women's status in their communities. Contributing financial resources to the family or community confers greater legitimacy and value to women's views and gives them more entitlements than they would otherwise have. Studies of microfinance clients from various institutions around the world show that the women themselves very often perceive that they receive more respect from their families and their communities—particularly from the male members—than they did before joining a microfinance program. Where women have the freedom to move about

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publicly, their success in business is often highly visible in the community. Their success can pave the way for them to become respected and valued members of society (Cheston& Kuhn, 2002).

Widespread political empowerment is a fairly rare outcome of most microfinance programs. Although microfinance programs offer services and products that can enhance individual women's abilities to participate effectively in politics, few microfinance organizations explicitly seek political mobilization or structure their programs in such a way as to deliberately nurture collective action. Nevertheless, many examples testify that women's participation in lending centers and groups increases their knowledge of political parties, processes, and channels of influence. Women clients of Opportunity Microfinance Bank have gained leadership experience and confidence as leaders of their Trust Banks and have gone on to be elected as leaders (Shresta& Milan, 1998).

Empowerment is also defined as a process through which women are able to transform their self perceptions-equivalent to alchemy of visibly transforming gender roles. Empowerment generally involves change at three broad levels: within the household,within the community, and at a broader institutional or policy-making level (Zafar, 2002).

Most micro finance organizations target poor women and usually those from socially excluded groups. The reason for the targeting of women under microfinance schemes is the relationship between gender and development. Various researches conducted by institutions such as UNDP (1995) and the World Bank (2001) indicate that gender inequalities inhibit growth and development. Hence, acknowledging the prevalent gender inequalities and the impact on development, microfinance provides women with access to working capital and training to mobilize women's productive capacity to alleviate poverty and pave the way for development.

Women are basically the poorest of the poor. According to UNDP (2003) Human Development Reports, women make up the majority of lower paid and unemployed portion of most economies. It is believed that the welfare of a family is enhanced, when women are helped to increase their incomes. This is due to the fact that women spend most of their incomes on their households. Hence, assisting women generates a multiplier effect enlarging the impact of the family needs and, therefore, another justification for giving priority to them.

Women's empowerment should also reflect on their sexual and reproductive rights and health. An empowerment approach to women's health emphasizes women's individual sense of self worth connecting to the values they attach to their own health (linked to "power within") women's individual decision making over access to health care and women's collective empowerment through organizing to make health services more accountable and to increase women's choice decision making and control over their bodies (Cheston& Kuhn, 2002).

The World Bank has identified empowerment as one of the key constituent elements of poverty reduction, and as a primary development goal (Malhotra, Anju, Schuler &Boender, 2000). The promotion of women's empowerment as a development goal is based on the dual argument that social justice is an important aspect of human welfare and is intrinsically worth pursuing. A similar dual rationale for supporting women's empowerment has been articulated in the policy statements put forth at several high level international conferences in the past decade e.g. (Beijing Platform for Action, 1995; Beijing +5 Declaration, 2000; and CEDAW, 1979). However, no major development agency has developed a rigorous method for measuring and tracking changes in levels of empowerment. It is, therefore, difficult for the international development community to be confident that their efforts to empower women are succeeding (Malhotra et.al, 2000).

Empowerment of women and gender equality are prerequisite for achieving political, social, economic, cultural and environmental security among people (Beijing, 1995). Both the Convention on the Elimination of Discrimination Against Women (CEDAW) and the Beijing Platform for Action (BPFA, 1995) address women's access to financial resources. For example, BPFA includes thirty five references to enabling poor women to gain access to credit. As stated by Narayan (2002), in most poor countries, men's domination of women is strongest within the household. Widespread political empowerment is a fairly rare outcome of most

microfinance programs. Although microfinance programs offer services and products that can enhance individual women's abilities to participate effectively in politics, few microfinance organizations explicitly seek political mobilization or structure their programs in such a way as to deliberately nurture collective action. Nevertheless, many examples testify that women's participation in lending centers and groups increases their knowledge of political parties, processes, and channels of influence. Women clients of Opportunity Microfinance Bank have gained leadership experience and confidence as leaders of their Trust Banks and have gone on to be elected as leaders (Shresta& Milan, 1998).

Women's access to credit is generally believed to result in their economic empowerment.
As a result, the provision of microfinance to women has been called for by various international and national organizations in light of their productive role for economic development and women's rights. However, many still question the empowering capacity of credit in relation to the economic social and political conditions of women (Mayoux, 2002).
In addition to economic impacts, social changes also result from the work of microfinance organizations (Kabeer, 2005). The delivery of microfinance is expected to result in social changes because women working in groups can achieve what might not be achievable individually. Micro finance organization strategies provide the poor the possibility of belonging to a group they choose despite the socially or economically imposed relationships (Kabeer, 2005). This allows for meeting with others of similar experience and share knowledge. Such practices in effect are believed to empower them both individually and collectively.

Microfinance is viewed as an effective tool for overcoming the political exclusion of women (Cheston& Kuhn, 2002). The global average of women's representation in national parliaments remains low at 17 per cent as of 31 January 2007 (UN, 2007). Women in government, parliament, the judiciary and other institutions serve as role models and thus as pull factors for other women who have been involved in politics or public service.

Access to credit and participation in income-generating activities is assumed to strengthen women's bargaining position within the household thereby allowing them to influence a greater number of strategic decisions. Prior to formal banking systems in Ghana, many of the poor, mainly women, and those in rural communities relied heavily on informal banking services and the semi-formal savings and loans schemes(Egyir, 2010). Cooperatives, especially among cocoa farmers of the 1920s, engaged in thrift and credit. The mission of the informal microcredit organizations or microfinance services in Ghana was to provide social and economic support for the less advantaged, especially rural women and their families (Egyir, 2010). The main objective of the study was to assess theimpact of microfinance on women empowerment in Ghana; specifically, the study sought:to verify why women are the focal point for microfinance;to identify the role of microfinance in empowering women, economically, socially and politically; to assess the challenges of women clients in the microfinance institutions in the Sunyani Municipality; to assess the effects of microfinance in business expansion; to examine the role of microfinance in the saving behavior of SAT's clients.

2. METHODOLOGY
2.1   Study area
The study was conducted in the Sunyani Municipality, located in the heart of BrongAhafo, Ghana between latitude 70, 55' N and 70, 35' N and longitude 20, 30'W. Sunyani municipality has a human population of about 141880 of which 70771 are females and 71109 are males as stated by the Ghana statistical Service as at 2009. It has about 37978 households and 4.7 average household size.

Population and Sampling procedure
The sample size is 50 clients from the total 400 who all live in Sunyani Municipality, which includes farmers, food vendors, artisans/ small scale manufacturers, service providers (carpentry, masons and dress making) and petty traders. Sinapi Aba Trust was purposively selected. The Convenient method was also used to sample the views of respondent who were ready and prepared to answer the questionnaire.

2.2   Research Design

2.2.1   Data Source

Questionnaires were the tools mainly used to collect the data. The data was also collected from groups like the farmers, traders (small-scale traders and market venders) and beauty-related enterprises (Hair dressing salons). Data collected from the study include types of challenges of microfinance, microfinance savings habits, and impact of microfinance in household decisions. The study asked questions on why women are the focal point in microfinance programmes.

The Open-ended questionnaires and the close-ended questionnaires were the two main types of questionnaires. Secondary data for the research were collected from internet, newsletters, books, brochures, articles, reports ofSinapi Aba Trust (SAT) and Microfinance Institutions (MFIs) which were important to the study.

2.3   Research Method and Tools

In order to obtain the best results, the researchers used quantitative as well as qualitative methods. While more emphasis was given to the qualitative method, quantitative analysis was used as a supplement to the former approach. Relevant research literatures such as books, brochures, articles, reports, etc. on the issues and roles of microfinance and women empowerment were reviewed and presented in this study.

With the objective of obtaining accurate quantitative information, a questionnaire was developed for a total of 50 respondents. The questionnaire was translated from English into local language since most of the respondents are not literate. In addition, only 30 of the respondents were able to complete the questionnaire by themselves owing to the illiteracy of most clients. With the majority of the respondents being either illiterate or barely able to read and write, three assistants were assigned to read and explain the questions to the respondents and fill out the questionnaire on their behalf according to the replies given. Qualitative methods are usually employed for deeply rooted studies that attempt to interpret social reality (Roger &Nall, 2003). Gender issues being one aspect of social reality, qualitative analysis is believed to provide an appropriate understanding of the subject. Feminists have used qualitative research methods in order to make women's diverse voices and experiences heard (Jane & Lewis, 2003). In accordance with the above, this research mainly focused on

qualitative method with the view of assessing the areas and extent of empowerment resulting from the intervention of microfinance and also identifying the challenges and problems faced by the clients in the undertaking. The interviews were held with respondents that were proposed by staff of SinapiAba Trust (SAT) in Sunyani Municipality. The researchers chose two potential informants from each place owing to time and resource constraints. The privacy and confidentiality of the respondents was kept both during the interview and in the compiled reports. This is because sensitive issues such as domestic violence and various aspects of the SAT perceived by the clients as negative were raised during the interview.

Descriptive statistics ie percentages and tables were used to analyze the data via Statistical Package for Social Science (SPSS)-17.0.

3. RESULTS

Ninety percent (90%) of the respondents said there has been positive change or improvement in their business structure since they took loan from SAT. Microfinance delivery in various points has resulted in an improved economic position of households, enhancing the asset base and diversification in to higher return occupations among members. Improvement in the business structure and size has led to engagement of more hands, resulting in increase in size of employees after joining SAT.

Eighty eight percent (88%) of the respondents said they often participate in household decision. While there is evidence that microfinance can have an impact on women's role in household decision-making, it has not occurred evenly in all contexts or in all areas of decision-making.

The survey proved that 78% of the respondents responded that there have been improvements in their self confidence and also increases in their overall life qualities.

Sixty eight percent (68%) of the respondents also held they had personally been responsible for taking decision for the utilization of funds/loan thereby transforming their lives.

4. DISCUSSION

4.1   Demographic   Characteristics   of Respondents

The characteristics of the respondents considered in the study questionnaires were administered to

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a total of 50 individuals. The majority of the participants were above the age of 35 and were predominately Christians. The respondents, whose educational level ranged from illiterate to secondary level, mostly learned about the existence and function of the microfinance institution from friends and relatives. The respondents have been members of the microfinance institution from one to more than four years. Furthermore, it was observed that the participants differ in their marital status, i.e., consist of single, married, widowed and divorced women. Detailed presentation of demographic characteristics is indicated at the Appendix section.

4.2   Types of business operated by SAT clients

From Table 1, sixty two percent (62%) representing (31) of the respondents were engaged in trade (buying & selling), followed by food selling- 24% (12) of the respondents. 10% (5) of the respondents were also involved service provision business, such as carpentry, hair dressing, and head-potters.   2% (1) of the respondents were involved agricultural activities (crops & animal farming) and the rest; representing 2% (1) of the respondents were also engaged manufacturing business (batik, tie & dye, & soap making business). This indicates that agricultural lack support and this is perhaps due to the perception that agriculture is a risky and less lucrative business.

4.3   Changes/improvement in Working Capital since joining the SAT programme

From Table 1, eighty two percent (82%) representing (41) of the respondents said there have been much improvement in their capital since they joined SAT, whiles the rest, representing 18% (9) answered that there were no improvement (their capital have either remained the same or decreased).

Microfinance provides women with increase in access to working capital and training to mobilize women's productive capacity to alleviate poverty and pave the way for development. It is believed that increasing women's access to microfinance services will lead to individual economic empowerment through enabling women's decisions about savings and credit use to set up microenterprise, increasing incomes under their control as well as changes and increase inprofit margins.

4.4   The Utilization of Profit

From Table 1, twenty eight percent (28%) representing (14) of the respondents used the profits to cater for their ward's education, 18% (9) of the respondents also used the profits for household needs such as food, 14% (7) of the respondents used theirs for their health care needs. The rest, representing 40% (20) of the respondents reinvested their profits for the improvement and expansion of the business ventures. It appears that for the majority of borrowers income increases are small and even in some cases negative. This is due to the fact that most women invest in existing activities which are low profit and insecure. In addition, women's choices and ability to increase income is constrained by gender inequalities in access to other resources for investment in household responsibility and lack of mobility (Mayoux, 2002). Child education has also improved with the provision of microfinance. In this regard, the delivery of microfinance to women results in greater return as compared to men (Kaber, 2005).

4.5   Changes In Business Structure Since Accessing A Loan From SAT

From Table 1, ninety (90%) representing (45) of the respondents said "Yes" there have been positive change or improvement in their business structure since they took loan from SAT, the rest, representing 10% (5) of the respondents, responded "No"that there have not been any improvement. Microfinance delivery in various points has resulted in an improved economic position of households, enhancing the asset base and diversification in to higher return occupations among members. Improvement in the business structure and size has led to engagement of more hands, resulting in increase in size of employees after joining SAT.

4.6   Major challenges of businesses

From Table 1, fifty two percent (52%) representing (26) of the respondents' stated inadequate capital as the major challenge facing business, followed by competition representing 30% (15) of the respondents. The rest, representing 18% (9) of the respondents also stated low sales as the challenge facing today's business.

4.7   Experience with savings before joining SAT

From Table 1, twenty four (24%) representing (12) of the respondents said "Yes" they were

already saving before joining SAT. The rest, representing 76% (38) of the respondents answered "No" they were not saving before joining SAT. This is a clear indication that SAT has been able to change the savings attitude/habits of its clients through its microfinance programme.

4.8   The person responsible for decisions on use of funds/ loans

From Table 1, sixty eight percent (68%) representing (34) of the respondents said they have personally been responsible for taking decision on the utilization of funds/loan, followed by 28% (14) who also said their spouse are responsible for that. The rest, representing 4% (2) said their children are responsible for taking decision on funds/ loans utilization in the household. However, women sometimes face constraints, like the double burden of running a business while bearing responsibility for the majority of caring tasks. It can also happen that husbands use their wives' microfinance money, i.e women are not free to spend the money they earn, or that women are not involved in decision-making at various levels (Majoor&Manders, 2009).

4.9 Sat And Education

From Table 1, ninety four percent (94%) representing (47) of the respondents said "Yes" there have been improvement in their children's education since joining SAT, whiles the rest 6% (3) said "No" there have been no improvements. Education plays a vital role in the social empowerment of women (Indian National Policy, 2001). The empowerment requires the provision of equal access to education for girls and women. It also requires taking special measures to eliminate discrimination, universalize education, eradicate illiteracy, create a gender-sensitive education system, increase enrollment and retention rates of girls and improve the quality of education to facilitate lifelong learning as well as development of occupational/vocational/ technical skills by women.

4.10   Self Confidence Level, Relationship with God and Overall Life Qualities since Joining SAT

Forty two percent (42%) representing (21) of the respondents, responded that there have been improvements in their self confidence. 22% (11) of the respondents said it has strengthened their relationship with God. The rest, representing 36% (18) also said it has increased their overall life qualities.

Women clients of Opportunity Microfinance Bank have gained leadership experience and confidence as leaders of their Trust Banks and have gone on to be elected as leaders (Shresta& Milan, 1998). This has resulted in common understanding to achieve collective goals where as power within refers to self confidence, self awareness and assertiveness.

4.11   SAT loan and socio-economic status

Fifty six percent (56%) representing (28) of the respondents said the loan has contributed to their household finances, 32% (16) of the respondents said it has contributed in sustaining their marriages. The rest, representing 12% (6) also said it has contributed in expanding their business opportunities. Most women have done at least some small trading or had a service business to help make up for shortfalls in their husbands' income or household contribution.

Eighty eight percent (88%) representing (44) of the respondents said they often participate in household decision, whiles the rest, representing 12% (6) of the respondents said they rarely and never participate in household decisions. Claims that participation in microfinance activities has implications for women's empowerment within the household was investigated. Intra-household decision-making was one commonly investigated indicator of women's empowerment. While there is evidence that microfinance can have an impact on women's role in household decision-making, it has not occurred evenly in all contexts or in all areas of decision-making (Cheston& Kuhn, 2002).

4.12   SAT and training

Eighty eight percent (88%) representing (44) of the respondents responded "Yes" they have been receiving training from SAT and during their group meetings. The rest, representing 12% (6) of the respondents also said "No" they have not received any training from SAT.

Fifty eight percent (58%) representing (29) of the respondents had received training on Business management. 14% (28) of the respondents had received training on health education, including HIV/AIDS. 6% (3) of the respondents had also received training on spiritual life and prayers. The rest, representing 10% (5) of the respondents

had received training on personal relationship. Women received training in business skills such as customer care, pricing, marketing, and selling on credit, and they have the opportunity to exchange business tips among themselves. They also discuss social, community issues and reproductive health.

All the fifty (50)respondents give good remarks about the training they have received from SAT, the training have had positive impact on their standard of living. It has made them to participate in civic activities.

Eighty six (86%) representing (43) of the respondents said "Yes" it has made them to aspire and take up leadership positions, whiles the rest, representing 14% (7) said "No" they have not been able to take leadership position. In fact, women clients of Opportunity Microfinance Bank have gained leadership experience and confidence as they have gone on to be elected as leaders (Shresta& Milan, 1998).

Empowerment approaches are utilized in a variety of development initiatives in addition to micro credit programs, democratization programs and leadership training programs. However, questions have to be raised as to what constitutes empowerment and when is the program empowering and when it is not. For example, increased decision-making power at individual level and greater access to economic resources by women does not necessarily translate into greater representation on power of women within political institutions (Cheston& Kuhn, 2002).

5. CONCLUSION

Microfinance has the potential to have a powerful impact on women's empowerment. Although microfinance is not always empowering all women, most women do experience some degree of empowerment as a result. Empowerment is a complex process of change that is experienced by all individuals somewhat differently. Strengthening women's financial base and economic contribution to their families and communities plays a role in empowering them.

Targeting women continues to be important in the design of both products and services, because women by default have less access to credit. Product design and program planning should take women's needs and assets into account. By

building an awareness of the potential impacts of their programs, SAT can design products, services, and service delivery mechanisms that mitigate negative impacts and enhance positive ones. Even when products and services target primarily women, women still face considerable disadvantages relative to men because of more limited business networks and opportunities, greater domestic burden, weaker self-confidence, less education, and, in many cases, a restrictive legal environment. These disadvantages can sometimes be perpetuated in microfinance programs, with men dominating mixed lending groups and women receiving smaller loan amounts than men.

The results confirmed that the poor will often use loans to meet their needs as they see them, regardless of the intent of lending programs. Loans may be used for a wide variety of purposes, including:
• To invest in an income-generating activity, of the borrower herself or another family member
• To use as collateral to obtain a larger loan from a moneylender
• To engage in money lending
• (a female borrower) to hand over to a male family member for either investment or nonproductive purposes
• To pay off debts with moneylenders
• For consumption or emergency purposes

One lesson is clear in income generation promotion: Unless men are sharing domestic work more equitably, microcredit for income generation will likely increases women's, and in some cases children's, workload, especially girls who share domestic responsibilities and are less likely to be attending school.

6. RECOMMENDATIONS

It is recommended that there should be more investment in building capacity training in microfinance programmes to enhance women's managerial control, control over spending/utilization of earnings, skills development, and social development, opening market access for women, and changing women and men's attitudes to issues of women's financial independence.

Secondly there should be division of the domestic workload within the family unit which would be a useful indicator of impact.

Furthermore there must also be a design for individual loan products and graduation strategies that meet the needs of women.

In addition, consider empowerment impacts when evaluating microfinance program performance and making funding decisions.
Also, charges on microloans should be minimal by microfinance institutions in other to reduce default rate.

Moreover microfinance institutions should be strictly monitored by the regulatory body in other to ensure that in the bid to empower women they are not exploited.

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APPENDIX

Table 1

ITEMS	FREQUENCY	PERCENT
TYPES OF BUSINESS OPERATED BY SAT CLIENTS		
Trading	30	62.0
Food Selling	12	24.0
Agriculture	1	2.0
Service Provider	6	10.0
Manufacturing	1	2.0
Total	50	100.0
CHANGES/IMPROVEMENT IN WORKING CAPITAL SINCE JOINING THE SAT PROGRAMME		
Yes	41	82.0
No	9	18.0
Total	50	100.0
UTILIZATION OF PROFIT		
Education	14	28.0
Household Expenses	9	18.0
Health Care	7	14.0
Reinvestments	20	40.0
Total	50	100.0
CHANGES IN BUSINESS STRUCTURE SINCE ACCESSING A LOAN FROM SAT		
Yes	45	90.0
No	5	10.0
Total	50	100.0
CHALLENGES OF BUSINESS		
Lack Of Capital	26	52.0
Competition	15	30.0
Low Sales	9	18.0
Total	50	100.0
EXPERIENCE WITH SAVINGS BEFORE JOINING SAT		
Yes	12	24.0
No	38	76.0
Total	50	100.0
PERSON RESPONSIBLE FOR DECISION ON USE OF FUNDS/LOAN		
Personal	34	68.0
Spouse	14	28.0
Children	2	4.0
Total	50	100.0
SAT AND EDUCATION		
Yes	47	94.0
No	3	6.0
Total	50	100.0

Source: Field survey, September, 2011

Demographic Characteristics of Respondents

Items	**Frequency**	Percent (%)
Gender of the Respondents		
Male	2	4.0
Female	48	96.0
Total	**50**	**100.0**
Age		
25-35	10	20.0
36-46	20	40.0
47-57	15	30.0
58-68	5	10.0
Total	**50**	**100.0**

Years with Sinapi Aba Trust (SAT)		
1	10	20.0
2	14	28.0
3	7	14.0
4	5	10.0
5	3	6.0
6	4	8.0
7	2	4.0
8	2	4.0
9	3	6.0
Total	**50**	**100.0**
Marital status of the Respondents		
Single	5	10.0
Married	30	60.0
Divorced	10	20.0
Widowed	4	8.0
Separated	1	2.0
Total	**50**	**100.0**
Educational background of the Respondents		
Primary/ JHS	8	16.0
Secondary	6	12.0
Vocational	5	10.0
SHS/SSS	4	8.0
Tertiary	2	4.0
None	25	50.0
Total	**50**	**100.0**
Religious Background of Respondents		
Christian	38	76.0
Moslem	11	22.0
Others	1	2.0
Total	**50**	**100.0**
Number of children		
1-3	20	40.0
4-6	19	38.0
5-7	9	18.0
8-10	2	4.0
Total	**50**	**100.0**
Description of SAT's clients living environment		
Self/spouse owns house	19	38.0
share family house	7	14.0
Rented house	24	48.0

Total	**50**	**100.0**
Amount of loan taken		
Gh₵100	29	58.0
Gh₵200	10	20.0
Gh₵300	8	16.0
Gh₵400	3	6.0
Total	**50**	100.0

Source: Field survey, September, 2011

Potential Chemical Attack on Concrete Foundations due to Groundwater Chemistry

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Abstract
The presence of some chemicals such as sulphate, chloride and pH above the permissible limits in groundwater is detrimental to concrete foundations. These chemicals attack the foundation when the groundwater comes in contact with the foundation. The attack could reduce the structural integrity of the foundations leading to total collapse of the super structure and loss of life. To ensure effective and economical design against chemical attack from groundwater, available information on chemical composition of groundwater is vital at the design stage in infrastructural development. Thirty seven water samples were obtained from boreholes and wells in different locations within the Dangbe East-West Districts of the Greater Accra Region in Ghana. The samples were subjected to chemical analysis in accordance with ATSM standards in chemistry laboratory of Wadia Institute of Himalayan Geology in India. Chloride, sulphate and pH concentrations in the samples were determined, based on the results, the concentration of sulphate is between 7.5mg/l and 2290.5mg/l with an average of 204.6mg/l, the chloride concentration is between and 6.5mg/l and 6051.1mg/l with an average of 930.8mg/l. The pH ranges between 4.86 and 8.76 with an average of 7.4. The results show that majority of the samples recorded chloride concentrations which are above the maximum permissible value of 500mg/L. The pH values were also above the permissible value of 6. It is possible that these chemicals in the groundwater in the study can attack concrete foundations, precautionary measures should be considered during construction.

Keywords: Chemical Composition; Groundwater; Sulphate; Chloride; Concrete

1.INTRODUCTION

Geotechnical investigation is a prerequisite for any safe and economic design of any civil engineering structure. The main objective is to ascertain the suitability of the site to contain the proposed structure in the long term (Craig,2004). It involves exploring the ground conditions at and beneath the surface and making the appropriate recommendations for safe design and construction. Groundwater conditions especially the chemical composition and its potential attack on concrete foundations is one of the parameters that are required for safe and economic design of the foundation of the structure. The presence of some chemicals such as sulphate, chloride and pH above certain limit in groundwater is detrimental to concrete foundations and had attracted the attention of numerous researchers in the past (Tulliani et al. 2002; Hobbs, 2002; Rajasekaran et al., 2005; Czerewko et al. 2005; Glasser ,2008; Sotiriadis at al., 2013; Ouyang, 2004 and Bader, 2003). Tulliani et al. (2002) reported a sulfate attack by sewage on the foundation plinths and piers of a concrete building in Torino, Northern

Italy. Inspections and analyses of the concrete structures showed that an appreciable deterioration affected the plinths and piers closer to the internal courtyard of the building. From the analytical data, it was possible to clearly recognize a sulfate attack, induced by sulphuric acid. The chemical degradation was accompanied by a dramatic strength loss. Hobbs (2002) reported on chemical attack on buried concrete bridge foundation in the UK. Investigation of the attack revealed that oxidation of pyrites within the backfill led to the formation of sulfuric acid, reducing the pH of the groundwater and resulting in attack on the foundations and in reactions that raised the groundwater sulfate level. Observations made on thin sections taken from the affected bridge foundations were in accordance with sulfuric acid attack being the probable primary cause of deterioration. According to Rajasekaran et al. (2005), chemical attack on concrete have resultedin serious structural damages including uplifting of tunnel floors, rocks under dams and the foundations of offshore structures resting on marine clays.

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Groundwater containing acidity and dissolved sulfate species are a primary factor in the attack on concrete and other construction materials. In the case of concrete, attack may be prevented by the use of suitably resistant concrete, eliminating sources of acidity and/or sulfate ions or by protecting the concrete structure from the offending solutions (Czerewko et al., 2005). It is evident from literature that, chemical attack on concrete is major problem worldwide and several efforts have been made to control it.

In Ghana, Infrastructural development is increasing in the Dangbe East-West Districts of the Greater Accra Region, due to the proximity of the location to the sea; it is possible that the groundwater in the location will contain some chemicals that will be harmful to concrete foundations. Therefore, it is very imperative to determine the chemistry of the groundwater in the study area for possible chemical attack for sustainable infrastructural delivery. This paper present the chloride, sulphate and the pH concentrations of the groundwater samples obtained from the study; the results were used to determine the potential attack on concrete foundations by comparing the values to the permissible limits for concrete works.

### 1.1 Description of the Study Area

The study area is located in the Dangbe East and West Districts of the Greater Accra Region of Ghana (Figure 1). The area has wetlands and marshes, sand dunes and islands. The Songor wetland situated within the study area consists of a shallowwater lagoon (10-50cm) with mudflats, river islands, a broad sandy beach southwards, flood plains with degraded mangroves and coastal savannah vegetation. The highest elevation above sea level is 75m whilst the lowest elevation below sea level is 10m (Ghana National MAB Committee, 2009). The area receives about 750mm rainfall recorded at Ada Foah Meteorological Station. Temperatures are generally high ranging from 23°C to 33° C.
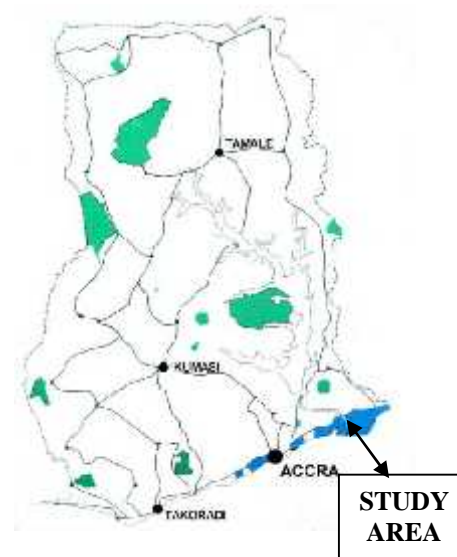
STUDY AREA

1.2 Geology of the Area and its Environs

According to Kesse (1985), the study area and its environs are underlain by three major geological units, the Dahomeyan, Accraian Series and the Togo Series. The Dahomeyan occupies greater part of the area.(Figure 2) The Dahomeyan formation comprises of alternating bands of massive acidic and basic gneisses, schists and migmatites. The Togo Series occurs mainly in the north-western part of the study area and consists mainly of quartzites and phyllites. Other rock types of the Togo Series include sandstones, shales, schists and silicified limestones.

The Accraian Series consists of sandstones, grits and shales and are found in the vicinity of the city of Accra. The Tertiary and Recent Sediments occur to the South-eastern parts of the Accra plains where the study was carried out. Since the main rocks are inherently impermeable, groundwater occurrence in the Accra Plains is controlled mainly by the development of secondary porosities e.g. fractures, faults, joints etc and the associated weathered zone.
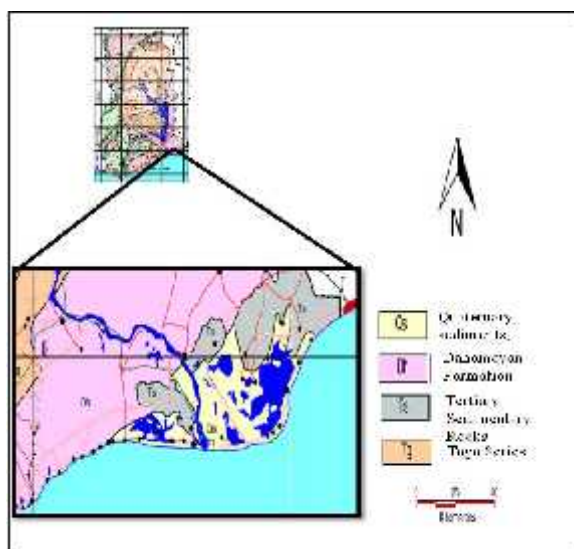
2.METHODOLOGY

Thirty seven groundwater samples were obtained from existing wells and boreholes in study area between April 2013 and June 2013, the samples were preserved in plastic containers before transportation to the Water Chemistry Laboratory of Wadia Institute of Himalayan Geology in India for the chemical analysis.

2.1 GPS Coordinates of Samples Locations

Table 1: Results of the Chemical Analysis

The geographical locations of the samples were recorded with the aid of a handheld GPS. The GPS was placed close to the sample location clear of any obstruction to the skies. The purpose of recording the GPS coordinates is to enable the samples location to be plotted on the map of the study area.On each samples point, three set of readings were taken after observing for about five minutes, the averaged value is taken as the coordinates.

2.2 Chemical Analysis of the sample

Prior to the chemical analysis all water samples were stored under hygienic and required temperatures in the Water Chemistry Laboratory of Wadia Institute of Himalayan Geology. After adjusting the samples to room temperature; the pH, chloride and sulphate content were determined in accordance with ASTM standards, the pH was analysed in accordance with ASTM D1293 and the chloride and the sulphate were analysedin accordance with ASTM D512 and D516 respectively.

3. RESULTS AND DISCUSSIONS

The results of the chemical analysis of the groundwater samples are presented in Table 1; it contains the concentration of chloride, sulphate and acidity of the groundwater.

The summary statistics is also presented in Table 2

No.	Location	GPS Positions Northings	Eastings	Well Depth (m)	Elevations (m)	Cl(mg/l)	SO4(mg/l)	Ph
1	ADA COLLEGE	236519	639452	4	7	97.0	17.7	8.22
2	ADA FOAH	237974	639735	5	7	243.7	127.6	8.76
3	ADDOKOPE	222232	652108	12	23.5	146.9	170.7	6.77
4	ADZOKATSEKOPE	228493	657481	3	7	101.0	7.5	6.78
5	AFIADENYIGBA	222339	656587	2	30.5	37.8	16.4	6.69
6	AGYEMAN KOPE	210920	645922	5	7	640.5	197.1	6.63
7	AGYEMAN KOPE-2	210974	645929	4	8	768.3	314.3	4.86
8	AGYEMAN KOPE-3	211006	645880	3	7	849.1	160.5	7.63
9	ALAVANYO	229108	640322	3	1	627.1	353.8	7.93
10	AMLAKPO-1	223092	651080	7	11	2118.0	54.7	7.34
11	AMLAKPO-2	223150	651124	6	13	2854.2	240.8	7.39
12	ANYAMAN-1	209384	640822	3	2	171.3	33.9	8
13	ANYAMAN-2	209413	640845	8	1	2381.8	290.5	8.29
14	ANYAMAN-3	208593	640863	2	4	1777.3	649.8	7.58
15	ANYAMAN-3	208593	640863	2	4	945.3	177.3	7.7
16	ASIGBEKOPE	224350	654274	19	28	78.7	10.0	6.27
17	ASIGBEKOPE1	224666	654189	21	29	115.0	30.7	6.23
18	BATTOR	213130	671475	6	7	6.5	123.7	6.66
19	DOGO	229901	650179	5	6	914.0	76.3	7.07
20	DONUKISAPO	230315	639704	2	9	175.3	94.2	7.44
21	GBANTANA	224612	651114	8	16	879.5	92.8	7.6
22	GOI-1	213854	641268	2	2	899.3	113.5	8.43
23	GOI-2	214200	640740	3	4	961.6	432.7	7.72
24	HWAKPO	220715	651708	11	20	463.9	34.4	7.08
25	KASEI-1	225264	652227	11	19	240.2	50.3	7.85
26	KASEI-2	225429	652835	11	20	73.7	42.6	8.07
27	KORLEY KOPE	226280	651362	8	14	214.0	42.6	7.98
28	KPOTAME	226195	661998	10	8	819.1	92.8	7.17
29	LOLONYA	215727	640885	2	1	6051.1	2290.5	7.85
30	ADA COLLEGE	236494	639680	3	8	83.2	9.7	7.76
31	PUTEI	228505	639936	3	3	2559.9	328.9	8.39
32	PUTEI-1	227604	639866	3	4	2464.9	278.1	7.57
33	PUTEI-2	227604	639866	3	4	244.0	37.0	8.15
34	SOKPOE	231810	662287	4	5.5	312.1	23.6	7.11
35	SOKPOE1	231511	662216	2	3	215.2	31.9	6.83
36	WASAKUSE	229607	646382	2	0.3	1678.2	398.7	7.2
37	ZOTOKOPE	225524	661854	10	8	1320.4	45.4	7.1

Table 2: Summary Statistics of Concentrations

Parameter	Count	Max	Min	Median	Mean	St. Deviation
Cl	37	6051.1	6.5	627.1	930.8	1189.6
SO$_4$	37	2290.5	7.5	92.8	204.6	387.8
pH	37	8.76	4.86	7.57	7.4	0.75

4.0 Discussions

Based on the chemical analysis of the groundwater from the study area, the pH ranges from 4.86 to 8.76 with an average of 7.4. The chloride values are between 6.5mg/l and 6051mg/l with an average of 930.8mg/l. The sulphate values are between 7.5mg/l and 2290.5mg/l with an average of 204.6mg/l. The results indicate spatial variation in the values of all the parameters in the study area.

4.1 Potential Attack on Concrete Foundations

The ASTM standards stipulate 500mg/l as the permissible limit for chloride and sulphate for concrete works and the limit value for pH value is 6. This means that, chloride and sulphate values above 500mg/l and pH below 6 is a potential treat to concrete foundations. Scatter plots of the parameters are presented in Figure 3, 4 &5 respectively, the red line in each plot represent the permissible limits for concrete works. Figure 3 shows that, almost all the pH values are above the permissible limit of 6, this means that, the pH is less acidic.

Majority (99%) of the samples contain sulphate concentration below the permissible limit of 500mg/l (Figure 4). From Figure 5, it is clear that, about 50% of the groundwater samples contain chloride concentration above the permissible limit of 500mg/l. The higher concentration of chloride in the groundwater samples can be attributed to close proximity of

the study area to the sea. It is possible that this higher concentration of chloride above the permissible limit can attack concrete foundations.
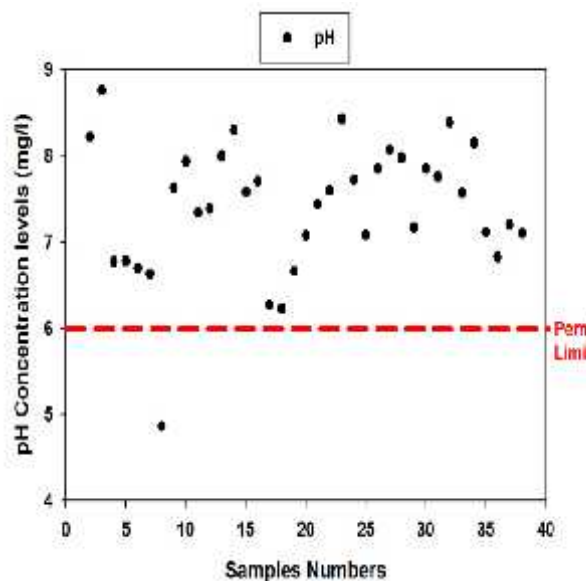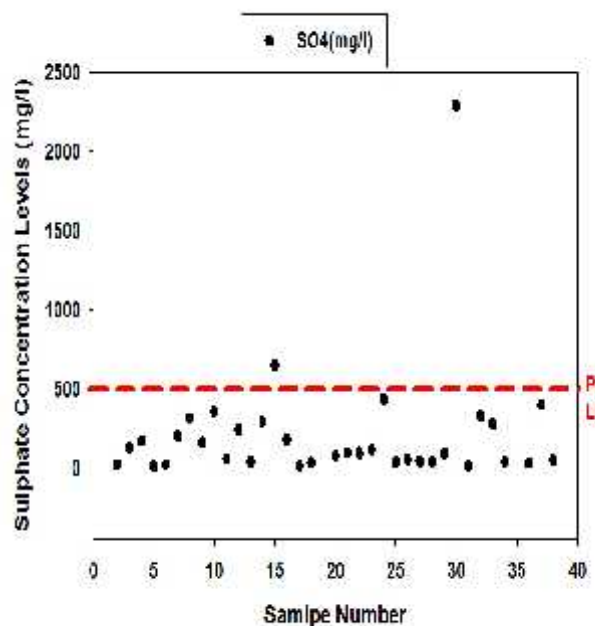

Figure 3: Scatter Plot of pH values

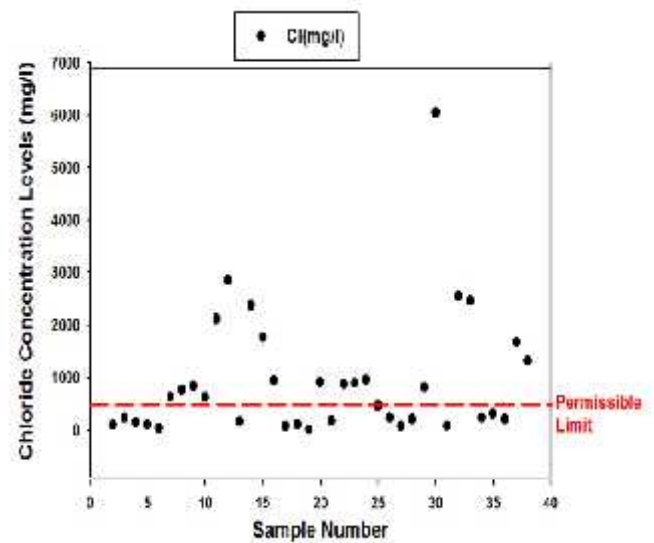Figure 4: Scatter Plot of Sulphate Concentration

Figure 5: Scatter Plot of Chloride Concentrations

5.CONCLUSIONS

The study have shown that groundwater in the Dangbe East-West Districts of the Greater Accra Region in Ghana contains chloride values that are above the permissible level for concrete works, however and the pH concentration is less acidic, sulphate will not pose any serious problem according to the study but should not be ignored. The implications of the study are that precautionary measures should be taken against chemical attack on concrete foundations in the study area and should be considered at the design stage for sustainable infrastructural development.

The chloride resistance of concrete depends on the permeability properties of the concrete and the thickness of the concrete reinforcements. Chloride resistance can thus be improved by controlling the concrete mix constituents, proportions and the degree of compaction of the fresh concrete. A suitable cover for the reinforcement will also improve chloride resistance of concrete works in soils with high chloride content in the groundwater.

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Design, Construction and Performance Testing of a Mixed Mode Solar Dryer

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Abstract
A designed mixed-mode natural convection solar dryeris constructed using local materials then tested experimentally using fresh pepper of known initial moisture content. The performance of the mixed mode natural convection dryeris investigated using results obtained for open sun drying as baseline values. Experimental tests performed on the dryer recorded maximum temperature and irradiance of 74.1 C and 1050W/m² respectively. The dryer dried 2.6kg of pepper with initial moisture content of 88.6% to the desired final moisture content of 8% wet basis within 18 hours. The drying process was done intermittently.However, it took 30hrs to dry the same mass of pepper under the same weather conditions in the open sun. This research thus seeks to enhance the environmental and energy sustainability of the country.

Keywords: Solar collector; Moisture; Pepper; Chamber; Irradiation

1 INTRODUCTION

Drying may be required for several reasons. First and most often, water is removed from the fresh crop to extend its useful life. The dried product is later rehydrated prior to use in order to produce a food closely resembling the fresh crops, for example, in the use of dried vegetables. Second, a crop may require drying so that it can be further processed. For example, many grains are dried so that they can be ground into flour. Third, fresh crops are sometimes dried so

that a new product distinctly different from its original form can be produced.
Reducingmoisture content of foodstuff down to a certain level slowsdown the action of enzymes, bacteria, yeasts and molds,thus, food can be stored and preserved for long time without spoilage. Around 30% to 40% of the food production such as vegetables and fruits are losses in developing countries annually due to the spoilage(FADHEL et al, 2005).

Open sun drying is a traditional method practiced widely in tropical climates for drying agricultural products. Considerable savings can be made with this type of drying since thesource of energy is free and sustainable. However, this method of drying is extremelyweather dependent and has the problems of contamination, infestation, microbial attacks, time consuming etc., thus affecting product quality. Additionally, the drying time required for a given commodity can be quite long and can result in some post-harvest losses. Solar drying of agriculturalproducts in enclosed structures by natural convection is an attractive way of reducing postharvest losses and low quality of dried products associated with traditional sun-dryingmethods(Chua K.J. , Chou S.K., 2003).The application of solar dryers can reduce post-harvest losses in developing countries and contribute to the availability of food in these countries.

The term solar dryeris applied to a structure made for the deliberate use of solar energy to heat air and/or the products to achieve dehydration, or drying of the products. The advantagesof solar drying over sun drying have been well documented(Simate, 2003).However, compared to some other solar technologies, solar dryers continue to struggle to gainacceptance by commercial producers of dried products. The reasons for this are complex and varied,and depend on many factors(Battock, 1990).

A natural convection solar dryer is the most possible for use in areas where electricity is not available.Among the different types of natural convection solar dryers, the mixed-mode type has beendemonstrated to be superior in the speed of drying(Simate, 2003). In this type of dryer, during daytime the heat for drying are from both direct and indirect solar radiation. For direct mode, the product is allowed to directly absorb heat from solar radiation by applying a transparent cover on the drying chamber. While, for indirect mode a solar

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collector system is commonly applied to collect heat-to-heat air, andthe heated airflows through the drying products.

Design Theories

Solar intensity on collector surface

The total solar radiation, I_T on a surface of an arbitrary orientation is given as

$$I_T = I_b R_b + I_d R_d + \rho R_r (I_b R_b) \dots \dots eqn(1)(\text{Lui, B.Y.H., Jordan, R.C., 1962})$$

Where, I_b is beam radiation (W/m^2), I_d is diffuse radiation (W/m^2), R_b is beam radiation conversion factor, R_d is diffuse radiation conversion factor, R_r is reflection radiation conversion factor and ρ is reflection coefficient of the ground.

Collector overall heat loss

The overall heat loss was determined by considering the thermal loss from the collector to the surroundings by conduction, convection and radiation. The heat loss to the surrounding from the plate through the glass cover as top loss, from the plate through the insulation as back loss and the side of the collector casing as edge loss. The overall heat loss coefficient, U_L is the sum of thetop, back and edge loss coefficients and is given by equation 2.

$$U_L = U_T + U_b + U_e \dots \dots eqn(2)(\text{Tiwari 2002})$$

Where, U_T is top loss coefficient (W/m² K), U_b is back loss coefficient (W/m²K) and U_e is edge loss coefficient (W/m²K)

Energy absorbed by the collector

The rate of useful energy gain by the collector under steady state condition is proportional to the rate of useful energy absorbed by the collector minus the amount of energy lost by the surroundings. The useful energy gained by the collector will be transferred to the medium passing through it. Therefore, useful energy is given by (Duffie, J. A., Beckman, W. A., 1991)

$$Q_u = m_a C_p (T_o - T_i) \dots \dots eqn(3) (\text{Duffie, J. A., Beckman, W. A., 1991})$$

Where, m_a is mass of air (kg), C_p is specific heat at constant pressure (J/kg), T_i is inlet fluid temperature, T_o is outlet fluid temperature.

The maximum possible useful energy gain in a solar collector occurs when the whole collector is at the inlet fluid temperature. Therefore, the actual useful energy gain, Q_u, is determined by multiplying the collector heat removal factor F_R by the maximum possible useful energy gain and the expression is known as the

"HottelWhillier -Bliss equation given by(Duffie, J. A., Beckman, W. A., 1991)

$$Q_u = F_R A_c [I_T (\tau\alpha) - U_L(T_i - T_a)] \dots eqn(4)(\text{Duffie, J. A., Beckman, W. A., 1991})$$

Where, F_R is collector removal factor, A_c is collector surface area (m²), T_i is inlet temperature ( ), T_a is ambient temperature ( ),τ is transmittance of glass cover and absorber plate and α is absorbtance of glass cover and absorber plate.

Solar collector area

The solar collector surface area can be deduced by considering equations (3) and (4), and assuming that collector inlet air temperature,T_i, and the ambient air temperature, T_a, are approximately equal, we obtain thecollector area, A_c as:

$$A_c = \frac{m_a C_p (T_o - T_a)}{F_R[(\tau\alpha)I_T]} \dots \text{eqn (5)} (\text{Duffie, J. A., Beckman, W. A., 1991})$$

Where, A_c = Lb (collector area), b = collector breadth and L = collector length.

Air Mass Flow on the Absorber Plate

The mass flow rate of air on the absorber plate was determined by considering the average air speed of the location Koforidua, the breadth of the collector and the air gap height between the absorber plate and the collector glazing. Thus, volumetric flow rate of air,$\dot{V}$,is given by the expression.

$$\dot{V} = V_a hb \dots \dots eqn(6)$$

Where, V_a is ambient air velocity, h is air gap height, b is collector breadth Density of air, ρ_a is given as mass per unit volume.

Therefore, the mass flow rate of air, m_a was be given by the expression

$$m_a = \rho_a \dot{V} \dots \dots eqn (7)$$

System Drying Efficiency

Drying efficiency is defined as the ratio of the energy required to evaporate the moisture inside the product to the energy supplied to the dryer. Total heat in this case of solar dryer is the available solar radiation upon the collector surface supplied to the dryer. The system drying efficiency is calculated from (Brenndorfer, B., Kennedy, L., Oswin, B. C. O., Trim, D. S., 1987):

$$\eta_{sys} = \frac{W L_v}{t A_c I_T} \dots \dots eqn(8)$$

Where, W = moisture evaporated, L_v = latent heat of vaporization of water, t = time.

2. MATERIALS AND METHODS

Material Selection

In deciding on the material for the construction of the solar dryer even though was locally acquired, it was necessary to consider the environmental and weather conditions of the location. The location which is Koforidua Polytechnic Campus has latitude and longitude values of 06°03'N and 00°17'W respectively. Values of beam radiation(G_{bt}), Diffuse radiation, (G_{dt})and Total radiation on titled surface (G_t) were adapted from table 1.

Table 1: Monthly solar radiation on the tilted collector surface for the location (Akuffo, F.O., Jackson, E.A. , 1998)

Months	Beam radiation on tilted surface ($\frac{G_{bt}}{88\,}$)	Diffuse radiation on tilted surface ($\frac{G_{dt}}{2n\,}$)	Total radiation on tilted surface ($\frac{G_t}{17\,}$)
January	288.042	429.2297	717.272
February	260.776	370.6983	631.474
March	477.560	438.9849	916.544
April	455.338	292.6566	747.994
May	422.137	341.4327	763.570
June	57.878	497.5162	555.394
July	52.831	321.9222	374.753
August	77.940	351.1879	429.128
September	149.962	468.2505	618.212
October	175.303	487.751	663.064
November	394.296	292.652	686.952
December	313.680	302.4118	616.092

A typical mixed mode solar dryer consists of three basic units, the collector (primary collector), the drying chamber (secondary collector) and the chimney. The collector constructed consists of the glazing, absorber plate and the insulator. The material selection was based on cost and availability of material in the local market. Table 2 gives an account of the various materials selected for the components of the solar dryer constructed.

Table 2: Materials Selected

Dryer Component	Materials
Absorber plate	Galvanized plate & black oil paint
Glazing	Tempered glass
Tray	Metal mesh, net & wood buttons
Frame	Metal
Insulation	Wood, sawdust, foam
Fixing joints	Metal angle bar and square bar
Air inlet cover	Metal mesh
Sealant	Epoxy, RTV silicone sealant & PVC adhesive
Chimney	Polyvinyl chloride pipe & union

Table 3: Tools used in the construction

- Hack Saw
- Rip Saw
- Hammer
- Metal Cutting Machine
- Try Square
- Round File
- Rivet Machine
- Drill Machine
- Goggles
- Weighing scale
- Data logger(8430-20 MemoryHi-LOGGER)
- Gloves
- G - Clamp
- Grinding Machine
- Lathe Machine
- Bench Vice
- Glasscutter
- Painting Brush
- Marking knife
- Welding Machine
- Tape measure

Design Consideration and Assumptions

Temperature:- the minimum temperature for drying pepper is 30   and the maximum temperature is 70°C, therefore 45°C (318K) and above is considered average and normal for drying vegetables, fruits, roots and tuber crop chips, crop seeds and some other crops.(Tiwari 2010)

The glass covering with thickness 5mm was chosen which conforms to (Yunus C. et al 2011)and for this work, this was the one available on the local market.The transmittance of a single glass sheet is about 0.88 and that of the absorptivity is 0.80, the absorptivity of a new galvanized iron is 0.66. (Tiwari, 2010)

Description of the Mixed-Mode Solar Dryer Collector(Primary collector)

The collector area is 4.15m² and consists of different parts assembled together. These parts are; absorber plate, insulation material, air inlet material, and glazing. The heat absorber plate of the solar air heater was constructed using a 2mm thick galvanized plate, dimensioned $1.52\,m \times 0.62\,m$, painted black,

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and was mounted in a well-built metal box. The thickness of the collector insulation beneath the absorber plate was 0.13m and the thickness of the insulation at the sides was 0.3m. The gap between the glazing and the absorber plate was 0.08m. The glazing is a single layer of 5mm thick transparent glass sheet; it has a surface area $of\ 1.22\ m \times 1.52\ m$. One end of the solar collector has an air inlet vent, which is covered by a galvanized wire mesh to prevent insects and other foreign materials entering the collector.

The Drying Cabinet

The drying chamber was made out of metal plates which will have a long lifespan if properly maintained. The dimensions of the drying chamber are $0.9m \times 0.9m$. Access door to the drying chamber was provided at the side of the chamber. The chamber cover is a 5mm thick glazing, which has a dimension of about $0.9m \times 0.9m$.

Drying Trays

The drying trays are contained inside the drying chamber and constructed from a double layer of fine wire mesh.The trays were made from wood buttons of length 0.06m and a thickness of 0.05m, metal mesh and net of smaller holes.

Chimney

The construction of the chimney was doneusing a polyvinyl chloride pipe. The chimney is found at the upper part of the dryingchamber.The chimney inlet is 0.08m below the drying chamber glazing; with a height of 0.36m and a diameter of 0.05m.

The final design and construction are shown in plates 3 and 4 respectively.
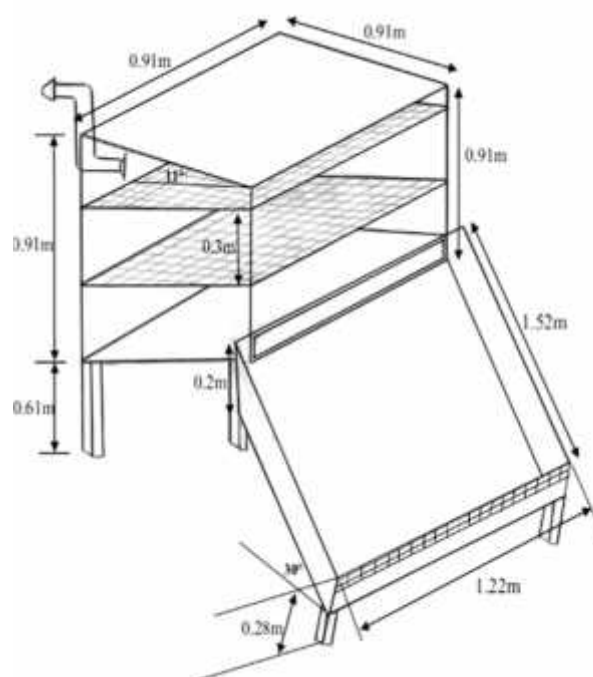

Plate 1: Design of Mixed-Mode Solar Dryer

Plate 2: The constructed Mixed-Mode Solar Dryer

Table 4: Testing Conditions

Items	Conditions
System Location	Koforidua
Drying Material	Pepper
Drying period	June
Loading rate, per bed [kg/day]	1.3
Initial weight of pepper (kg)	1.3
Final weight of pepper for storage (kg)	0.3
Initial moisture content, m_i [%].	88.6
Final moisture content, m_f [%]	8
Number of trays	2

Experimental setup and procedure

The mixed-mode solar dryer was tested using 3.9kg of pepper in all. 1.3kg was placed on each tray thus 2.6 kgin the drying chamber and 1.3 kgon the tray to be dried outside in the open sun as a control. The drying process took place in the following ways:

The pepper was first sorted by taking out the stocks of the pepper and was measured to the right quantity expected.

The sorted weighed pepper was then spread on individual trays of which two trays were of mass totaling 2.6kg. These trays were placed in the chamber and a third tray of 1.3kg mass of pepper was also placed outside in the sun at the same time.

In every ten minutes during the drying period, the temperature of the absorber plate, the collector outlettemperature, the drying chamber temperature and the solar irradiation readings were taken and recorded using Data Logger (I-V Checker MP – 170). The readings were measured to two decimal places.

Weight of the pepper on each tray was taken using the weighing scale and recorded after drying each day.

3. RESULTS AND DISCUSSION

Solar collector performance

From the variation of temperature against time for the period of the drying, the peak and minimum temperatures of air at the solar collector outlet as observed were 55ºC and 38ºC respectively and are shown in Figure 1. The average collector air outlet temperature was found to be 46.25ºC, which is in agreement with.(Tan D. et al. 2006). The average dryer temperature was found to be 55.99ºC. The average plate temperature was found to be 70ºC as shown in figure 1.
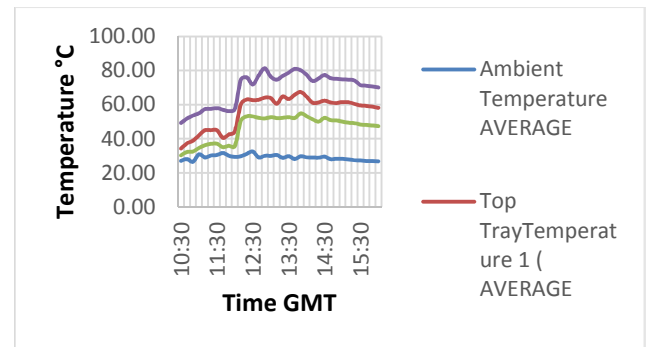

Figure 1: The Variation of average Temperature

Drying efficiency

The average weight losses of pepper for the upper tray, the lower tray and in the open sun observed were 0.38kg, 0.28kg and 0.14kg respectively. It took three days for the pepper in the upper tray to reach the final moisture content of 8%, four days for the lower tray and 8 days for the open sun drying. The output quality of pepper dried in the chamber was foundto be far better than that dried in the open sun as shown in plate 5.
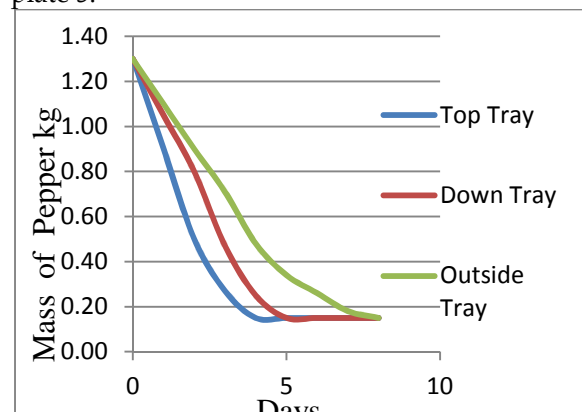

Figure 2: Variation of moisture removed against Time

Plate 3: Final dried pepper from solar dryer

Plate 4: Final dried pepper in the open sun

3.3 Solar irradiation

The average irradiation for the period of testing 10th to 20thJune, 2013 was found to be 563W/m^2 this was consistent with (Akuffo, F.O., Jackson, E.A. , 1998) because it was in the raining season.

4   CONCLUSION   AND RECOMMENDATION

The following conclusions can be drawn.

A mixed-mode solar dryer was designed, constructed and tested and on an average it took 3 days to dry 1.3kg of pepper with initial moisture content of 88.6% to 8% on wet basis whiles it took 8 days in the open sun. Drying rate varied with position of trays; it was highest on the upper tray and minimum in the open sun.

As the country struggles with energy sustainability and seeks to exploit other energy sources, it is highly recommended that institutions into renewable energy are well equipped to be able to undertake research to develop these areas for a holistic national development.

Figure 3: Variation of average irradiance with time

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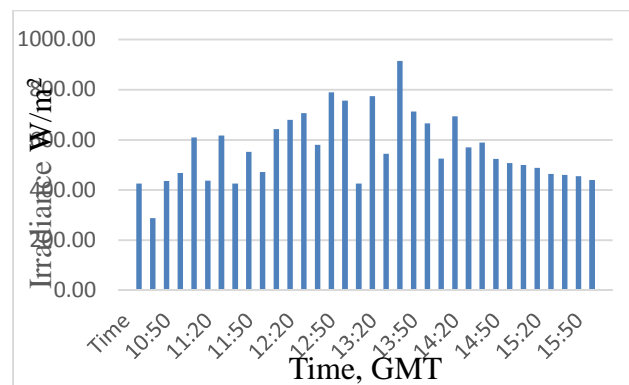
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Switching Barrier and Customer Loyalty in the Telecommunication Industry

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Abstract
The study investigated the relationship between switching barrier and customer loyalty among customers of mobile network providers in the telecommunication industry in Koforidua. Cross – sectional survey research design was adopted. Convenience sampling method was adopted for the study. Five hundred customers participated in the study. Questionnaires were used for data collection. The responses were analyzed using the Chi -square analysis. The study revealed that the most important factor determining the effect of the switching barrier and customer loyalty was the ability of service providers to add - value to customer's expectation, contrary to the common belief that low price keeps customers with the same provider. However, it was found that relative importance of the factors is not the same between two different groups. It also indicates that service quality and switching barriers are separate constructs that combine to determine customer loyalty. It was recommended that network provider needs to develop strategies that will better capture customers perceptions of its service offerings by improving service attributes through investing in equipment to enhance call quality and coverage, and also enhance customer care through routine personnel training, which will in turn have influence on the extent of switching between different network and loyalty.

Keywords: Customer Loyalty; Customer Satisfaction; Switching Barriers; Service Quality; Mobile Telecommunication Industry.

1. INTRODUCTION

The spread of mobile technology has varied significantly between countries with majority of mobile subscribers in the developing countries, (ITU, 2013). In 2013, statistics from the International Telecommunication Union revealed that the penetration rate of mobile phone subscribers is 96.2 per 100 inhabitants globally, The report also suggests that there are now more mobile phone users in the developing world than in the developed world (ITU, 2013).

The importance of customers has been highlighted by many researchers and academician. Bamfo (2009) quoted Clegg (2000) as saying; "however, good products, however strong the brand, customer satisfaction is the only way to have a competitive edge and to keep customers coming back all the time". Customers are aware of what constitute satisfaction and therefore organizations cannot take them for granted.

Moreover, customers are becoming more demanding and less forgiving. They are approached by many more competitors with equal or better offers (Hamel, 1996, Koltler & Keller, 2006). The challenge now is far beyond producing satisfied customers as competitors can do. The challenge is to produce delighted and loyal customers (Kotler & Keller, 2006; Keller et al., 2011).

In a study of the overall customer satisfaction in Ghana's mobile telecommunication networks, noted that, irrespective of the mobile telecommunication networks in Ghana, customer satisfaction is low (Nimako et al; 2010; Mahmoud & Hinson, 2012). Now, operators of the industry are facing the challenge of demonstrating customer-focused and continuous service improvement than before, as a way to ensuring customer satisfaction, brand supremacy and ultimately customer loyalty (Boohene & Agyapong, 2011; Henry & Quansah, 2013).

However, as the competitive environment increasingly becomes fierce, the most important issue the telecom providers face is no longer to provide excellent, good quality products or services, but also to keep loyal customers who will contribute long-term profit to organizations (Kotler, 2009; Tseng, 2007). The study seeks to examine the factors that determine customer loyalty and switching barriers in the mobile telecommunication industry in Ghana.

1.1 State of the Telecommunication Industry in Ghana

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In 1996, the telephone density of Ghana was 0.26 per cent; this translate to 2.6 telephone lines per everyone thousand (1000) people, including thirty-five pay phones in the entire country out of which 32 were located in Accra. This was one of the lowest in Africa. Today there is one phone for every four Ghanaians (NCA, 2013) this tremendous increase in the telephone density has resulted from the establishment of the National Communication Authority (NCA) in 1997, and the subsequent deregulation of the telecommunication industry.

Deregulation and reduced entry barriers into the Ghanaian Mobile industry have led to intense competition as the number of operators swell-up to contend for market shares Mobile Operators are engaging various marketing strategies to attracting new customers and retaining existing ones. There are already six competitors in the industry, namely, Mobile Telecommunications Network (MTN), Tigo, Vodafone, Glo, Airtel and Expresso (Frempong, 2002).

NCA in 2011, introduced a project known as the mobile number portability, which means that a subscriber can move from one mobile network to another and still retain existing telephone number the reason can be dissatisfaction with any aspect of the services provided by their current mobile service provider or the customers just want to take advantage of offers, features or pricing available on a different network (www.nca.org.gh).

According to NCA, (2013) the number of data subscribers in Ghana increased to 10,564,180 at the end of August, 2013 from 10,344,322 at the end of July 2013, showing a growth rate of 2.1%. Also the overall penetration rate in the country increased from 40.0% to 40.7% as at the end of August 2013.While the subscriber base for mobile voice telephony has shown a growth rate of 0.1% from 27,244,579 subscribers recorded in July 2013 7,511,659 as at the end August 2013.

The market share of mobile operators (telecom voice) in Ghana for the month of August 2013 is MTN 46.31% which is the market leader, followed by Vodafone 21.21%,Tigo 13.76%,Airtel 12.24%,Glo 5.92% and at the last position is Expresso 0.57 (NCA ,2013).

1.2 Statement of the Problem

Mobile telecommunication industries play a crucial role in Ghanaian economy and satisfying customer needs is very critical to managers and stakeholders as to their survival. The mobile telecommunication business has increased over the past years and in view of developments in the economy, it can be speculated that, more people will be turning to it for employment and income.

There has been significant growth in mobile telecom subscription in recent times in the country. According to the National Communication Authority, from as low as 250,000 in 1999, mobile phone subscribers increased to 3 million in 2005 and in 2007, the subscribers reached 7 million. As at August 2013, the number of data subscribers and the subscriber base for mobile voice telephony in Ghana is now 10,564,180 and 27,244,579 subscribers respectively (NCA, 2013).

Also, statistics available from NCA shows that by the end of June, 2013, 702,008 unique phone numbers had been ported. It further stated that, 86.5% had been ported only once, 12.9% had been ported twice, and the remaining 0.6% had been ported between three and nine times. Of the 13.5% numbers which had been ported more than once, 12.1% were ported back to their original network at the end of June, 2013, while 1.4% had been onward to a third network.

The competition in the Ghanaian telecom market is influence by low switching cost among the subscriber of the various network, which manifest in the frequency with which the subscribers enter and leaves the network.(Sey, 2008; Nimako,2012) therefore it cost subscribers only GH1 to acquire SIM (subscribers identification module)

A recent study by Boateng and Quansah (2013) in Ghana indicate that understanding of drivers of brand choice by customers in telecommunication industry is not clear. The major challenge confronting all the mobile operators in Ghana, is the execution of various marketing initiatives that would not only lead to attraction of new subscribers, but retaining existing ones who would then become loyal customers (Okyere et al., 2011; Davidson & McCarty, 2011).

Also there are overwhelming arguments supporting that it is more expensive to win new customers than to retain customers (Harmozl and Gils, 2004; Kotler & Armstrong, 2010) the main problem of this study is this seemingly ironic situation. The questions that arise are that; what is customer satisfaction? What is customer loyalty? Answers to these questions will provide better clarity and in-depth analysis of the dynamics of the relationship between the switching barrier on customer loyalty and customer satisfaction in the mobile telecommunication industry in Ghana.

1.3 Research Objectives
The main objective of the research is to find out the relationship between the switching barrier on customer loyalty and the effect of customer satisfaction in the mobile telecommunication industry in Ghana. Specific objectives are as follows:
- To identify the criteria which customers will use in measuring satisfaction.
- To evaluate the satisfaction level of customers.
- To find out the level of customers loyalty to their service providers.
- To explore the reasons behind customer loyalty and disloyalty.
- To investigate the reasons behind the use of more than one network at the same time.

1.4 Hypotheses
The question which needs to be answered is whether there is any association and/or relationship between customer satisfaction and customer loyalty and switching barrier.

H0   Switching barrier has no influence on customer loyalty and has no effect on customer satisfaction.

H1   Higher levels of service quality are linked with higher levels of customer satisfaction.

H2   Higher levels of call quality are linked with higher levels of customer satisfaction.

H3   Higher levels of value-added services are linked with higher levels of customer satisfaction.

H4   Service Quality has positive impact on customer loyalty.

H5   Brand Image has positive impact on customer loyalty.

H6   Switching Barriers has positive impact on customer loyalty.

H7   Higher levels of each switching cost are linked with higher levels of the switching barrier.

1.5 Limitation/Scope of Study
The study is expected to cover only mobile telecom users within Koforidua Polytechnic in the Eastern Region of Ghana. This study is also limited to few customer loyalty and barrier variables as well as other tactics and quality measurements are excluded in the study.

This study of switching barrier on customer loyalty and customer satisfaction in the mobile telecommunication industry in Ghana is a quantitative research. The research was conducted from customers' point of view and so the population was expected to involve the people who are consuming mobile services from the six mobile telecommunication operators in koforidua the capital city of Eastern region in Ghana.

The decision about the size of the sample was taken considering time and cost, the need of precision and a variety of further considerations. Due to the limit of time and costs, the population was narrowed to mobile phone users in Koforidua. The sample was determined by convinces sampling.

2.METHODOLOGIES
2.1Data collection and questionnaire design
A self-completion questionnaire with closed questions was developed for primary data collection. According to Bryman and Bell (2003), closed questions have some advantages: it is easy to process answers; it enhances the comparability of answers, and makes them easier to show the relationship between variables.

The questionnaire was composed of two parts and total 20 statements. The first part was about individual characteristics with two questions by asking respondents' gender and the name of the mobile telecom operator they are using currently. The second part contains all four constructs as suggested by (Peng and Wang, 2006). Several items on each construct were developed and adopted from relevant literatures. All of the items were measured by using a five-point Likert-type response scales,

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anchored at 5 strongly agree and 1 strongly disagrees.

The author and well trained research assistants personally administered questionnaires to all participants and received 500 valid responses out of 810 questionnaires in December 2013.

2.2 Pre testing

Pre-testing was used as a valuable indicator to find out the effectiveness of the questionnaire. This involved selecting, approaching and interviewing a small segment in the same manner which was followed in the full scale operation. It helped the researcher to know whether the replies or questionnaire responses provided the type of information needed or respondents were misinterpreting any of the questions. In addition, results obtained in the pre-test could suggest new ideas or questionnaire worthy of further examination. Eighty (80) questionnaires were tested on sample of 80 respondents in Oda also in the Eastern region in order to eliminate any ambiguities and improve clarity in all questions.

2.3 Statistical analysis

Field data was process by editing coding and classification and tabulation to present a clearer view of the analysis. The coding was necessary for efficient analysis of data. For this research, coding decisions were taken at the designing stage of the questionnaire. All of the items under each of the 4 constructs were measured by using a five-point Likert-type response scales, assigning numerals to question responses with 5 coded for strongly agree, 4 for agree, 3 for neutral, 2 for disagree and 1 for strongly disagree.

In this study, the research chose the software SPSS for Windows to do analysis. SPSS for Windows is probably one of the most widely used computer software for analysis of quantitative data for social scientists. SPSS (Statistical package for the social science) has been in existence since the mid 1960 and over the years has undergone many revisions particularly since the introduction of personal computers (Bryman and Bell, 2003).

3. RESULTS

Following the guidelines indicated in the research methodology section, we collected data during the period

Demographics information

Table 3.1: Analysis of respondent demography Variables

Age's	Frequency	Percentage
14-18	50	10.0
19-40	390	78.0
41-60	50	10.0
61-100	10	2.0
MobileNetworks		
MTN	330	66.0
Vodafone	60	12.0
Airtel	50	10.0
Glo	20	4.0
Expresso	10	2.0
Tigo	30	6.0
No. of years on network		
0-2	410	82
3-5	50	10
6andabove	40	8

Survey results, 2013

The demographic data of the respondents are presented in Table 3.1. In terms of gender, 48.0 % of the respondents were males and 52.0% were females.

In the case of mobile network used by respondents, 66% are on MTN, 12% are on Vodafone, 10% are on Airtel, 6% on Tigo, 2% on Expresso and 4% on Glo network. As regard to the number of years on the network by respondents, 82% of the respondents have stay with their network between 0and 2years and, 10% of them have been on their networks for between 3 and 5 years while 8% of them have been on their network for 6 years and above. This indicate that many females use mobile phones than that of Males

Factors considered before choosing the service provider
Table 3.2: Showing the general factors
Source: fieldwork (December 2013)

Factors	Call rate	Promotion	Customer service	Friends
Frequency	200.0	90.0	110.0	100.0
Percentage (%)	40.0	18.0	22.0	20.0

In all the respondents, 40% of the respondents were influenced by call rate, 22% were influenced by customer service, 20% were influenced by friends and 18% were influenced by promotions to choose their service provider.

Switching barrier in relation to economical loss and psychological burden
Table 3.3 switching barrier

Factors	Frequency	Percent	Cumulative Percent
Economical Loss	36	72.0	72.0
Cost Associated with calling	34	68.0	88.0
Per second Billing	2	2.0	98.0
Psychological Burden	14	2.0	100
Total	100	100	

Source: fieldwork (December 2013)

Switching barrier in relation to economical loss and psychological burden, and economical loss in relation to cost associated with calling and per second billing.
Correlation analysis

Table 3.4 Correlation analysis on Economical loss and Psychological Burden

	Chi - Square	Correlation	df	Sig.
Pearson	2.08	0.89	4	.72

Source: fieldwork (December 2013)
MTN users express dissatisfactions whiles in the other service providers most expresses satisfaction. Although, a strong positive correlation (.89) was found between satisfaction and the choice of service provider, it was not statistically significant (P>0.05).

However, 62.0% of the respondents are not considering switching from their main service provider to another. Among those that are not switching from their main service provider, economical loss associated with switching carries is the main reason why most of them (72.0%) are not considering switching from their main service provider to another. Whiles 28% of the respondents' decision was because
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of psychological burden associated with switching carriers

Economical Loss In Relation To Calling Cost and Per Second Billing
Out of the 72%, 68% of the respondents related the economic loss associated with switching carriers with the cost associated with calling a different network while 4% associated it with per second billing.

Correlation analysis

Table 3.5 Correlation Analysis on Calling Cost and Per Second Billing

	Chi - Square	Correlation	df	Sig.
Pearson	3.806	0.98	8	.874

Source: fieldwork (December 2013)
Although a strong positive correlation (.98) was observed between cost associated with calling a different network and the main service provider, it was not statistically significant (P>0.05).

4.DISCUSSION
In general 58.0 % of the respondent claimed they are satisfied with their service provider whiles 42.0% are not satisfied. Despite the dissatisfaction the customers are not considering switching to other network.
Although as a general rule, customer satisfaction and customer loyalty are very closely related. The relationship between customer satisfaction and customer loyalty is not always a linear relation, even though it constitutes a positive relationship (Fornell, 1992 & Soderlund, 1998). Although a strong positive correlation (.89) was found between satisfaction and the choice of service provider, it was not statistically significant (P>0.05).

Among those that are not switching from their main service provider, economical loss associated with switching carries is the main reason why most of them (72.0%) are not considering switching from their main service provider to another. Whiles 28% of the respondents were because of psychological burden associated with switching carriers.

The Switching Barriers and Customer Loyalty according to Burnham's (1998) in his research review the typology, he broadly grouped

switching costs into three categories: procedure, financial and relational, attractiveness of alternatives means the reputation, image and service quality of the replacing carrier, which are expected to be superior or more suitable than those of the existing carrier.

Subscribers who are not satisfied are not considering switching to any other network. Research done by (Kim, 2004), elaborate that switching cost means the cost incurred by customers who shift from the current product and service providers to other operators on the market. This does not only include the study cost that consumers have to pay to familiarize themselves with the services of other operators but also the cost of sacrificing the original phone number value and accumulated scores of service (Liang, et al, 2005).

According to Shy (2002) the switching costs could be said to be partly consumer-specific. With this rationale, a switching cost can be seen as a cost that deters customers from demanding a rival firm's brand. Economic or financial switching cost which is a sunk cost will appear when the customer changes his/her brand, such as the costs of closing one bank account with a particular bank and opening another with a rival bank, also the cost of changing one's long-distance telephone service (Klemperer, 1987) or the costs of changing one's GSM operator.

5.CONCLUSIONS

The researcher summarises the conclusions reached on hypotheses framed in the study. The papere also provides strategic suggestions for mobile service providers.

Mobile service providers must first of all, maximise customer satisfaction and the switching barrier in order to augment customer loyalty. Mobile service providers must focus more on quality of service and offer customer-oriented services to increase customer satisfaction in particular. At one fell swoop, efforts to heave the switching barrier must build a long-term relationship with customers by additional investing in customer relationship management.

Moreover, among factors ascertaining a service provider, the factors with the important impact on customer satisfaction appeared to be call rate, promotion, customer service and word of mouth. This suggests that, while mobile service providers have improved call rate over the years of existence of the mobile telecommunication industry through immense investments in advanced technology investments, call rate and coverage, from customers' perceptions, it is still their importance factor. Additionally, mobile service providers must focus their efforts on emergent promotional packages to increase satisfaction and convenience.

Furthermore, factors which significantly affect the switching barrier appears to be switching costs such as Economic loss associated with switching carriers and psychological burden associated with switching carriers. Service providers must instantly develop customer reward programs that will concentrate on compensating customers, such as per second billing and price discounts, in order to reduce economic loss and psychological in switching networks.

Additional, in order to retain customers, service providers must develop healthy interpersonal relationships with the customers so that, even when competitors attempt to win them over with lower prices or offers of other conveniences they will not succeed.

More so, it was discovered that switching barrier had a modification consequence on customer satisfaction and customer loyalty. It was also found out that, in a mature market building a switching barrier emerges as a necessary strategy to safeguard one's market. For this reason, mobile service providers must provide a system to increase the cost of switching from one network to the other in order to increase customer lifetime value and customer retention. Also to develop and carry out relationship-oriented marketing strategies to enhance interpersonal relationships with customers.

Operational and strategic suggestions to network services providers are:
- Ensure quality services at all times.
- Organize training, seminars and workshops to keep customer service personnel's abreast with new and better customers care methods.

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- Create relationship marketing among clients

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Principal Component Analysis of Customer Choice of Telecommunication Networks in the Eastern Region of Ghana

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Abstract
Mobile phones are arguably indispensable tool in today's business activities. Its role towards productivity is overwhelming and immeasurable. Equally important is a vibrant telecommunication industry. Thus, these two industries are better described as Siamese twins. The study aimed at using Principal Component Analysis (PCA) to understand what factors inform customer's loyalty and their propensity to switch among network; to investigate the market share of the various telcos; to investigate challenges face by the telcos in delivery quality service, among others. Factors that were observed to influence customer loyalty were freebies, and reliability of network, per minute charges, customer relations, network being used by family members and friends, among others. A Chi-square test also revealed that, there is an association between packages offered by other networks and customers desire to own a second line. The study revealed that MTN is the market leader (44.2% market share) in the telecom industry of Eastern Region, followed by Vodafone (26.2% market share). The rest are Tigo, Airtel, Glo, and Expresso, respectively. Cable theft, high fuel and utility prices, sim box fraud, power fluctuation and outage were some of the problems that telcos face in Ghana.

Keywords: Product Differentiation; Telecommunication Network; Principal Component Analysis, Eigenvalues; Kaiser-Meyer-Olkin Test.

1. INTRODUCTION

Global system for mobile communication which has become the digital cellular technology of choice has the fastest growth rate and represents the largest segment within mobile communication in Ghana.

The ability of mobile telecommunication operators to focus successfully on the customer has proven to be one of the most competitive issues in the 21st century. Several developments such as introduction of new technology, creative and innovative marketing strategies, new and varied products etc. embarked upon by the service providers have rendered the industry very competitive. In Ghana's mobile telecommunication industry, customers switching from network to another or acquiring additional network(s) have become very prevalent. The phenomena brings to fore the need to investigate customers loyalty to their service providers.

The emergence of the telecommunication industry, over the past decades in the world, has seen several and unimaginable inventions and innovations in the field of competing. It has brought about dynamic changes in the Information Communication Technology (ICT). Communication is one of the key ingredients and frameworks to economic growth and development in both developed and developing country such as Ghana. Since access to most cities, towns and villages across the country are most of the times not accessible by vehicles due to bad road network; one will require communication gadgets such as telephones, internet services and mobile phones to reach out to business partners, families and friends located at these remote areas of a country. This can be done through a phone call, text messaging, video conferencing voice mailing, e-mailing or internet browsing, among others.

Among the most crucial factors which sustain accelerated economic growth and development are international trade and access to information that are essential for socio-economic development. In addition, the technological advancement, innovation and the renewal of infrastructure frequently by telecommunication service providers have been the major transformation seen on both the domestic and global stage of mobile telecommunication industry of many countries. Ghana's situation depicts a largely monopolized and state-owned model to a broadly competitive, private participation and open market telecommunication industry.

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The work covers aspects of factor that account for customers' loyalty to a Telco, some challenges face by the Telco strategy and the level of competition in the mobile telecommunication industry in Ghana. Over the past decades, Ghana's telecommunication industry was monopolized by the government. In the early 1990s, the country saw some deregulation and restructuring by the National Communication Policy. By 1994, it brought about a split of the state owned Post and Telecommunication Company into two mutually exclusive entities with each having its own budget allocation as well as Management team.

Consequently, Ghana Telecommunication was christened Ghana Telecom (GT) to operate with a Management contract agreement with Telekom Malaysia (TM), an Asian telecommunication giant. Presently, operate under the brand name Vodafone Ghana and it provides both telephone and mobile communication services across the length and breadth of Ghana.

This brought about liberalization and boast private sector participation in the Telecommunication industry of Ghana as the industry further welcomed Millicom Ghana (now Tigo) as the first investor in the industry. Now we have other firms such as Scancom Ghana (now trading under the brand name Metropolitan Communication Network, MTN), CellTel Ghana (now trading under the brand name Expresso,), Westel Ghana (now trading under the brand name Airtel) and Glo with the industry regulator as the National Communication Authority (NCA). They had the mandate to supervise and control activities of these operators. The presence of the private sector in the telecommunication industry has brought about fierce and tremendous competition in the in the industry. The fierce competition has led to better service quality, competitive pricing, among others as a result of the fact that each firm in the industry is desirous of becoming a market leader. Hence, the market share of each Telco is greatly dependent on the firm's house style and marketing strategies.

1.1 Service Quality and Satisfaction

There is a general consensus among customer relationship marketing practitioners that no business survives without customers. It is therefore critical that organizations form a close working relationship with their clients to ensure that they are satisfied with the services being provided for them.

In service management literature customer satisfaction is viewed as the result of a customer's perception of the value received in a transaction or relationship – where value equals perceived service quality relative to price and customer acquisition costs (Alvarez et al., 2005).

Customer satisfaction refers to the extent to which customers are happy with the products and services provided by a business. Gaining high levels of customer satisfaction is very important to a business because satisfied customers are most likely to be loyal and to make repeat orders and to use a wide range of services offered by a business.

Panrajan (2011) caution organizations to pay particular attention to the way they treat their customers since some customers may not openly display their dissatisfaction with the kind of treatment meted them immediately. One important component in the concept of satisfaction is complaint management.

1.2 Customer Loyalty

Customer loyalty can be defined in two distinct ways. First, loyalty is an attitude. Different feelings create an individual's overall attachment to a product, service, or 23 organizations. These feelings define the individual's (purely cognitive) degree of loyalty. The second definition of loyalty is behavioral. Examples of loyalty behavior include continuing to purchase services from the same supplier, increasing the scale and or scope of a relationship, or the act of recommendation (1998, Bolten). Customer loyalty is developed over a period of time from a consistent record of meeting, and sometimes even exceeding customer expectations (Batra, 1997). Hardy (2001) asserted that the cost of attracting a new customer may be five times the cost of keeping a current customer happy. Furthermore, Hoyer et al., (2009) noted that the degree to which a customer exhibits repeat purchasing behavior from a service provider,

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possesses a positive attitudinal disposition toward the provider, and considers using only this provider when a need for this service exists.

Chan and Sylvia (2001) hold a contrary view about customer loyalty. According to the authors, Loyalty may be interpreted as true loyalty rather than repeat purchasing behavior, which is the actual re-buying of a brand, regardless of commitment.

1.4 Hypothesis of the Study
H_0: The correlation matrix is identical.
H_1: The correlation matrix is not identical.

1. 5 Objectives of the Study
The study was sought to meet the following objectives:
1)   To investigate the factors that influence customers' choice of a particular mobile telecommunication service provider.
2)   To determine the factors that motivates customers' choice of second network.
3)   To measure the level customer satisfaction.
4)   To investigate the customer share of the individual mobile telecommunication service providers.
5)   To investigate the challenges faced by telecommunication providers.

2. MATERIALS AND METHODS
The research work was purely survey in nature. Thus, the main instrument used was questionnaire. The questionnaires were administered to mobile phone users in some selected principal towns in the Eastern Region of Ghana to investigate what motivate and inform their choice for a particular mobile phone telecommunication service provider. These towns were Koforidua, Nkawkaw, Nsawam, Akim Oda, Somanya, Asamakese, Akropong and Mampong. In all, a total of five hundred (500) questionnaires were distributed by proportion across these aforementioned selected towns.

2.1 Data Analysis
The collected data was analyzed in two ways- exploratory/preliminaries and further studies. Under exploratory analysis pictorial tools were employed to illustrate some pertinent features of the answered questionnaire. Further analyses were done by using SPSS to determine

the contribution of each factor that contribute to customers' choice of Telco in Ghana.

2.2 Structure Detection
The Bartlett's test of spherecity and the Kaiser Meyer Olkin measure of sampling adequacy were used to test whether principal component analysis of factor analysis was appropriate for the selected factors.

2.3 Principal Component Analysis
Principal component analysis (PCA) is a statistical procedure that uses orthogonal transformation to transform a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables known as principal components (Jolliffe, 2002). The number of principal components therefore is less than or equal to the number of original variables. This transformation is defined in such a way that the first principal component account for the largest possible variance, and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to (i.e., uncorrelated with) the preceding components. Principal components are guaranteed to be independent if the data set is jointly normally distributed. PCA is sensitive to the relative scaling of the original variables.

2.4 Principal Component Analysis (PCA)
PCA is mathematically defined as an orthogonallinear transformation that transforms the data to a new coordinate system such that the greatest variance by some projection of the data comes to lie on the first coordinate (called the first principal component), the second greatest variance on the second coordinate, and so on.
Consider a data matrix, X, with zero empirical means (the empirical (sample) mean of the distribution has been subtracted from the data set), where each of the n rows represents a different repetition of the experiment, and each of the p columns gives a particular kind of datum (say, the results from a particular sensor).
Mathematically, the transformation is defined by a set of p-dimensional vectors of weights or loadings $W_{(k)} = (w_{1, \dots} w_p)_{(k)}$ that map each row vector $X_{(i)}$ of X to a new vector principal component scores $t_{(i)} = (t_1, \dots t_p)_{(i)}$ is given by

$$t_{k(i)} = x_{(i)} \cdot w_{(k)} \quad \text{.............................. (1)}$$

In such a way that the individual variables of **t** considered over the data set successively inherit the maximum possible variance from **x**, with each loading vector **w** constrained to be a unit vector.

2.5 First Component

The first loading vector $w_{(1)}$ has to satisfy

$m=2$

Equivalently, writing this in matrix form gives

$$w_{(1)} = \frac{\arg\max}{\|w\|=1} \left\{ \left\| Xw \right\|^2 \right\} = \frac{\arg\max}{\|w\|=1} \left\{ w^T X^T Xw \right\} \text{.................. (3)}$$

Since **w**(1) has been defined to be a unit vector, it equivalently also satisfies

$$w_{(1)} = \arg\max \left\{ \frac{w^T X^T Xw}{w^T w} \right\} \text{....................... (4)}$$

The quantity to be maximized can be recognized as a Rayleigh quotient. A standard result for a symmetric matrix such as **X^T X** is that the quotient's maximum possible value is the largest eigenvalue of the matrix, which occurs when **w** is the corresponding eigenvector. (Jackson, 1991)

With $w_{(1)}$ found, the first component of a data vector **x**(i) can then be given as a score $t_1(i) = x_{(i)}$. $w_{(1)}$ in the transformed co-ordinates, or as the corresponding vector in the original variables, {**x**(i). **w**(1)} **w**(1).

2.6 Further Components

The kth component can be found by subtracting the first k − 1 principal component from **X**:

$$\hat{X}_{k-1} = X - \sum_{s=1}^{k-1} Xw_{(s)} w_{(s)}^T \text{.............................. (5)}$$

And then finding the loading vector which extract the maximum variance from this new data matrix

$$w_{(1)} = \frac{\arg\max}{\|w\|=1} \left\{ \left\| \hat{X}_{k-1} w \right\|^2 \right\} = \arg\max \left\{ \frac{w^T \hat{X}_{k-1}^T \hat{X}_{k-1} w}{w^T w} \right\} \text{............... (6)}$$

It turns out that this gives the remaining

eigenvectors of **X^{T}X**, with the maximum values for the quantity in brackets given by their corresponding eigenvalues.

The kth principal component of a data vector **x**(i) can therefore be given as a score $t_k(i) = x(i)$. **w**(k) in the transformed co-ordinates, or as the corresponding vector in the space of the original variables, {**x**(i) . **w**(k)} **w**(k), where **w**(k) is the kth eigenvector of **X^{T}X**.

The full principal components decomposition of **X** can therefore be given as

$r = 0$

where **w** is a p-by-p matrix whose columns are the eigenvectors of **X^{T}X**

2.7 The Eigenvalue Problem

Consider a square matrix A with a full rank of **N**. A vector **w** is considered to be eigenvector of A with associated eigenvalue } if

$$Aw = \} w \quad \text{...} \text{(8)}$$

The eigenvalue problem can be resolved analytically by subtracting $\} w$ from both sides,

$$(A - I\}) w = 0$$

.... (9)

Taking the determinant of both sides yields an Nth order polynomial in } known as the characteristics polynomial of A,

$$\det(|A - I\}|) = 0$$

.... (10)

The N roots are the eigenvalues, and each eigenvalue $\}_k$ has a corresponding eigenvector **w**k.

Every solution of the eigenvector problem is a paired eigenvalue and corresponding eigenvector $(\}_k, w_k)$. From equation (15), it should be noted that if **w** isan eigenvector, and k is an arbitrary scalar, then **kw** is also an eigenvector with the same eigenvalue. Given a non-repeating eigenvector }, the corresponding eigenvector is unique except for scale k. Without loss of generality, eigenvectors are usually scaled such that

$$|w| = \sqrt{w^T w} = 1$$

.... (11)

If the eigenvalue $\}_k$ are unique, that is non-repeated, then a unique eigenvector exists for

each eigenvalue. The normalised eigenvectors $\mathbf{w}_k$ are othonornal

$$w_j^T w_k = \partial_{jk}$$

.... (12)

Let a modal matrix **W** be a matrix whose columns are the normalised eigenvector of **A,**

W = [w₁   w₂ w₃.................wₙ]....................................... (13)

In general, there are N! Permutation of eigenvectors. Without a loss of generality, order the vectors such that the eigenvalues are non-increasing,

$$\}_1 \geq \}_2 \geq ... \geq \}_N .$$

Again let Λ be defined as a diagonal matrix comprising of the main diagonal of the eigenvalues of A

$$\Lambda = \begin{bmatrix} \}_1 & 0 & . & . & . & 0 \\ 0 & \}_2 & . & . & . & 0 \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ 0 & 0 & . & . & . & \}_N \end{bmatrix}$$

The eigenvalue problem can therefore be restated in a matrix notation as:

$$A = W\Lambda W^T$$

....

(14)

Whenever equation (21) is satisfied, A is said to be diagonalizable. The orthonormality condition can therefore be stated be stated

$$WW^T = W^T W = I$$

....(15)

3.0 RESULTS
This section presents the results of the findings of the study using frequency tables and principal component analysis.

3.1 Objective one: To investigate the factors that influence customers' choice of a particular mobile telecommunication service provider.

Table 3.1: Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Spherity

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.832
Bartlett's Test of Sphericity	Approx. Chi-Square	1588.926
	df	28
	Sig.	.000

Source: SPSS Output

Table 3.2: Total Variation Explanation

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.274	53.420	53.420	4.274	53.420	53.420
2	1.115	13.936	67.355	1.115	13.936	67.355
3	.788	9.850	77.205			
4	.528	6.602	83.807			
5	.494	6.177	89.984			
6	.295	3.686	93.670			
7	.277	3.459	97.129			
8	.230	2.871	100.000			

Source: SPSS Output

252
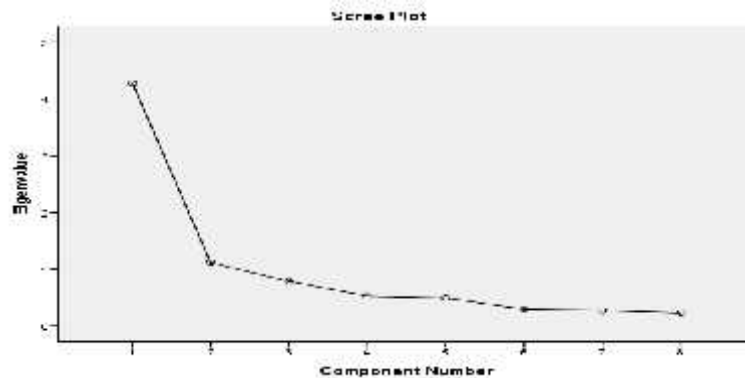
Figure 3.1: Screen Plot of Eigenvalues for the Components
Source: SPSS Output

Table 3.3: Component Matrix of the Factors That Influence Customers' Choice of Particular Network.

Factors	Component	
	1	2
Quality of reception	.703	.130
Coverage	.783	.003
Tariffs/billing	.760	.067
Reliability of service	.672	-.555
How easy it is to make calls	.776	-.414
Customer relations	.610	.529
Response to your complaints to call centers	.669	.553
Availability of service at all time(Maintainability)	.846	-.170

Source: SPSS Output

3.2:Objective Two: To Determine the Factor That Motivate Customers' Choice of A Second Network
 Table 3.4: Factors That Motivate Consumers Choice Of A Second Network

Reason for another mobile phone service		Networks						Total
		Vodafone	Tigo	MTN	Airtel	Expresso	Glo	
Because of the free night calls new network offers	Count	13	0	5	3	4	0	25
	% of Total	3.2%	0.0%	1.2%	0.7%	1.0%	0.0%	6.2%
I want to have the experience of	Count	14	6	40	8	0	5	73

using all the networks	% of Total	3.5%	1.5%	10.0%	2.0%	0.0%	1.2%	18.2%
Because all my friends are using that network	Count	18	7	54	5	16	9	109
	% of Total	4.5%	1.7%	13.4%	1.2%	4.0%	2.2%	27.1%
In case of a failure in one network	Count	18	16	43	13	10	9	109
	% of Total	4.5%	4.0%	10.7%	3.2%	2.5%	2.2%	27.1%
Because they offer a better call reception	Count	14	4	11	8	0	0	37
	% of Total	3.5%	1.0%	2.7%	2.0%	0.0%	0.0%	9.2%
My old network is charging too much	Count	3	3	17	1	0	1	25
	% of Total	0.7%	0.7%	4.2%	0.2%	0.0%	0.2%	9.2%
The new network is not expensive to use	Count	5	1	16	2	0	0	24
	% of Total	1.2%	0.2%	4.0%	0.5%	0.0%	0.0%	6.0%
Total	Count	85	37	186	40	30	24	402
	% of Total	21.1%	9.2%	46.3%	10.0%	7.5%	6.0%	100.0%

Source: SPSS Output

3.3 Objective Three: To measure the level customers' satisfaction.
Table 3.5: The Level of Customer Satisfaction.

Measurement Indicators		Freq.	Percent	Cumulative Percent
Valid	Not at all satisfied	72	14.4	14.8
	Not satisfied	170	34.0	49.6
	Satisfied	210	42.0	92.6
	Extremely Satisfied	36	7.2	100.0
	Total	488	97.6	
Missing	System	12	2.4	
Total		500	100.0	

Source: SPSS Output

Table 3.6: Chi-square Test on The Correlation Between Packages of Networks And Customers' Choice for a Second Line.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	79.829	30	.000
Likelihood Ratio	92.956	30	.000

Linear-by-Linear Association	.680	1	.410
N of Valid Cases	402		

A Pearson Chi-square value of 79.829, statistically significant, and it is indicative of the fact that there is some level of association between extraordinary packages of other network and customers choice of owing a second line. In conclusion, customers are motivated to own other networks as their second line due to exclusive package of these networks.

3.4 Objective Four: To investigate the customer share of the individual mobile Telecommunication service providers

Table 3.7: The Market Share of Networks of the Individual Telecom Service Providers

Vodafone	131	26.2	26.2
Tigo	46	9.2	35.4
MTN	221	44.2	79.6
Airtel	43	8.6	88.2
Expresso	34	6.8	95.0
Glo	25	5.0	100.0
Total	500	100.0	

Source: SPSS Outputs

4. DISCUSSION
This section explains the tables and figures that were produced with SPSS. These tables are shown under results.

4.1 Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Spherity
Table 4.1 shows two tests that indicate the suitability of Principal Component Analysis. It was observed that Kaiser-Meyer-Olkin Measure of Sampling Adequacy which measures the proportion of variance in the latent factors revealed that the PCA is effective or very useful (0.832) to be used for telco variables. The second test, the Bartlett's test of sphericity tests the hypothesis that correlation matrix is an identity matrix, which indicate that factor variables are unrelated and therefore unsuitable for PCA is rejected. The Bartlett's test (0.000) in the table shows a significance influence PCA have on selected telco variables. This indicates that all the factors selected are useful in the analysis and therefore there is no need to include or exclude some of the factors in the model.

4.2: Total Variation

The variance explained by the initial solution, extracted components, and rotated components is displayed in Table 4.2 which shows the Initial Eigenvalues. The Total column gives the eigenvalue, or amount of variance in the original variables accounted for by each component. The % of Variance column gives the ratio, expressed as a percentage, of the variance accounted for by each component to the total variance in all of the variables. The Cumulative % column gives the percentage of variance accounted for by the first two components.

4.3: Scree Plot of Eigenvalue for Components
The scree plot of figure 4.1 determines the optimal number of components to be considered in the model. The eigenvalue of each component in the initial solution is plotted. The components on the shallow slope contribute little to the solution. The last big drop occurs between the second and third components; therefore it is essential to consider only the first two components for factor loading.

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4.4: Component Matrix for the Factors That Influence Customers Choice for a Particular Network.

Table 4.3 represents PCA model derived from table 4.2 using extraction method. Eigenvalues of 4.274 and 1.115 respectively was derived for components one (1) and two (2) which were loaded on the other indicators. It was realized that all the indicators on component one are highly correlated with factors that influence customers' choice of a particular network while most of the indicators on component two move in different direction. It was observed that availability of service at all time (maintainability) was the variable which was highly correlated (0.846) with the selection of customers 'choice of a network which was followed by network coverage (0.783) on component one. This implies that customers' selection of a particular network is based on availability of service and coverage and vice versa. The study found that respondents ability to make calls easily (0.776), tariffs/billing (0.760) and quality of reception (0.703) were significant factors for choice of network selection. The rest of the variables on component one were all strongly correlated with customer choice to for selecting a network provider.

It was revealed that on component two that the variables were weakly and negatively correlated with the factors with the exception of customer relations (0.529) and response to customers' complaints (0.553) which were moderately correlated with customers' selection of network provider. The study found that what influence customer choice of network provider selection are well loaded on component one than that of component two.

4.5: Factors That Motivate Customers Choice of a Second Network

The table revealed that, 6.2% of the total respondent owns a second network because of friend on that particular network; 18.2% claimed that they want to have experienced of other network: 27.1% claimed that, their reason for a second network is because of failure of their main line. Another 6.2% claimed that their reason for a second network is because better reception. 6% claimed that their reason is because the second network is less expensive, and lastly, 9.2% responded that their old networks are charging too much.

4.6: Measurement of Consumer Satisfaction
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Table 4.5 represents the level of satisfaction, or otherwise of the five hundred (500) customers of telecommunication service providers in the Eastern Region. The table shows that 7.2% the respondents are extremely satisfied with the service providers, and 42% indicated that they are satisfied. Again, 14.4% claimed that they are not satisfied at all, whereas 34% indicated not satisfied.

4.7: Chi-square Test on the Correlation between Packages of Other Networks and Owing a Second line

Table 4.6 has a Pearson Chi-square value of 79.829, which is statistically significant, and it is indicative of the fact that there is some level of association between extraordinary packages of other network and customers choice of owing a second line. In conclusion, customers are motivated to own other networks as their second line due to exclusive package of these networks.

4.8: The Market Share of the Individual Telecom Service Providers.

Table 4.7 revealed that, MTN has the largest market share in the Eastern Region. It had 44.2%, out of a total of 500 customers interviewed. The second largest telecom operator is Vodafone. It had 26.2%, of the customers interviewed. Tigo is the third largest telecom operator, with a market share of 9.2%. The rest are Airtel, Expresso and Glo respectively.

4.9: Challenges of Telecommunication Service Providers

A structured questionnaire to the managers the six telecommunication service providers in the region revealed cable theft, power fluctuation and outage, price war, high direct and indirect tax, sim box fraud, and highly competitive industrial.

5. CONCLUSION

The sovereignty of the consumer in the capitalist market cannot be underestimated in the wake of global competition. Industrial players, therefore, compete in order to increase their market size. Such fierce competition is seen in the Ghana telecommunication industrial, which consist of six firms, namely, MTN, Vodafone, Tigo, Airtel, Expresso, and Glo. The study was therefore conducted to among others things, investigate the factors that influence customers' choice for a particular

telecommunication network, to determine the factors that motivate customers choice for a second network, to determine the market share of the individual Telco, to investigate the challenges of the telecom service providers, and to measure the level of customers' satisfaction.

Principal Component Analysis (PCA) was used to investigate the factors the factors that motivate consumers' choice of a particular network. The appropriateness of PCA for the telecom variable was determined by first conducting Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Spherity which revealed KMO value of 0.832, which is significant for the application of PCA. Again, theBartlett's test of sphericity revealed that the correlation matrix is identical, thus, we failed to reject H_o. Eigenvalues of 4.274 and 1.115 were derived for the first and the second components (Availability of network and Network coverage). It was evident that all the indicators on component one were highly correlated with the factors that influence customers choice for a particular Telco, while most indicators on component two moved in different direction. Again, table 3.2, revealed that, only the first and the second components accounted for over 67% of the total variation regarding a consumers' choice of a particular network. Figure 3.1, pictorially, represented this claim. Significant drops occur between the second and the third component, therefore, it is imperative that only the first and the second components may be considered for factor loading.

Again, respondents claimed that free night calls, the desire to experience other networks, failure of other networks, high call prefer to have a second network, a chi-square value of 0.897 meant that there is a strong correlation between packages other networks offer and customers desire for a second network.
Furthermore, table 3.5 shown that 7.2%, the respondents are extremely satisfied with the service providers 42% indicated that they are satisfied, 14.4% claimed that they are not satisfied at all, whereas 34% indicated not satisfied.

Table 3.7 revealed that, MTN has the largest market share in the study area. It had 44.2%, out of a total of 500 customers interviewed, and followed by Vodafone with 26.2%. Tigo is the third largest telecom operator (9.2% market share). The rest are Airtel, Expresso and Glo respectively.

Lastly, the telecom service operators claimed to have cable theft, simbox fraud, stiff competition, power fluctuation and outages, high cost of utility, and fuel as their major challenges in their operations.

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Communication and Motivation - Tools for Project Success in the Ghanaian Construction Industry

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Abstract
The success of a given construction project is affected by a couple of factors. Quality, time and cost have become well linked up to project success but the changing trends of construction brings to the fore other factors. Effective communication within an organization and between institutions contributing to the construction project can improve motivation levels and the project cycle. Conversely, ineffective communication can result in a demotivated workforce and problems in production.This research was aimed at ascertaining the effect of communication, motivation and demotivation on the construction industry in Ghana. Through literature reviews, interviews, site visits and site meetings, data was obtained, analysed conclusions and recommendations drawn. From the research, it was concluded that effective communication and motivation in the construction industry is a major factor leading to a project's success. It is recommended that the modes of communication and motivation of workmen should be enhanced for optimum project success.

Keywords: Construction; Communication; Success; Project; Motivation

1 INTRODUCTION

According to Frimpong-Manso (2008), the construction industry deals with economic activities such as renovations, extensions, repairs, refurbishments, creation of new structures, etc. The industry is noted for being a major employer of both skilled and unskilled workmen (Owusu Tawiah, 1999).

In the construction industry, site workers account for 40% of direct capital cost of large construction projects and there is the need to maximize the productivity of human resources (Thomas et al, 2004). More so 30% to 50% of workers time is spent directly on the work and, hence, there is the need for proper utilization.

Communication is an important topic in the construction industry, as also reported in the literature. Communication in construction is a means by which operatives and other members of the building team are linked (considering construction) in order to achieve the overall goal.

There are different communication instruments, such as contracts, specifications, reports, manuals, schedules, calculations, drawings, computer files, disks, print-outs, photographs, agendum and minutes of meetings (Knipe, 2002). All these documents describe different range of usage at different project lifecycle.
It is understood that without proper standard documents and communication structure, the

development of a project could be delayed. Communication is used to express facts, ideas, opinion and emotions between two or more people and through communication, exchange of thought, information is also a good tool for human relation (Knipe, 2002).

Successful communication between construction parties is critical to the overall success of a construction project. Often problems in construction are referred to as communication problems (Emmerson, 1962); (Higgins and Jessop, 1965); (Latham, 1994); (DETR 1998).

Due to its characteristics, the construction industry forms a complex communication environment. Construction is a fragmented and dynamic sector with a project based nature. This makes that many stakeholders operate in frequently changing sets of relationships which are contractually driven Communication can be described as a two way process as information is not only sent but also received, understood and implemented (Adeleke, 2004).

Problem Statement and Justification
Lack of workers' motivation on construction sites has been identified as a contributor to the high employee turnover (Thomas et al, 2004). This has been a result of the difficulties in emphasising the positive side of worker motivation. These have generated numerous attempts over the years to enhance workers' motivation as it is essential to eliminate the

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negative side of motivation which may be more psychological.

Contemporary research and observations show that well motivated employees are more productive and creative towards achieving company or organizational goals. On the other hand de-motivated employees are less performing and tend to divert from attaining organizational goals. Motivation as incentive systems are fundamental to developing capacities and to translating developed capacities into better performance.

Some researchers have often referred to the problems in construction to communication problems (Emmerson, 1962); (Higgin and Jessop,1965); (Latham,1994); (DETR,1998). Due to its specific characteristics, the industry forms a complex communication environment. Construction is a fragmented and dynamic sector with a project-based nature. This means that many stakeholders operate in frequently changing sets of relationships which are contractually driven. The culture shows a reality of conflicts and lack of mutual respect and trust (Dainty et al, 2006).

Effective communication has not been given the needed attention in the construction process by construction firms thereby creating many challenges in information dissemination. As a result of this poor attitude in the industry, it is found necessary to create solution to such problems through this research to help improve communication in construction firms.

Aim and Objectives
The research aims at investigating the effect of communication on construction sites and also to ascertain on impacts of motivation and demotivation factors on the performance of workers in the construction industry.
To achieve this aim, the following objective was analysed:
1. Identified the modes of communication in the construction industry
2. Assessed the factors that affect communication in the construction industry.
3. The effect of motivation and demotivation of workers on work performance.

4. To make recommendations enhancing the performance of the construction industry.

Communication
Communication is commonly defined as the transference of meaning from one person to another (Berlo 1960) and is known to be affected by such things as beliefs,attitudes, values and knowledge. It can also be defined as the formal and informal sharing of meaningful and timely information between organisations (Anderson and Narus 1990).

Dainty et al. (2006) describe communication as a link between people where information flows. Further, Dainty et al. (2006) list five different aspects that together constitute the science of communication.
1) Firstly it is fundamentally a flow of information;
2) Secondly it aims to work as a tool to aid interpretation;
3) Thirdly it is a skill governed by social ability;
4) Fourthly it is the foundation to building interpersonal relations; and
5) Fifthly it is a necessity when exchanging information within a multi-facetted group.

Communication in construction
A number of researchers have outlined four reasons why improvements in communication are needed.
The first reason is that an improvement in the communication within the building team (Higgin and Jessop, 1965) or project teams (Thomas et al 1998) and between project manager and contractors (Franks, 1998), (Somogyi, 1999) could reduce project failures.
Second, more open communication at all levels could lead to innovations (Lenard and Eckersley, 1997) and better technical solutions (Sörensen, in Atkin et al 2003). Third, communication improvements in early phases of projects would positively influence the quality as perceived by all stakeholders involved (Emmit and Gorse, 2003); [Brown 2001); (Usmani and Winch, 1993).

Finally, improved communication during the briefing might lead to better decision making; for example less haste in moving to solutions
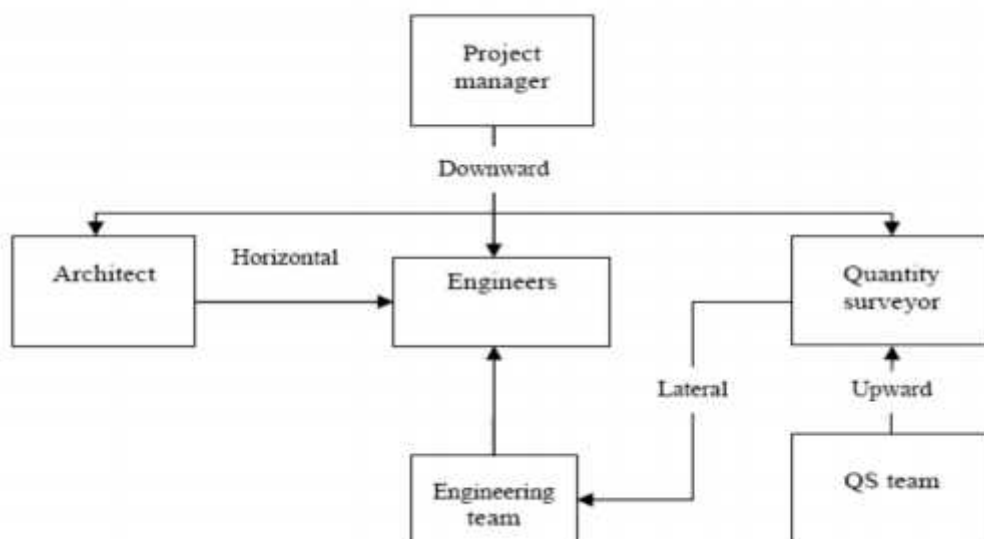
and better ways of looking at the requirements first (Salisbury 1998).

Communication is influenced by several factors. These factors are explained as follows: The first type of factors is related to the organization of the construction process. Main aspects are the differences between formal and informal communication routes during the design phase (Mackinder and Marvin,1982) as well as during the phases of development (Pietroforte 1992), (Higgin and Jessop 1965); and the separation of design and production (Hill 1995); (Emmerson 1962).

The second type of factors is related to the stakeholders themselves. Opposing interests could lead to hidden agenda, often leading to restricted communication (Richardson 1996); (Brown 2001); (Cuff 1996); (Preiser 1993); (CIB 1997);(DETR,1998), and all stakeholders' (assumed) frames of reference are found of great influence on communication as well (Moore and Dainty 2001); (Salisbury and White 1980]; (Gray et al 1994);(O'Reilly 1996); (Usmani and Winch 1993).

The flow of communication in the construction industry takes place in four directions: downwards, upwards, horizontally and laterally. Figure 1 below shows the communication flows as adopted by Smit& Cronje, (2002).

Figure 0.1 Communication Flows: Source (Adapted from Smit& Cronje, 2002)

Modes of Communication

The modes of communication have presented a challenge to construction projects in how these are used and which are preferred (Tai et al., 2009). A study performed by Gorse (2002) it was found that all of those surveyed found each communication mode having varying degrees of effectiveness.

Adeleke, (2004), explains the various means by which information can be transmitted in the construction industry for the successful execution of any project as the success of such project relies largely on the establishment of a clearly defined framework or communication. The usual means of communication as stated by Adeleke (2004), are as follows:

❖ The print media (e.g. Newspapers, bulletins, magazines etc.).
❖ Drawn and visual materials(e.g. drawings, programmes and charts, photographs)
❖ Verbal (site meetings, site visits, other forms of vocal discussions).
❖ Written materials (e.gs. Specification, Schedules, Bill of quantities, Certificate of payment, Tender document, Reports, Letters).
❖ Notice board.

Motivation of construction workers

Pinder (1998, cited in Dwivedula and Bredillet, 2010, p. 158) defines work motivation as:

"A set of energetic forces that originate both from within and beyond the individual's being leading to work-related behaviour in terms of determining the form, direction, and intensity of this behaviour"

This definition is very similar to the one provided by Latham and Ernst (2006, p. 181) which in addition emphasize that it is a

psychological process that results from the interaction between the individual and the environment.

Motivation in the organisation context has traditionally been related to issues such as: secured job, interesting job, ability to perform the job, recognition from others, adequate salary and feedback on performance (Dwivedula and Bredillet, 2010). People are motivated if they feel they are valued in the organisation, as stated by PMI (2008, p. 234).

Demotivation of construction workers

Site workers (labourers) account for up to fortyper cent of the direct capital cost of large construction projects (Yisa, et al, 2000). There is a need to maximize the productivity of labour resources to improve performance in the construction work as observed by Ng, et al (2004). However, research has shown that only a third to a half of workers' time is spent on direct work activities (Uwakweh, 2000).

According to Adjei (2009), motivating workers is as important as attracting and retaining the workers. Without the ability to motivate workers, they may become mediocre workers. Workers cited lack of employment in the country, hence, had to be content with whatever environment in which they were engaged in. Workers always deliver their best whenever tasks they were assigned within the stipulated time.

Studies have found that an unsatisfactory work environment can have adverse effects onworker motivation, and motivation is directly linked to productivity [(Borcherding and Oglesby, 1977) and Chishty and Choudhry(1996)]. Workers who areinadequately motivated become apathetic or even resentful of their work.

Unmotivatedworkers tend to make only a minimal effort, with a commensurate lowering of potentialoverall output and quality of work. Since the workers are directly responsible for carrying outthe construction work, suitable motivation is necessary for maximizing their productivity.

Demotivation of construction workers may be mitigated through the recognition of basic human needs, giving praise, and providing adequate management support (e.g.

preplanning, scheduling and coordination) Luthens (1998). To help construction managers improve worker productivity, the factors that are likely to induce worker demotivation on their specific sites need to be identified.

Six key de-motivational factors were identified in literature. Factors such as 'Poor work condition', 'poor administrative policy' and 'Poor work relationship' were selected from the Herzberg's two factor theory (1968). The factor 'My colleague gets more benefit than me in spite of his/her lower performance' was obtained from Adam's equity theory (1965). 'Lack of communication' and 'lack of appreciation' were derived from other established studies (Borcherding, 1977; U.S business roundtable proceedings, 1982).

According to Adjei (2009), various researches have been undertaken to investigate reasons that usually contributes to the inability of projects to achieve set targets. Some of the findings are listed below:

a)   Late payment of wages and salary,
b)   Low teamwork,
c)   Late inspection by consultants,
d)   Late instruction from consultants,
e)   Late delivery of drawings,
f)   Frequent variations in design,
g)   Absenteeism of personnel and
h)   Delay in task completion by other crew

Criteria for Successful Construction Project Delivery

Construction project development involves various parties, various processes, different phases and stages of work with a great deal of input from public and private sectors. The major aim is to bring the project to successful completion. The successful delivery of construction project development activities depends on the quality of managerial, financial, technical and organisational performance of the respective parties (Lim. and Zain, 1999). The common assessment of the success of construction project is that they are delivered on time, to budget, to technical specification and meet client satisfaction.

Successful project delivery should be viewed from the different perspective of individual, owner, developer, contractor, general public etc. Project success is normally thought of as the achievement of some predetermined project goals, which commonly include multiple parameters such as time, cost, performance,

quality and safety. Often the client and contractor would generally consider a project to be successful as long as their respective project objectives are achieved, particularly the financial ones (Lim. and Zain, 1999).

The criteria of time, cost and quality have long been used to evaluate the performance and success of development projects (Chan el al, 2002). This criterion has been named as "the iron triangle" (Atkinson, 1999). Although these basic criteria (cost, time and quality) are easy and timely to measure, they have been criticized for being inadequate for several reasons. Researchers have argued that these basic criteria are insufficient on their own unless they are continuously measured. These parameters do not provide an adequate vision of the potential for improvement and the information obtained usually arrives too late for corrective action to be taken. Project success is a strategic management concept where project efforts must be aligned with both short and long term goal of the company.

2 MATERIALS AND METHODS

A survey study was deemed appropriate for this research for three reasons:

- Survey research involved data collection from a group, generalizing the result of study to predict the attitude of the population of interest;
- The survey questionnaire may be structured to elicit information from the population of interest in a systematic and unbiased manner; and
- They permit statistical analysis of data and generalization to a larger population, which makes them suitable to construction management research.

2.1 Sample Design Process

The purpose of the sample was to gain information about the population by observing only a small proportion, i.e. the sample size.

Population Definition

The selection of the respondents was limited to only the D1K1 Building Contractors, Consultants comprising mostly Quantity Surveyors and Architects and Clients in the Greater Accra and Eastern regions. The choice of this class of building contractors was made on the basis that they are well established firms with their offices quite easily to be located.

Clients consisted of public and private individuals, e.g. Ministries, Departments Agencies, District Assemblies, Financial institutions, etc.

The decision to focus on these two regions was based on the list obtained from the Association of Building and Civil Contractors which showed about 39% of D1 building contractors are located in Accra and Koforidua, 20% in Kumasi,25% in Central and Volta regions and 16% representing the remaining regions. In addition, the limited time available for the study and financial constraints did not allow the researcher to travel to the other regions.

Sampling Techniques Used

Purposive sampling was used in the selection of Contractors for the study. This resulted in D1 contractors from the Greater Accra and Eastern regions to be selected since the researchers believed that they were representative to the population of interest and could give practical and convincing answers to the questions asked. The random sampling technique, as a means of selection, was used to obtain the sample size for Consultants.

Sample Size Obtained

According to Israel (1992) there are several approaches used in determining the sample size. These, include using a census for small populations, imitating a sample size of similar studies, using published tables, and lastly applying formulas to calculate a sample size. For this study the first and the latter were applied.

The total number of registered consultants was 65. The sample size was determined using the formula (Kish, 1965).

(i)   statistical formula as stated below:

$$n = \frac{n1}{(1 + n1/N)}$$

Where,
n = Sample Size
n1 = S^2/ V^2
N = Population Size =65
S = Maximum standard deviation in the population element (Total error = 0.1at a confidence level of 95%)
V = Standard error of sampling distribution = 0.05
P = The proportion of the population elements that belong to the defined class.
S2 = P (1-P) = 0.5(1-0.5) = 0.25

$V^2 = 0.05^2 = 0.0025$

$n1 = \frac{0.25}{0.0025} = 100$

$$n = \frac{100}{1 + (100/65)}$$

$n = 39$

The sample size formulae like the one used above, provides the minimum number of responses to be obtained. From previous works done, researchers such as Cochran (1963), and Israel (1992) commonly add 10% to the sample size to compensate for persons the researcher is unable to contact and a 30% increase on the simple size to compensate for non-response.

The sample size for the consultants was therefore increased by 40% accordingly as follows:

$n = \frac{140}{100} \times 39 = 55$

Thus a total of sixty five (65) questionnaires were personally sent (in the case of those offices which were easily located) and those whose offices could not be reached were telephoned for directions. This number of questionnaires was sent out to allow the size to be larger than the required (n=55) for a desired level of confidence and precision and also since the difference between the population (N) size and the sample size (n) was not much.

The population sizes (N) for the clients and D1 contractors targeted for this study was 30 each, as a result the use of census for small populations was used to obtain the sample sizes of the D1 contractors(n=30) and Clients(n=30).

In all the sample sizes targeted for the study were 65, 30, and 30 for consultants, clients and contractors respectively, making the total of 125.

Response Rate

Sixty-five (65) questionnaires were issued to the consultants comprising largely of QS firms and a total of 50 were received representing 77% rate of return. Thirty (30) questionnaires were also issued to the D1 contractors and a total 27 were received representing 90% rate of return. Finally 20 answered questionnaires were received from the clients' organization representing 67% rate of return. All these are represented in table 1 below.

Table 1a Response rate of respondents

Contact Group	Questionnaires Issued	Response	Percentage Response (%)
CONTRACTORS	30	27	90
CONSULTANTS	65	50	77
CLIENTS	30	20	60
TOTAL	**125**	**97**	**77.6**

In addition to the above, one hundred and six (106) respondents were contacted on issues relating to the motivation and demotivation of the construction worker. The status of the respondents are shown in table 2 below

Table 2: Occupation of workmen

S/N	PROFESSION	NUMBER
1	Supervisors	5
2	Masons	17
3	Steel benders	12
4	Carpenters	16
5	Painters	10
6	Electricians	8
7	Plumbers	8
8	Labourers	30
Total		106

2.2 Research Methodology

In order to achieve the objectives, the study focused on contractors, clients and consultants in the industry. This was because these contact groups are those who are directly confronted with these issues as they occur in the industry.

Literature Review

Works done by other researchers relating to communication and motivation in the construction industry and other relevant documents were reviewed. This guided the research team in selecting the best methods for the research from which salient conclusions and recommendations were drawn.

Primary Data Collection

Under the primary method of data collection, information was collected from various contractors, consultants and clients. The following methods of data collection were used in the research:

Field Survey: the researchers visited various construction sites, offices of consultants and clients to obtain basic information for the work to be done. Site meetings were also attended to obtain data.

Structured Questionnaires: Questionnaires were sent out to seek information.
Interviews: key informants and personnel were interviewed to share their experience and knowledge with the researcher.
Data Analysis: Statistical methods were used for the analysis of the data obtained from the tests. This gave a more scientific basis for the conclusions and recommendations derived.

3 RESULTS AND DISCUSSIONS

Questionnaires were sent to 125 persons, consisting of clients, consultants and contractors of which 97 responses were received for a response rate of 78%. The respondents were made up of consultants, clients and contractors. For the assessment of the motivation of workers, the researchers sampled the knowledge of one hundred and six workers alongside that of the contractors and consultants.

Demographic variablesof the Respondents
Results from the survey indicated that 26.7% of the consultants were Quantity surveyors, 30.6% by Construction Project Managers, 22.4% by Architects, 20.3% by Civil/Structural Engineers.
The above information indicates that the respondents, who are often involved in key communication decisions, handled a lot of the questionnaires. About of 77% of the respondents had more than 5-years of experience in the construction industry. It was necessary to find out the working experience of the respondents so as to be able to obtain practical and convincing answers to the questions asked

All the stakeholders contacted agreed to the fact that effective communication is very essential for the success of a given construction project.

Modes of communication and frequency of usage
From the research, verbal (face-to-face) communication is the most frequently used means of communication in construction projects in Ghana, with 89.7% frequency. The

second most frequent means of communication with 76.3% is drawn and visual materials. The third most frequent means of communication is the use of written materials representing 74.2% of the frequency. The notice board as a means of communication in construction projects is in medium use with 57.8% frequency. The frequency of usage of print media for communicating in construction projects in Ghana is very low.

Factors affecting communication in construction projects
From the interactions with the respondents, five (5) most important communication factors (in order of significance) which contribute to construction project success in Ghana that were identified, according to the three contact groups, are:
1. Appropriateness of organizational structure in managing the Project (i.e. well laid out lines of responsibility, delegation and communication at site).
2. Clarity of project scope and definition
3. Adequacy of information at the briefing and design stage
4. Proper documentation
5. Separation of design and construction activities

It can therefore be inferred that when an organisation is well structured to manage a project and the project scope is well defined, it makes a significant contribution to the success of the project. Adequate information on a project at the early stages of and proper documentation on the project are also major determinant of the success of a project. When design and construction are done by two separate parties and there is no collaboration between these parties, the success of the project can greatly be affected.

Effects of Motivational and De-motivational factors on Performance of workers
Effects of De-motivational factors on performance of workers
According to the contractors, the top five demotivating factors that affect the performance of workers are:
1. Late payment of interim certificates.
2. This results in the shortage of funds for payment of worker's remunerations and procurement of materials for work.
3. Late issuance of construction drawings. This results in the slowdown of work

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and sometimes giving of instructions that are not in the approved drawings by the consultants on a given project.
4. Materials shortage. Workmen tend to idle about causing loss of man-hours.
5. Making of corrections on wok done or rework due to constructional errors is really demotivating.
6. Slow response of staff of consulting firms for site inspections and instructions affects performance.

The workmen indicated that the top five demotivating factors that affect the performance of workers are:
1. Rework due to variations and communication lapses;
2. Materials shortage on site;
3. Waiting for other crew;
4. Inadequate site planning;
5. Workers strike due to unpaid wages

Effects of Motivational factors on performance of workers
Both the contractors and workmen indicated that the performance of workers is highly motivated by a numbers of factors and these factors are ranked as follows:
4. Payment of salaries and financial
5. Provision of safety of plans
6. Job security of workmen
7. Provision of canteen services.

4.CONCLUSIONS AND RECOMMENDATIONS
Based on the research conducted above, the following conclusions were drawn
1. Effective communication is a major factor that contributes immensely to the success of every construction project. Therefore removing the various barriers of communication would culminate into saving time, stress and resources required for handling communication related problems.
2. Informal means of communication continues to be dominate the modes of communication and hence must be well structured to maximize its importance. This is because the verbal means of communication remains the most used approach.
3. It can also be concluded from the study that the most significant /important

factors that affect communication in the Ghanaian construction industry were:
a. Appropriateness of organizational structure in managing the Project (i.e. well laid out lines of responsibility, delegation and communication at site);
b. Clarity of project scope and definition;
c. Adequacy of information at the briefing and design stage;
d. Proper documentation;
e. Separation of design and construction activities;
4. The motivation of the workmen highly affects the performance of work on the site and the overall project success.

The following recommendation have been deduced form the research:
1. Construction contracts should incorporate the necessary requirements for all parties to the project to spell out communication strategies.
2. Construction companies should have well laid out communication units which would be responsible for all communication issues with the various stakeholders.
3. The wording in the contract documents should be clear and reflect the intention of the parties involved so that no party uses any contract language to unfairly shift risk to the other party without appropriate compensation
4. Prompt payment of the wages and salaries of workmen helps to keep them committed to the project whilst it is also necessary to issue instruction that would minimize if not avoid reworks.

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Evaluating the Implementation of Value Added Tax: A Case of Construction Industry in Ghana

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Abstract
The objective of the study is to assess the level of awareness and perception of contractors and consultants within the construction industry about Value Added Tax (VAT) implementations within the industry. Data was collected from 52 contractors and 8 consultants in Brong Ahafo Region of Ghana using questionnaires. Descriptive statistics was used to analyse the data. The study revealed that a large proportion (75%) of the respondents are aware of the need to register and charge Value Added Tax as a result of sensitisation workshops organised by Ghana Revenue Authority in the region. The consultants perceive the implementation of the Value Added Tax as important in national development however; they see the registration process as cumbersome. Contractors also had a good perception about Value Added Tax implementation within the construction industry but believed that they need more education about the modalities of registration and payment. The study further revealed that the state lost GH¢ 8,053,407.52 ($5,033,379.70) in the 2012 fiscal year due to non-compliance with the Value Added Tax by contractors and consultants in the region. In order to improve the implementation of Value Added Tax within the construction industry Ghana Revenue Authority must intensify education of the contractors on modalities of registration and payment. In addition issuance of the tax identification number should be decentralized in order to facilitate registration and eliminate unnecessary bureaucracy. Also the Registrar Generals' Department should encourage contractors to register for Value Added Tax upon registration of their company. Sanctions for non-registration and compliance of Value Added Tax should also be actively enforced.

Keywords: Value Added Tax; Construction Industry; Brong Ahafo; Ghana Revenue Authority

1. INTRODUCTION

The generation of income through tax is very essential for every nation's development. Tax revenue provides funds to support government business in all nations. Silvani and Baer [1997] noted that most African states are always in deficit funding with respect to their budget because about 60% of potential tax in these countries goes untapped. As a result, most of the countries in Africa have to depend on donor funds to support their budget [World Bank, (2005)]. However, with dwindling donor funds there is the need for an effective tax administration system. According to Hadler [2000] African countries can increase their tax revenue by 30% through efficient tax administrative system. Therefore, most of the African states, including Ghana, are making considerable effort to expand the tax net and also improve tax administration systems. An example includes the introduction of Value Added Tax in 1998 in order to expand the tax net and improve tax revenue to support the business of government. Value Added Tax was established by the VAT Act which replaces the sales tax legislation that was deemed to be too narrow in generating the needed revenue. The

contribution of VAT to government revenue over the years has seen a steady increase from 5% to 18%. The introduction of VAT was a very controversial issue. The tax was introduced in 1995 but had to be repealed because of some implementation challenges. These challenges included inadequate education of the public about the VAT system [Osei, (2000)]. The VAT rate of 17.5% was deemed too high because the sales tax rate which VAT replaces was 15% [Gray et al., (2001)]. In addition tax payers argued that the tax applied to a wider range of products and services compared to sales tax. The above issues lead to civil unrest; consequently VAT implementation was stopped by Parliament in June 1995 [World Bank, (2001); Osei, (2000)].

As a result of the enactment of the VAT Amendment Act 2002 (Act 629), section 16(c) of Schedule 1 of the VAT Act 1998(Act 546) has been repealed. In view of the VAT Law of 2002, works contracts are to attract VAT and the National Insurance Levy. This means that Client/Users are to pay VAT and NHIL on works since the value has been added to the material, equipment and labour inputs which

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constitute the components from which the work is obtained as a finished product. Under this amendment, items which attract Value Added Tax in the construction industry include demolition, maintenance work on building and roads as well as all costs associated with the construction of both roads and buildings. Examples of such taxable services include the following: installation of electrical fixtures; air-conditioners; communication equipment; sprinklers; safety equipment; aluminum glazing; provision of landscaping services; main works and roofing etc. The construction industry is very wide and made up of many parties. However, it can be said that the construction industry comprises of two main parties: contractors (building contractors, road contractors and sub-contractors) and clients. In Ghana the construction industry is large and plays a key role in the economic development of the country.

The flat rate scheme was introduced to encourage small and medium scale enterprises (SMEs) to register and charge VAT on their goods and services. This scheme is open to only retailers and SMEs whose average annual turnover is below one hundred and twenty thousand (GH¢120,000). This scheme attracts a 3% flat rate on goods and services.

Since its inception the laws governing VAT placed an emphasis on the goods and services and not on construction; meanwhile those in the construction industry are capable of receiving huge sums of monies as profit from central government, being the main client, upon completion of their projects. However, those businesses who supply goods and services (such as petty traders, retailers, other contractors) to government institutions and consultants are being asked to pay their VAT returns to the Domestic Tax Revenue Division of the Ghana Revenue Authority latest by the middle of every month based on their revenue generation.

With effect from 1st January, 2012 works contracts are to attract Value Added Tax (VAT) and National Health Insurance Levy (NHIL), pursuant to VAT Amendment Act, 2002 (Act 629); and therefore all contractors are to be registered to enable them to submit returns to the Domestic Tax Revenue Division of the

Ghana Revenue Authority. This scenario is a major issue facing the nation.

Apparently, the effort of government to reduce the account deficit and reduce over reliance on donor funds to support the national budget requires an improvement in revenue generation through taxation. This calls for the expansion of the tax net and an efficient and effective tax administration system: consequently tax reforms are needed to achieve the above goals. In Ghana, the introduction of VAT in the construction industry is one of the reforms which aimed at expanding the tax net and improving government revenue. However, the implementation of the VAT in the construction industry has not yielded the desired results as most of the contractors and consultant within the industry are not registered for VAT. Hence there is the need to understand the implementation challenges of the tax in the construction industry in order to formulate policies to improve the registration and VAT payment by the actors within the industry. Thus this study aimed at evaluating the implementation of the Value Added Tax on the construction industry in Ghana using the Brong Ahafo Region as a case study.

1.1 Concept of Taxation

Taxation is defined as "the levying of compulsory contributions by public authorities having tax jurisdiction, to defray the cost of their activities" (Ali-Nakyea, (2008)]. No specific reward is earned by the tax payer. The money collected is used by the government for the production and payment of goods and services, provision of infrastructure and maintenance of law and order. Agyeman [2005] also defines taxation as "the demand by the central or local government for a compulsory payment of money by citizens of a country other than as payment for some specific service or as a penalty for some specific offence". Other benefits of taxation are to decrease inequalities arising from the distribution of wealth; to restrain certain types of consumption, for example, alcoholic beverages and cigarettes; to protect home industries; and to control certain aspects of the country's economy.

Tax administration in Ghana has gone through a number of reforms like all other economies in which it is applied. Tax administration in developing countries has, however, not been effective due to some challenges it poses.

According to Tanzi and Zee [2000], institutional sustainability of an effective and efficient tax system in developing countries is not an easy task as it faces several challenges. These challenges include the structure of the economy; limited capacity of the tax administration; the poor quality of basic data; and the political set up.

1.2 The Construction Industry and Value Added Tax

The construction industry is very wide and made up of many parties. However, it can be said that the construction industry comprises two main parties: contractors (building contractors, road contractors and sub-contractors) and clients. The construction industry is governed by contracts which specify the terms and conditions agreed between the parties. In the construction industry, the contractor can be said to be the supplier and the client, the buyer. This is because in contractual terms, the client pays the contractor a sum of money in consideration of work done. This equates to the contractor selling the work done as goods to the client who pays for the cost of the completed work as if it were goods bought.

The construction industry is very important in the economic development of Ghana. It supports job creation and employs both skilled and unskilled labour. For example employment can be generated in the construction industry though physical infrastructural development. It also provides the needed infrastructure for other economic activities to take place. It is well known that an active construction industry adds to growth of the economy. Before the contractor can execute the work for the client he needs to the purchase materials, hire equipment and hire labour. This is where the input tax comes in with respect to construction work to be done. The contractor is expected to charge a standard rate of 15%; which comprises 12.5% Value Added Tax and 2.5% National Health Insurance Levy.

2. METHODOLOGY
3.1 Sources of Data

The data for the study were predominantly primary data collected from contractors and consultants who have registered their business with the Registrar General and are operating in the Brong Ahafo Region of Ghana. In all there were 60 registered contractors and eight registered consultants within the region. For the consultants all of them were interview due to their small number. However, in the case of the contractors the sample size was determined by using an estimation method given byBartlett et al. (2001).

$$n = N/1 + N(e)^2$$
Where
n is the sample size;
e = error level;
e = 1 – confidence level; and
N is the total population of registered contractors.

Assuming 95% confidence level, e = 0.05 and an estimated 60 registered within the study area as provided by the regional office of the Contractors Association, a sample size of 52 registered contractors were sampled for the study. The sample size for this research is 52 contractors and 8 consultans. A simple random sampling technique was used to select the respondents contractors.

2.1 Analytical Framework

Descriptive statistics such as frequency tables and percentages were used to present the socio–economic characteristics of respondents and their levels of awareness of Value Added Tax Law.The Chi-square test was used to assess if there is an association between educational level and VAT registration among the respondents. Kendall's Coefficient of Concordance (W) analysis was used to rank the items identified as constraints to the implementation of Value Added Tax by the respondents. The degree of agreement of the rankings by the contractors and consultants was then measured. W ranges from 0 to 1. In deriving W, let T, represents the sum of ranks for each constraint being ranked. The variance of the sum of ranks is given by:

$$Var_T = \frac{T^2 - (\Sigma T)^2/n}{n} \qquad [1]$$

Where Var denotes variance and n denotes the number of constraints. The maximum variance of T is given by

$$m^2 (n^2 - 1)/12 \qquad [2]$$

Where m is the number of respondents. The formula for Kendall's coefficient of concordance W is given by

$$W = \frac{\left(\sum T - (\sum T)^2/n\right)/n}{m^2 \cdot (n^2-1)/12}$$ [3]

By simplifying equation 3 above results in the computational formula for W as:

$$W = \frac{12[\sum T^2 - (\sum T)^2/n]}{mn^2(n^2-1)}$$ [4]

In this study, n includes elements like cumbersome procedure; lack of tax personnel; lack of understanding of the process; lack of education on the VAT process; bureaucratic procedures; and ignorance of the VAT law. The hypotheses are that for the null hypothesis: (H_0): there is no agreement between the rankings of the constraints identified by the respondents, and the alternative hypothesis (H_1): there is agreement between the rankings of the constraints identified by the respondents. The hypothesis was tested for significance in terms of the F distribution. Chi-square statistics were also used to test independence between VAT registration and educational level of the respondents and age of business respectively. The value of the test-statistic was determined as follows:

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$ [5]

Where
X^2 = Pearson test statistics
O_i = Observed frequency
E_i = Expected frequency
n = Number of cell in the table

The p-value was then used to assess if there exists a significant relationship between these variables and VAT registration.

3. RESULTS AND DISCUSSION
3.1 Demographic Characteristics of Respondents
The study revealed that the majority of the sample population for contractors were above 42 years whilst half the numbers of the sample population for consultants were between 37-42 years. Respondents from consulting firms were the youngest in the sample study.

All the consultants had tertiary school education as against 44% of the contractors who had tertiary school education. 12% of the contractors completed Junior High School. This implies that for one to be in the consultancy firm, he or she must have acquired a certain amount of education whilst the contractors mostly needed the required skills and knowledge Almost all respondents were married except for 4% of the contractors who were still single. Although, 25% of the consultants were between 25-30 years, it had no influence on their marital status.

Table 1: Socio-Economic Characteristics of the Respondents

		Contractors		Consultants	
		Frequency	Percentage	Frequency	Percentage
Age	25-30 years	0	0	0	25
	31-36 years	12	24	2	25
	37-42 years	2	4	4	50
	Above 42 Years	37	72	2	25
	Total	52		8	
Educational level	Junior high school	6	12	0	0
	Senior High school	23	44	0	0
	Tertiary Institution	23	44	8	100
	Total	52		8	
Gender	Female	0	0	0	5
	Male	52	100	8	95
	Total	52		8	
Marital Status	Single	2	4	0	0
	Married	50	96	8	100
	Total	52	100	8	100

Source: Field data, 2013

In all, 56% of the construction firms were registered as a sole proprietorship company while 44% were registered as a limited liability company. Most of these contractors have had considerable experience in the business. 80% of them have been in operation for more than 5 years. Only 20% of them have had between 1-5 years' experience in operation. Most of the respondents are currently operating more than two sites. These contractors composed of 19 road contractors 35 building contractors and 2were into both road and building construction. Classification of contractors in the construction industry is shown in the Table 2 below.

**Table 2: Type of Licence Held by the Respondents' Organisations**

	Class of licence	Frequency	Percentage
Building Contractors	D1K1	9	25
	D2K2	13	37.5
	D3,K3	13	37.5
Road Contractors	A1B1	4	22.2
	A3,B3	13	66.7
	A4,B4	2	11.1

Source: Field data, 2013

Some of the respondents indicated that there are laws governing the VAT compliance in the construction industry. This law differs from those applied in other businesses in that, the Construction Levy Act 629 of 2002 amended
.
Act 546 of 1998 which governs VAT & NHIL now included the construction industry: therefore this amendment made construction taxable

Figure 1: Respondents Level of Awareness of VAT
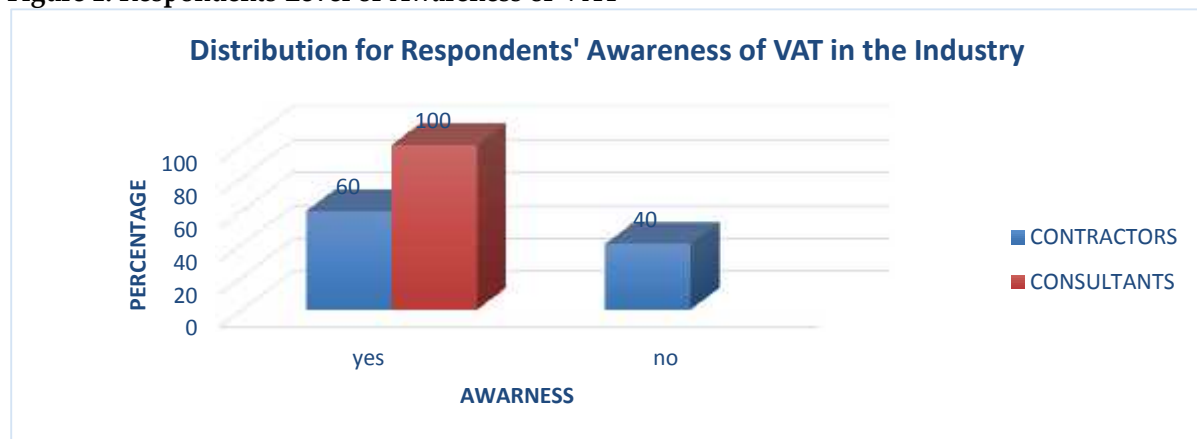
Source: Field data, 2013

Figure 1 above shows that all the consultants were aware of the VAT law in the construction industry, 87.5% of the consultants indicated that they became aware of the VAT law in the industry through Ghana Revenue Authority; and 12.5% became aware through other professional bodies. This is an indication that awareness of the law among consultants is very high. On other hand, 60% of the contractors were aware of the registration of VAT in the construction industry; whilst 40% indicated they were not aware. Those who were aware indicated that they became aware through consultants, Ghana Revenue Authority and contractors' associations. Since more than half the sample population confirmed their awareness of VAT in the construction industry.

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Despite the high level of awareness of the respondents about VAT, the study revealed that 72% of the contractors have not registered with VAT because of lack of education and bad collection systems. This was confirmed by the fact that 92% of the respondents indicated their company have not been offered any training on VAT on the registration and modalities for VAT. Although the regional office of the Ghana Revenue Authority is responsible for ensuring the implementation of VAT in the construction industry, the Tax Identification Number (TIN) is issued in Accra. This is making their work difficult as they cannot track those who have registered and those that have not registered.

3.2 Constraints Associated with the Implementation of Value Added Tax among Contractors in the Construction Industry

The study identified three main constraints which influence the implementation of VAT within the construction industry in Ghana. These are lack of appropriate education on VAT by the tax authorities; bureaucratic procedure in registering for VAT and accessing registration certificates; as well as procedure used to collect VAT from those who have registered for VAT. The respondents were asked to rank these constraints and the result of the ranking is presented in Table 3. The tests of significance in terms of F distribution of the degree of agreement or concordance (W) between the rankings of the constraints to VAT implementation within the construction industry in Ghana is fairly high with above 60% degrees of agreement between the rankings of the respondents. The study revealed that the most important constraint in implementation of VAT in the construction industry is the lack of education followed by bureaucratic procedure. The least constraint is bad collection systems

Table 3: Ranking of constraints identified by the respondents in the implementation of VAT

Influencing factors (Constraints)	Ranking
Lack of education	1
Bureaucratic procedure	2
Bad Collection systems	3
Number of respondents	60
Coefficient of Concordance (W)	0.6375 (63.75%)

Source: Field data, 2013

This explains why respondents were requesting for education on the modalities for VAT, and could be a large part of their reasons for non-registration and non-compliance. Due to these constraints associated with the implementation and compliance of the VAT law in the construction industry, the study has revealed the amount lost by the state as these firms failed to comply with VAT on the contracts awarded. These are summarized in the Tables 4.

Table 4: Estimated sum of VAT unaccounted across selected districts in 2013

Districts	Contract Sum	VAT(GH¢)
Sunyani West District	1,033,282.90	13477603
Techiman Municipal	1,651,247.74	21538014
Kintampo Municipal	827,038.54	10787459
Jaman South	868,253.83	11325050
Nkoranza South Municipal	882,995.36	11517331
Total	5,262,818.37	**68645457**
Estimated sum of VAT unaccounted across selected districts		
Consultant	Contract Sum	VAT(GH¢)
A	27,130,064.85	3,538,703.9
B	2,515,872.16	328,157.24
C	9,882,718.77	1,289,050.30
Total	16,951,317.39	**2,211,041.40**

Source: Consultant Contract Document, 2013

The state has lost a total amount of GH¢ 70,856,498.40 ($ 35,606,281as at December 2013) because of Consultants' non-compliance with VAT on the projects awarded in 2012.

4.3 Dependency between VAT Registration and Educational Level of Respondents and Age of Business

The results of the test of hypothesis are presented in Table 5. The Chi-square test of dependency between educational levels of the respondents and VAT registration showed Pearson Chi-square value of 0.048 with a p-value of 0.976. As the p-value is greater than 0.05, we therefore fail to reject the null hypothesis. This indicates that there is no significant relationship between educational level of the owners of the firms and registration for VAT. This means that VAT registration is independent of the educational level of the owners of the firm. Thus for owners of construction firm to decide whether or not to register to implement VAT does not depend on their educational level. In order to test the dependency between VAT registration and age of the firm's structure, Chi-Square test was conducted. The test result showed a Chi-Square value of 2.170 and a p-value of (0.538) for age of the firm (Table 5). Since the p-values are greater than 0.05, the test fails to reject the null hypothesis, and indicates that VAT registration is independent of the age of the firm.

Table 5: Dependency of VAT registration on educational level of the respondents

Attributes	Registered for VAT		Chi-Square Value	P-Value
	Yes	NO		
Educational level				
Junior high school	2	4	0.048	0.976
Senior High school	6	17		
Tertiary Institution	9	143		
Age of Business				
Less than 10 years	30	12	2.170	0.538
Above 10 years	13	5		

Source: Field data, 2013

4   CONCLUSION AND RECOMMENDATION

The study revealed that awareness of Value Added Tax among contractors and consultants was high. The level of awareness of VAT among the respondents was created by the Ghana Revenue Authority and other professional bodies. However; they need more education about the modalities of VAT to increase the compliance among the construction industry in Ghana. Despite the level of awareness of the respondents about successful if the staff of GRA are taken through regular training programmes on emerging issues within the sector they are operating.

The Ministry of Finance and Economic Planning should collaborate with the Ministry of Housing and Road and Transport to ensure that the state owned consulting firms in the region implement the VAT law applicable to the construction industry. Also Value Added

VAT, a large proportion has not registered for VAT because of lack of education and bad collection systems. This is the major reason why most of them cited lack of education as the major constraint to VAT registration. Thus the staff of Ghana Revenue Authority should be equipped through training programmes to be conversant with the amendment of the VAT Act for effective administration of the tax law. They should also intensify their education on VAT in the construction industry since respondents have high awareness but lack of education on the basic principles and modalities for VAT. This would be most certificates should be part of the tender requirements to ensure that contractors register before competing for any contract works within public institutions as it is being required from suppliers. The Ghana Revenue Authority must collaborate with the Registrar General's Department so that as soon as the contractor registers a company a VAT taxpayer identification number is issued. In the case of existing firms, information centres should be

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established within the regions to facilitate the process of acquiring VAT certificates for those without VAT registration numbers. Because the fact that the Ghana Revenue Authority has only one Tax Identification Number (TIN) centre that is located in Accra makes the whole process cumbersome and as a consequent substantial delays are occurring in the system.

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Promoting the Use of Sorghum [Bicolor (L) Moench] in the Baking Industry

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Abstract
Ghana's agricultural policies seek to increase food production, provide food security and generate income for sustainable development. Corn and rice are commonly processed and widely accepted but sorghum, a major cereal grown in the Northern part of Ghana is under-utilized as food. It is used extensively in brewing,animal feed and biogas. The research sought to find ways of processing sorghum into flour to develop new recipes to promote its use in food production. Sample size of 99 respondents was selected through random sampling at Koforidua Polytechnic. Five sorghum flour products were prepared and sensory attributes of taste, texture, flavour and acceptability were determined based on responses from a sensory panel. Mean responses were compared by the use of ANOVA to determine thesignificant difference between sorghum, rice and wheat using SPSS software. The findings indicated no significant difference between sorghum and the other cereals. Most respondents 76% accepted sorghum products while 24% did not and expressed that the texture was gritty.Respondents encouragedpromotion andsustainability of sorghum through food fairs, exhibitions, workshops and the mass media. It was recommended that processing machinery and innovative techniques on uses would spearhead the grain sorghum to meet the challenges of food securityand climate change.Sorghumfood should be featured on our dining tables to break the monotonycharacterised with its consumption.

Keywords: Sorghum; Sensory Attributes; Sustainable Development; ANOVA; Recipes

1. INTRODUCTION

Among the major cereals grown in Ghana is sorghumbicolor (L) Moench, which belongs to the genus sorghum family poaceae (Aba et al 2004 cited in Ogbonna 2010; Badi et al. 1976). It is believed to have originated from North Africa about 5000 years ago. (Dahlberg et al 2011; Bellum et al 2010). Sorghum is the fifth most important cereal and a dietary staple of more than 500 million people in more than 30 countries. (Ashok et al 2011). The world's largest producer of sorghum is United States of America, where it is used primarily as animal feed,fodder, forage,fuel and a little used as sweeteners (Reddy et al 2010). As much as 12% of domestic production of sorghum is used to produce ethanol and its various products. With demand for renewable fuel, sorghum is used as biogas (Renewable Fuel Association 2007). These reveal poor utilization of sorghum in food production. Sorghum is rated as one of the drought tolerant crops currently under-utilized. The International Water Management Institute (IWMI) warns that by the year 2015, 25% of the world's population will experience severe water scarcity (http://www.ocio.usda.gov/508/index/html.

However, production of crops can be increased through the cultivation of drought resistant crops like sorghum. (http://www.ocio.usda.gov/508/index.html). It is unique in its ability to grow under harsh environmental conditions than most cereals. It can thrive well in low rainfall areas with little or no fertilizer application (FAO, 1995, Ogbonna, 2011). While the total food consumption of most cereals has risen, that of sorghum remains stagnant, rather, consumption of sorghum as animal feed has increased from 30% to 60% since 1990. (FAO and ICRISAT, 1996). It has low image and regarded as poor man's food for people with insecure food security, though it compares nutritionally well with other cereals.(FAO and ICRISAT, 1996).Sorghum is neutral in taste and can absorb other flavours well. It is rich inessential micro--nutrients such as calcium, potassium, zinc as well as high levels of iron. (Icrisat.sorg.sorgume.html). Due to its high nutritional content it is recommended for infants, pregnant and lactating mothers, elderly and convalescents.(Obilana, 2005).It is affirmed that before the invention of daily supplements, physicians prescribed sorghum as a daily

supplement for those low in nutrients. (Icrisat,Sorg/sorghum.htm) Sorghum is targeted as a means to reduce micro--nutrient malnutrition globally by using it in food production.. (icrisat//sorghum.crop) This can be achieved by developing and deriving interesting recipes to inculcate its use in the food industry.

Sorghum is an important cereal food in India. Japanese snack food manufacturers have used sorghum flour in research and in recipedevelopment, leading to commercialization of snack products of sorghum. In many parts of Africa, sorghum has been replaced by maize as the latter is preferred as food.. There is relatively little research undertaken in Africa especially, Ghana inthe utilization of sorghum in food productionMostGhanaianappear to be ignorant about the immense nutritional /benefits and use of this naturally important cereal crop. In 1999, there was a workshop which took place inLome (Togo) on Sustainable Sorghum Production, Utilization and Commercialization in West and Central Africa. Also mass production of sorghum was initiated by the government of Ghana at Kpala in the northern part of the country to feed the breweries in the production of alcoholicand non-alcoholic beverages and biogas. From the above accounts it can be inferred that the main intention of cultivating sorghum is not for food productionbut for other uses despite its nutritional profile.

The aim of the research is to find ways of developing recipes that would improve the acceptability and promote sorghum as one of the cereal food as wheat, maize and rice.

1.1 Cultivation

Sorghum can be cultivated on many soil types. It can withstand water logging and drought but can be killed by frost. It can be grown as a rain-fed crop but can also be grown in rotation. When grown in ridges, more seeds are sown with 600g/hectre. Sorghum can be intercropped with legumes, which increase output. The weed that disturbs the sorghum plantduring cultivation is the striga spp. that attaches itself to the root of the flowering plant. It can be controlled by rotation or by growing trap crops.The best moisture contents for storage is 8-12 %.**(**Asare, 2010).

Table 1 Nutritive Value of 100g of whole grain Sorghum Compared with Other Cereals

Nutrient	Unit	Sorghum	Wheat	Rice	Corn
Energy	g	361	340	363	362
Protein	g	7.57	13.21	7.23	8.22
Carbohydrate	g	77.47	71.97	76.48	76.89
Fibre	g	6.6	10.7	4.6	7.3
Minerals					
Calcium	mg	12	34	11	6
Iron	mg	2.99	3.60	1.98	3.45
Magnesium	mg	120	137	112	127
Phosphorus	mg	288	357	337	241
Potassium	mg	311	363	289	285
Sodium	mg	4	2	8	35
Zinc	mg	1.44	2.60	2.45	1.82
Copper	mg	0.222	0.410.	0.230	0.193
Manganese	mg	1.262	4.065		0..498
Vitamins					
Thiamine	mg	0.277	0.502	0.443	0.385
Riboflavin	mg	0.053	0.165	0.080	0.291
Niacin	mg	5.187	4.957	6.340	3.632
Pantothenate	Mg	0.923	0.603	1.591	0.425
Vitamin B-6	Mg	0.345	0.407	0.736	0.304
Folate	Mcg	25	44	16	25.8
Vitamin A	EU	-		0.0	
Vitamin E-ATE	g	0.50	0.71	1.20	0.42

Nutrients Values: USDA National Nutrients Database for Standard Reference; Ihekoronye & Ngoddy 1985

1.2 Uses of Sorghum

Sorghum grain is utilized in a variety of ways as food includingunleavened bread (chapatti) and leavened bread (injera, khisra, tortilla), gruel /porridge (tuwo, couscous, bogove, ugali, kali) brewing (pito, beer, brukutu), sweetener (Asare2010:Ihekoronye&Ngoddy

1985). In India sorghum is popped and used to prepare snacks and special food for children. (Ayyanger). It is not only used for consumption but used as building materials for roofing, fencing and as brooms (Dogget, 1988, House, 1988, Rooney and Waniski 2010). It is also used as biogas and other ethanol products (Rooney 2000)

1.3 Characteristics of sorghum

Several myths negatively affect the acceptability of the nutritional and processing qualities of sorghum. Like corn, it is an incomplete source of protein which lacks lysine, an essential amino acid required for growth and deamination.Food scientists have found out that the protein in sorghum is difficult to digest compared to other grains due to a process called 'cross linking'. However, cooking, crushing, grinding and milling can make the protein more digestible (sorg/sorghum.htm). Some species of sorghum contain high level of hydrogen cyanide (HCN) and tannin. **(**Rooney 2000; Hamaker et al.;Asare, 2010)

2. MATERIALS AND METHODS

Sample size of 99 respondents was selected through random sampling atKoforidua Polytechnic. It was made up of 55 males 44 females. Five different sorghum flour products were prepared and questionnaires involving both open and closed ended were used. Sensoryattributes of taste, texture, flavour and acceptability was evaluated.

2.1 Data Collection Procedure

Respondents were invited in groups of ten (10) to taste dishes prepared with sorghum flour to give responsesin terms of flavour, appearance, taste, texture and the overall acceptability.The prepared food items were arranged on a table with each dish well labelled with the appropriate code.

Equipment

Oven, mixing bowl, sieve, wooden spoon, baking sheet, electric doughnut machine and piping bag.

Materials

Sorghum, margarine, castor sugar, wheat flour and flavourings.

Processing of sorghum flour

Methods
- Remove stones, dirt and other foreign materials from sorghum
- Put sorghum on a flat tray and winnow the hulls
- Grind sorghum into flour at the local mill
- Mill four to five times to obtain smooth flour.
- Sift with fine sieve into smoother flour
- Store in a dry container until use.

Recipes for selected sorghum dishes

The milled sorghum flour was used in the preparation of sorghum bread, sorghum cake, sorghum doughnut,sorghum pizza and sorghum ginger snap biscuit. Sorghum has no gluten as wheat therefore, composite of wheat and sorghum flours were used.
N.B: The recipes are for ten (10) portions.

Sorghum bread

Ingredients	Quantity
Sorghum flour	375g
Strong flour	125g
Butter or margarine	25g
Salt	
Yeast	15g
Liquid (half water, half milk)	300ml
Teaspoon castor sugar	½
Egg	1

Method
- Sieve the flour and warm in the oven
- Add yeast, liquid (warm), fat and the salt
- Knead firmly until smooth
- Leave in a warm place until double its size
- Knock back, mould into desired shapes and prove again
- Egg wash and bake

Sorghum ringdoughnut

Ingredient	Quantity
Sorghum flour	200g
Soft Flour	100g
Margarine	150g
Sugar	100g
Baking powder	1 teaspoon
Nutmeg	¼ teaspoon
Vanilla essence	
Fruit or mix peel	50g
Eggs	2-3
A little milk	

Method
- Cream fat and sugar together until light and fluffy
- Gradually add beaten egg into the creamed fat and sugar, mix well.
- Gently fold in the flour, adding a little at a time with a metal spoon
- Grease doughnut machine and heat for one minute
- Dish out creamed mixture with a table spoon into the grease and heated doughnut machine.
- Cover and bake for 10 - 15 minutes at 160°C.
- Remove and cool on a wire rack.

Sorghum cake

Ingredient	Quantity
Sorghum flour	375g
Soft flour	125
Margarine	300g
Sugar	300g
Eggs	8- 10
Baking powder	3-4 level teaspoon
Nutmeg	1 teaspoon
Vanilla essence	Few drops

Method
- Cream fat and sugar together until light and fluffy
- Gradually add beaten egg into the creamed fat and sugar and mix well.
- Sieve flour, baking powder and nutmeg together; gently fold in the flour, adding a little at a time with a metal spoon
- Pour mixture into a greased tin and bake

Sorghum pizza

Ingredient	Quantity
Sorghum flour	375g
Strong flour	125g
Margarine	25g
Yeast	10g
Castor sugar	10g
Fresh tomatoes	300g
Tomato puree	150g
Sunflower oil	100ml
Sausagemeat (chopped finely)	200g
Onion	100g
Green pepper	I00g
White pepper	
Hard cheese	150g
Salt	

Method
- Sieve the flour into a bowl and warm in the oven
- Add yeast, liquid (warm), fat and salt
- Knead firmly until smooth
- Leave in a warm place to prove
- Knock back and roll into a flat disc
- Leave in a warm place to prove
- Prepare filling and spread on proved dough
- Bake in a hot oven approx. 10 - 15min

Sorghum ginger snap biscuit

Ingredient	Quantity
Sorghum flour	150g
Plain flour	100g
Margarine or butter	150g
Castor sugar	100g
Golden syrup	100g
Ground ginger	10g

Methods
- Cream the margarine and sugar until light and fluffy
- Add the golden syrup and cream well
- Gradually fold in the sieve flour and ground ginger
- Place mixture into a piping bag with a ½ cm plain tube
- Pipe on to a greased baking sheet into 1cm diameter rounds
- Decorate with cherry and bake in a hot oven approximately 220 C for 5 -15 mins.

3.   RESULTS

Efficiency of milling sorghum flour

During the milling processthe quantity reduced after each milling. The raw sorghum weighing 6kg, on milling was reduced in weight to 5.2kg and after sieving was again reduced to 4.2kg. The observation may be due to the coarser particles removed.

Table 2: Demography of respondent

	Frequency	Percent
Male 55		55.6
Female 44		44.4
Total	**99**	**100.0**

From Table2, it is observed that out of the 99 respondents surveyed, 55.6% and 44% werefemales .

Table 3: Result for sorghum products on taste

Attributes	Mean no of responses	Percentage
Very tasty	60	60.60
Tasty	30	30.30
Fairly tasty	7	7.10
Not tasty	2	2.00
Total	99	100

From Table 3 (60.60%) responded very tasty, 30.30% tasty; 7.10% fairy tasty whiles 2.00% responded not tasty.

Table 4: Result for sorghum products on texture

Attributes	Mean no of responses	Percentage
Like extremely	40	40.40
Like moderately	55	55.56
Neither like nor dislike	2	2.02
Dislike slightly	1	1.01
Dislike very much	1	1.01
Total	99	100

Table 4 summarises the texture of the products as 40.40% liked extremely, 55.56% liked moderately, and 2.02% ticked neither like nor dislike and 1.01% responded dislike slightly and very much meaning respectively.

Table 5   Result for sorghum products on flavour

Attributes	Mean no of responses	Percentage
Like extremely	42	42.42
Like moderately	54	54.55
Neither like nor dislike	2	2.02
Dislike slightly	1	1.01
Dislike very much	0	0
Total	99	100

The highest score of the attributes from Table 5 is liked moderately 54.55%: followed by like extremely 42.42% ,while 2.02%, 1.01% and 0% neither liked nor disliked, dislike slightly and dislike very much respectively.

Table 6: Result for sorghum products on appearance

Attributes	Mean no of responses	Percentage
Very good	44	44.44
Good	54	54.55
Not good	1	1.01
Total	**100**	**100**

It could be inferred from Table 6 that the appearance of the products were ranked 44.44% and 54.55%as good and very good respectively while not good was 1.01%

Table 7: Result for sorghum products on acceptability

Attributes	Mean no of responses	Percentage
Yes	75	75.76
No	24	24.24
Total	99	100

Table 7 illustrates that majority 75.76%accepted the sorghum productsand24.24%did not.

Table 8; Respondents who consumed sorghum and sustainability as food

	Yes	%	No	%
Consumed sorghum food	9	9.1	90	90.90
Sustainability of sorghum as food	84	83.16	16	15.84

Table 8 shows that 9.1% and 90.90% said they have not and consumed sorghum respectfully

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while 83.16 %recommend the sustainability of sorghum and 15.84% did not.
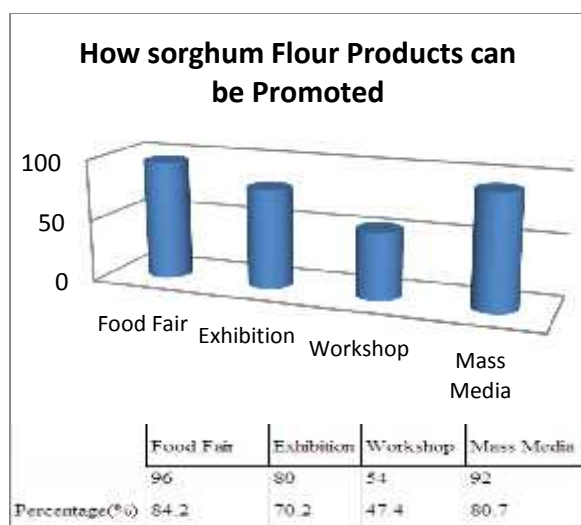
Figure 1:How sorghum flour product can be promoted

Figure 1 indicated that sorghum products could be promoted through food fairs 84.2%, exhibitions 70.2%, workshops 47.4% and mass media 80.7%.

Further analysis

Table 9: The distribution of varieties of cereal grain

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Wheat	33	22.5758	4.50021	.78339	20.9801	24.1715	15.00	29.00
Rice	33	22.7576	4.62352	.80485	21.1181	24.3970	15.00	30.00
Sorghum	33	21.9091	4.34715	.75674	20.3677	23.4505	15.00	29.00
Total	99	22.4141	4.46074	.44832	21.5245	23.3038	15.00	30.00

Table 9 reports the various descriptive statistics of the three (3) cereals which were used in the study. It can be observed that the minimum and maximum value for wheat is 15.00 and 29.00 respectively. The mean value for wheat is 22.58. When it came to rice, it had a mean of 22.76. It's maximum and minimum values are 30.00 and 15.00. Finally sorghum recorded a mean of 22.41. Its minimum and maximum value is 15.00 and 29.00. A deduction from the above is that all the three (3) cereals had minimum value of 15.00. Another deduction is that the differences between the mean of the various cereals are small.

Table 10: Comparing the means of the three foods

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	13.172	2	6.586	.326	.722
Within Groups	1936.848	96	20.176		
Total	1950.020	98			

From Table10, the significance level is 0.722 ($p = .722$) which is above $0.05(\alpha\sim value)$ and therefore fail to reject the nullhypothesisandconclude that there is no statistically significant difference in the mean mark of taste, flavour and texturein sorghum and other cereal crops such as rice and wheat.

4 DISCUSSIONS

The study results showed that respondents appreciated the taste of sorghum flour products Table3 with60.60%and 30.30%responding "very tastyand tasty respectivelyTable4revealed that 42.42%; and 54.55% respondents' liketexture of products"extremely and moderately".Most respondents'42.42%; 54.55 appreciatedthe flavour "extremely and moderately" while very few expressed their "disliked" (Table5). The appearance was liked since44.44%; 54.55% respondents said it was "very good and good" respectivelyTable 6. However, some respondents advised that the appearance should be improved by the addition of colouring agents to enhance the colour. The overall acceptability rating of the products was generally very high; Table 7 where majority 75.76% accepted and 24.24% did not.The sustainability of the products received a higher m 83.16%Table 8. However, it was obvious that the research revealed larger percentage of

respondents 90.90% who had notconsumedsorghum as food Table8.Sorghum flour products could be promoted through food fairs, exhibitions, workshops as well as the mass media, Figure 1.Furthermore, the test conducted with the analysis of variance (ANOVA) also proved that there was no statistically significant difference between sorghum and the other cereal crops, Tables 9 and 10.

5. CONCLUSION AND RECOMMENDATIONS

Modern processing machinery should be usedto ensure large scale production of smooth sorghum flour to be usedin the baking industries.Promotion and sustainability of sorghum should be done through food fairs, exhibitions, workshops and the mass media. Innovative techniques on uses would helpspearhead the grain sorghum to meet the challenges of food security and climate changeSorghum foods should be featured on our dining tables to break the monotony characterised with its consumption

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Corn Husk and Banana stalk for Practical Textile Making in Ghana

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Abstract
Finding viable alternatives to conventional textiles and fashion has proved to be a herculean challenge for Government and policy makers in Ghana. Corn husk and banana stalk identified as possible eccentric materials for textiles and fashion need to be examined to ascertain its feasibility. Particularly, the project seeks to employ experimental instruments and apparatuses to ascertain feasibility of corn husk braids and banana stalk braids for textiles. Test results from the study are necessary for determining the extent to which the materials could be adopted for varying textiles and costumes. Corn husk and banana stalkoften treated as waste could be turned into a valuable alternative resource for plausible textiles. Costumes from such textiles could be employed in textile art and conventional fashion. It Banana stalk also has the potential of being converted into sacks for packaging some foodstuffs like grains, tubers, and cocoa. The success of this research shall pave way for looking inward the nation for readily available and relatively cheap materials for addressing the concern of local textiles and fashion.

Keywords: Textiles; Corn Husk; Banana stalk;Waste; Alternative Material

1 INTRODUCTION

Corn husk and banana stalk have often been treated as waste in Ghana since the introduction of the two crops into the Ghanaian economy (Awudza, 2011 and Morton, 1987). Actually, no real alternative use has been made apart from packaging some indigenous food, animal feed packaging and mulching. However, the textile sub-industry which has been enduring great fluctuations leading to the sector near collapse needs a respite. Testing to ascertain the feasibility of braids from corn husk and bananastalk is revolutionary.~~for~~Successful outcome of the study should provide platform for alternative textiles. The new dimensional textiles has the potential to be adopted in textile art, apparel, accessories, and industrial packaging for items like grains and beans as concept of 'Creative Arts and Sustainable Development' alludes. Essentially, readily available textiles that is cheap and very Ghanaian which has unrelated but highly vital purposes like food at relatively cheap cost for the economy of Ghana should be a tremendously welcome news.Therefore, the purpose of the paper is to run test, analyse, and establish findings on extent of feasibility of corn husk and banana stalk employed as textiles..

Fibre Structure Analysis

The effective performance of a fabric and apparel is dependent on the properties of the fibre. By this, a textile fibre from the beginning could aid in determining possible future uses before conversion into usable materials. Fibre structure analysis which has been explained by Textile Printing Market, (2014), as fibre identification methods seeks to basically determine the potential uses of textile fibresthrough the characteristics and properties as determined by the following factors: 'Essential Characteristics', 'Physical Structure', and 'Chemical Structure'.

Essential Characteristics

Textiles is usually developed from tiny molecular elements called fibres from which yarns (another tiny molecular element but larger in diameter than fibre) are made. According to Sourcing Materials, (2014), some basic information about fibers and fabric specifications is essential for evaluating and comparing available materials.Extract fromElsasser, (2005), and Sommerville, (2002), andKadolph, (2007), claim that, **Essential Characteristics** is a textile terminology used to test the viability and applicability of a material to establish the extent, to which it could be classified as textile fibre, in this context, yarns. Four principles employed are listed as high length per diameter ratio, flexible, fineness, and length per unit weight.

Physical Structure

Benitez, (2014), infers that physical properties are fibre elements seen with the naked eye or

microscope. Upon examination, the outward appearances of both corn husk and banana stalk appear web-like but bear obvious differences. Other similarities and the differences of corn husk and banana stalk have been subjected to further scrutiny subsequently.

Corn Husk

Thefibre of the outer membrane formation of the corn husk interconnects with each other creating a sheet-like material. The corn husk has parallel uneven strokes drawing from one end to the other. The strokes appear bigger from the top edge of the cob and narrows down at the bottom of the cob. If cut longitudinally, an uneven line of fibre is revealed: this fibre does not stand in unison anyway as it is interconnected with the others in the sheet. If divided in cross-section, adjoined spots that are fairly circular are revealed. The size and smoothness of these spots are uneven re-iterating the irregularity of the parallel patterns that form the web to complete the husk. Characteristically, the fresh corn husk appears pale green and darkens as the plant matures. At maturity, the moisture contents get transpired and the colour turns into lighterbeige.

BananaLeaf

The banana stalk also appears to be webbed like the corn husk. Again like the corn husk, the banana stalk appears irregular but relatively glossy when dry. Fresh banana stalk is green, succulent, and juicy. Unlike the corn husk, the banana stalk is connected to the roots.Actually, the banana stem virtually intersects the leaves and the roots at the base of the plant. As matured leaves wither and get replaced by younger and fresher nodes, the older ones lose their water contents and shrink. The bright green colour turns into dark brown with patchy dark maroon and black shades intermittently placed. If overly dried, it becomes brittle and with little twists, the material simply disintegrates. This equally applies to corn husk but the breakage here is slightly less harsh than the former. In a longitudinal view, the banana stalk looks quite awkward but lengthy. It is thick layered especially, if at the base which is nearer to the roots but lighten as it approaches the real leaf. In relation to the corn husk where micro-fibres are seen running parallel in the web, a rather compact sheet is seen in the banana and it only gets disintegrated if retted

or subjected to other forms of pressure. At the cross-section, the banana stalk shows a chain of connected web with sporadic spots which are fairly circular and differ in sizes. In between is a strong mesh that forms the web sheet.

Carbon has been defined as an element which is a constituent of all organic compounds (IFIS, 2005). From MS Encarta Encyclopaedia, (2009), carbon is a non-metallic chemical element, known by the symbol C, which is the fundamental building block of materials in living organisms and is important to many industries.Many of the materials that are used in everyday life contain carbon-rich organic compounds. For instance, clothing is made of organic compounds-either natural fibres, such as wool, silk, or cotton; or synthetic ones, such as nylon or polyester.

MS Encarta Encyclopaedia, (2009), again considers hydrogen as a chemical element that exists as a gas at room temperature and symbolized on the periodic table by H. Hydrogen gas is odourless, tasteless, colourless, and highly flammable. According to IFIS, (2005), hydrogen is extremely abundant and combines readily with other organic or inorganic elements in the environment.

Oxygen is a colourless, odourless, and tasteless gas essential to living organisms, being taken up by animals, which convert it to carbon dioxide; plants, in turn, utilize carbon dioxide as a source of carbon and return the oxygen to the atmosphere,Britannica Encyclopaedia, (2010). Oxygen is essential for respiration in animals and aerobic micro-organisms, produced by photosynthesis and it is a common substitute of organic compound (IFIS, 2005).

Biological Test

This was a test done to determine the original source and the impact of man, domestic animals, bacteria, and fungi on the corn husk and the banana stalk. Since both corn and banana are crops, fibres from them surely should pass for vegetable fibres. Being vegetable materials also make corn husk and banana stalk as put by Florian, Kronkright, and Norton,(1990),pp. xiand 1, predisposed to biological processes that cause attacks through fungi, moulds, bacteria, insects, rodents, and ruminants. The biological process according to

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Britannica Encyclopaedia, (2010), is about the factthatthe progressive changes in size, shape, and function during the life of an organism by which its genetic potentials (genotype) are translated into functioning mature systems (phenotype).

Corn Husk
Based on the investigation, corn husk reacted with moisture under warm and humid conditions. The corn husk moulted turning into greyish-black patches with white spots. The major difference is the fact that, the pale colour of the corn husk makes it more discerning when damaged by fungi and bacteria. Also, it emits odour that is not too pleasant to perceive. Soggy conditions shall lead the corn husk to ret even if it does not ret, it develops unstable texture that leads to poor braid construction. If braided corn husk is soaked adequately, all the twist shall be loosened and the braids shall unravel. Additionally, many insects, caterpillars, rodents, and ruminants do find the corn husk a delicacy and thus, consume it as meal if not well preserved. If exposed to direct sunshine or strong heat, the corn husk gets discoloured in high temperatures and the woody outer membrane gets frittered off. If such conditions happen before braiding, compatibility of the twist is reduced as any effective twist shall lead to wearing and tearing of the corn husk leading to weak and dishevelled yarn formation. For humans, corn husk irritates when contact is established with the human skin. This is enhanced when the corn husk is bone dry. As stated earlier, the corn has limited lustre in contrast to the banana stalk but the natural pale colour of the corn husk makes it more visible. As such, excretion from man and animals as well as other bodily
Corn Husk

fluids like blood, tears, saliva, phlegm, and semen can stain the braids visibly.

Banana stalk
From the tests, it was observed that, the dried banana stalkmoulds with poor odour under warm moisturizing conditionsthat are facilitated by fungi and bacteria. Insects, especially caterpillars, then, rodents, and ruminants may nibblethe banana stalk too as they might find it edible. In excess water condition, the woody materials (corn husk and banana stalk) ret. This process breaks down the woody outer membrane and later, the inner cells to get the entire material to disintegrate into minute particles and then washed away. Growth of mildew is however restricted if there is adequate aeration. Too much of heat shall cause bone dryness from shrinkage that causes the textiles to harden into brittleness and break into particles under little stress. This impedes twisting and braiding as the materials disintegrate into pieces when subjected to little pressure. Where braiding is already completed before the bone dry conditions set in, the outer membrane of the braids shell off weakening the tenacity of the braids and leave behind a coarse texture that is not so pleasant to perceive. It also reacts harshly to the skin if shuffled against the skin; the overly dried fibres/yarns could scratch the surface of the skin to form minor injuries. Excretion from man and animals as well as other bodily fluids like blood, saliva, and semen can stain the braids too.

Physical Test
Physical test is examination to find the texture of the materials from sensual observation. It involves the use of perception from seeing, hearing, smelling, and feeling.

Table 1: Braided Corn Husk

Dried Corn Husk		
Lengthwise Observation	Cross-Section Observation	Longitudinal Observation
Web-like but disintegrate into hair-like strands when wriggled	Thin webbed thread-like pattern with uneven spots	Light rough thread like pattern

Source: Field Data, (2010)

Dried corn husk is off white and yellow (creamy-yellow) in colour with patchy lustre at the wrong side when perceived with the eyes. It looks dry and light. It has height that could extend just above 1ft. It appears coarse, rough, and hairy on the right surface with parallel vertical strips laid lengthwise. At the under, it rather has fairly smooth and glossy texture. Corn husk over the cob looks compact and conical but when separated from the cob, it looks light and gently curved as illustrated by Table 3. Beyond, absorption test was used for analysing other physical features of the corn husk as shown by the Plates 1 and 2 in the appendix:

Corn husk is relatively absorbent but,it is volatile and weak when wet and the braided corn husk easily unravel under such conditions. The speed of the unravelling is enhanced if hot water is adopted. When very dry, piercing of needles through sewing manually and mechanically causes both braids to wear off if they are bone dry.The corn husk in particular could be very itchy and create sensitive bodily irritation that is unpleasant and uncomfortable. Very dried corn husk is Table 2 below shows microscopic view of the Banana stalk

Table 2: Banana stalk

Dried Back of Banana stalk		
Lengthwise Observation	Cross-section Observation	Longitudinal Observation
Web-like but disintegrate into hair-like strands when wriggled	Thin webbed thread-like pattern with uneven spots	Thick rough thread like pattern

Source: Field Data, (2010)

Ideal dried banana stalk for textiles should appear even in weight and size. Its lengthwise structure should have uniformity so as to achieve evenness during braiding. In many instances, it is difficult to obtain ideal form from the plant, so it is advised that, a pair of scissors is used to prune and shape the material before chopped into strips for twisting and braiding.If very dry, the outer membrane of the banana stalk fritters off and this process is expedited when subjected to mechanical effect

quite harsh and could irritate the skin of humans upon contact. The volatility of the corn husk makes it convenient to be coloured with printing pastes where the goods do not necessarily have to be wetted that much. It is advised that where both braids are in joint use, printing pastes should be preferred in contrast to dyeing so as to avoid disturbing the stability of the corn husk.

Banana stalk
The banana stalkon the other hand is naturally brownish-grey in colour. In some instances, it appears a little pale or dark looking almost black. At the right side, it has light glossy look where as at the wrong side, it appears checked as though it must have been woven. It looks rigid and lightweight if felt with the palm and smells like dried leaves. It also smells like peeled unripe banana and could attain lengths of up to 13ft. If wringed briskly or subjected to severe blows, it disintegrates into tiny components. In addition, when wringed, it creates sound like the pounding or treading of dry straw.

like sewing with needles from both manual and electric machines.
When wet, the banana stalk relaxes and unlike the corn husk, become more stable, extensible, and elastic shown by Plates: 1 and 2. It has also been deduced that the banana stalk has good affinity to colorant. The banana stalk has better affinity to natural dyes, vat dyes, and reactive dyes as well as printing paste. The glossy banana stalkis a broad sheet that has patchy shades of brown indigo and black spots intermittently spreading across.

Conclusions from the physical examinations point to the fact that the corn husk and the banana stalk cannot stand out as fibres with minute strands as in the case of cotton, wool, rayon, polyamide, among others. These (corn husk and banana stalk) are webbed materials that reveal their textile nature upon being converted to yarns through braiding. Both materials are very strong but coarse. These materials have inadequate elasticity thereby

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making them unsuitable for athletic and swimming activities for they have the tendency to impede movements of the limbs

during manoeuvring. The bulky and coarse nature of the braids make it inconvenient to be worn on the human skin, as friction evolving from the body movements shall cause shuffling that can corrode the top layer of the skin. This is also the main reason why the artefact being

tendency of these gases affecting the users of such textiles and better still, clothing could be harmful as has been experienced with some cotton derivatives.

Chemical Test

Pertaining to the make-up of fibres, one of the most indispensable considerations is its implicit composites. Often, implicit molecules are not explicit and hence, cannot be observed with the naked eye unless with special apparatuses. Ultimately, the explicit and implicit determination of fibres is key ingredient in identification, construction, and maintenance. Being cellulosic, both corn husk and banana stalk all contain the listed elements of carbon, hydrogen, and oxygen. These elements have been presented earlier in the text in the ratio – C H O . Not-with-standing the knowledge of the above chemical components, peculiar tests under cellulose test were undertaking to establish the unique identification namely: starch test, sugar test, fat stain test, and general plant stain.

Starch Test

This test was performed to ascertain the presence of carbohydrate in the two fibres. The reagent used was iodine with which a few drops were put on the corn husk and interestingly, the portion where the solution was placed changed into dark blue, more or less indigo. The same was experienced with the banana stalk having been subjected to similar treatment. The colour change thus is indicative enough of the presence of starch in the fibres that are believed to be rich in carbohydrate.In their conclusion, Florian, Kronkright, and Norton, (1990), pp. 35-37, contend that having dissolved 1g potassium iodide in 100cc of water;add 1g iodine flakes. Place a dropon the material to be analysed or draw a drop through the prepared slide. Under the microscope, purple- black starch grains can be observed.

designed is to be clad on a monument. Additional reason is based on the advice fromAdusei-Akowuah in 2009who said that, remnants of fertilizers, herbicides, weedicides, pesticides, and other harmful atmospheric gases could settle on the materials. According to Adusei-Akowuah since the materials have not been scoured; the Apink colour may indicate micro-organism degradation of starch.

Sugar Test

Sugar tests like the former is a cellulose test designed to determine the presence of carbohydrate. During the investigations, Benedict's solution served as the reagent of which a few drops were added to 10ml of water and heated by placing the receptacle in a saucepan of water and heated over gas cooker. A little piece of the corn husk was dropped in the solution and not too long after heating the solvent, colour change of orange to brick red was observed. Similar application over the same conditions for the banana stalk produced the same result.

General Plant Stain Test

Likewise, Florian, Kronkright, and Norton, (1990), posits that if one mixes 0.1 % safranin 0 in water andthen places a drop on the material to be analysed or draw a drop through the prepared side. Just stand for 1 minute. Remove the excess stain by drawing water through the preparation. Wash off stain with water. Plant parts such as pollen grains, seed coats, grain glumes, woody tissue, and epidermal cells stain red.The essences of these tests are largely a determinant in identifying the braids and establishing the extent to which the braids could be harmful or otherwise to practitioners and users of the materials. Knowledge of this is significant for forensic investigations, designing, manufacturing, showcasing, and then, care and maintenance. It equally enhances blending and doubling with other yarns for other effects especially as it stands now, the braids may not be too convenient to be worn on the human body directly for dressing. The results of the tests are indicative that both materials contain carbohydrate in significant proportions. They are also endowed with the general key elements associated with

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cellulosic textile materials: carbon, hydrogen, and oxygen. Collectively, these led to the conclusion that indeed the materials were vegetable textile products hence its likewise, this is another major reason for which the research is directedto this cause.

Heat Testing

Heat could be taken for a condition where hot air is applied deliberately or accidentally. A major challenge faced by thetextile materials is that, exposure to persistent heat enhances the dryness which reduces its moisture content and in the process, making it bone dry that ends up making the materials brittle. If it happens before braiding, then, the slightest twist shall just end up tearing off the materials there by impeding the evenness of the subsequent braids (yarns) to be made. Already formed braids subjected to this condition loose its compatibility and consistency and could break off and unravel when exposed to some fair amount of stress from abrasion.

The hardness and stiffness developed by the excessive dryness could promote irritating and itching sensations as well if shuffled against the skin. Intense heat from direct exposure to sunshine with little ventilation is ideal for high rate of bone dryness. Deliberate domestic and industrial heat like that from kitchen as a result of cooking could equally create similar effect like the sun with time if allowed to prevail sustainably. The drying is exacerbated when positioned in concealed area and exposed to intense heat for a long time; for instance, placing behind the rear window of a completely sealed car and exposed to high sunshine.

On the contrary, if subjected to fair amount of moisturized heat as in water vapour, both very dry banana stalk and corn husk attain significant succulence that is ideal for twisting and braiding. This arose because of the porousness of the molecules of the materials that make it absorbent and hence, soft, and relaxed. However, care ought to be taken to avoid sogginess, as that shall cause retting. Retting shall break apart the molecular structure of the materials causing them to disintegrate and hence, utter destruction of it.

Tests for Other Essential Properties

consideration for this work. Also, artefacts of natural origin are associated with classic appreciation and perception:

Alongside the above treated subjects, the inquest also led to revelation of significant attributes of the corn husk and banana stalkbraids that are obvious in conventional textile features of which most have been treated already and listed below. The bases for the test of other essential properties were: elasticity, extensibility, tensile strength, resilience, absorbency, dye affinity, comfortability, and reaction to dampness.

The viability of a fibre is dependent on the fact that it passes as textiles, but beyond this, the need to determine the ultimate use of the fibre is even more significant as it forms the basis of the value of the fibre. This is also the underlining factor for the essence of other essential characteristics. It revealed the extent to which the fibre is endowed with these properties to determine the adaptability and adoptability in production and regular use. Basic tests were run with apparatuses at the laboratory of the Mechanical Engineering Department of KNUST, Kumasi. The list below represents the key factors relevant to the project under study.It is worth to note the issue of disclaimer pointing out the fact that humidity, air pressure, and temperature were not factored in during the experimentation for the simple reason was that the fibres involved are already bulky, coarse, and relatively, less fine and flexible as compared to the finer ones like cotton, silk, wool, rayon, acetate, etc. For the latter, the size and weight are so minute that, 0.001g in mass or 0.001mm in length could make a difference in its fineness and versatility that should reflect on collective fibre performance whereas with the corn husk and banana stalk, these could be taken as infinitesimal variables. It is for this reason that those significant details were ignored. Additionally, since most of the testing were done manually and mechanically, absolute conclusions should be quite difficult to attain.

Each of the two fibres was classified into three: wet (immersed into water for five minutes; wet (immersed into water for ten minutes); and then dry. Each of these three classifications was categorized further into two where braided yarns that have not been adjoined for

elongation were tested separately from the joined one to find out volatility to stress and friction. By this, twelve tests were run; six for corn husk and six for banana stalk. During the tests, 'before and after' measurements of the diameters and lengths were determined as well as the weight at which the fibres got broken.

Tensile Test

This was the first test to be undertaken aiming at deducing the feasibility and/or availability of the following essential properties in the two braids that have been itemized as: elasticity, extensibility, tensile strength, resilience, absorbency, and comfortability. For easier and expedient exercise, there was the need to have special apparatuses fixed under controlled conditions to regulate temperature, humidity, and conjecture. Since the materials involved were not as tiny as most fibres like cotton, silk, rayon, etc., the margin of relativity from atmospheric pressure could not greatly alter the concluding outcome of the inquest, hence, temperature and humidity of the laboratory were not controlled. Also, all the apparatuses involved were neither automated nor computerized. In that the braids were and/or are already bulky, coarse, and limited to some extent in fineness and flexibility.

Tools, Equipment, and Materials

Tools engaged in testing the corn husk were veneer callipers, metal tape, pair of shears, digital camera set, bucket, pen, and sketch pad; but the equipment were tensile testing machine and broad table. The materials utilised were the corn husk braids, banana braids, and the water at room temperature.

Corn Husk

In starting, all the fibres used for the exercise were braided following a tailored construction pattern that achieved a common diameter of 3mm and a length of 100mm. The first to be experimented was the braided corn husk that has not been adjoined (i.e. whole pieces that have not been elongated in any form) and immersed into water for five minutes. The results were that: at the weight of 1.75lbs, the fibre broke.

It was deduced that, the diameter remained virtually unchanged but at the breakage point it reduced by 0.15mm. It was so, because, the momentum by which the braid broke caused that aspect of the material to unravel and became dishevelled. This phenomenon was experienced throughout the rest of the tests.

This accounts for the reason why the diameter of 'after' was kept at 3mm through the experiments for tensile strength. The initial length of 100mm extended to 121mm at point of break. The second test was run on another corn husk that has been adjoined (series of fibres were braided in succession for elongation: sort of polymerization) and wetted for ten minutes but had the same dimensions as the former. The braided material got broken under weight of 2.5lbs and increased in length marginally to 122mm.Beyond, corn husk of similar structure and dimension of before was immersed in water for ten minutes and rather, major differences were observed. Firstly, the non-adjoined one broke at the weight of 4.25lbs and extended in length to 131.5mm. Its adjoined counterpart also broke at 4.25lbs but with varying length of 133mm.Finally, on this session, the dry ones came into the fore where the non-adjoined corn husk was the first to be tested which produced rather quite a pattern where it broke at the weight of 10lbs from 0lb and then stretched from 100mm to 120mm. The non-adjoined one on the other hand, broke at 13lbs from 0lb having been stretched from 100mm to 120mm.The data collated from the tests that were run have been organised in Table 3 below:

Table 3 – Data Chart for Tensile Test of Corn Husk

Data Chart for Tensile Test						
ITEMS		DI AMETERS		LENGTHS		BREAKAGE WEIGHTS	
		Before	After	Before	After	Before	After
Wet 5min in Water at Room Temperature	Non-Adjoined	3mm	3mm	100mm	121mm	0lb	1.75lbs
	Adjoined	3mm	3mm	100mm	122mm	0lb	2.5lbs
Wet 10min in Water at Room Temperature	Non-Adjoined	3mm	3mm	100mm	131.5mm	0lb	4.25lbs
	Adjoined	3mm	3mm	100mm	133mm	0lb	4.25lbs
Dry	Non-Adjoined	3mm	3mm	100mm	120mm	0lb	8lbs
	Adjoined	3mm	3mm	100mm	120mm	0lb	13lbs

NB: The 3mm length of the *after* diameter is approximated as infinitesimal figure differences between 0.015 and 0.035 from the *before* were recorded.
Source: Field Data, (2010)

By inference, it could be seen that dried corn husk and banana stalk are quite closely matched in strength; however, the corn husk becomes weak and volatile when moisturized. The corn husk further regains marginal strength following prolonged stay in water. However, moisture generally disorganises the compatibility of the corn husk as it leads the braids to become dishevelled. Also, if the joining during braiding is not properly secured, the extensibility of the braid is elongated as the observed revelations from the chart stipulate. Revelation from the test indicates further that the corn husk braid has tremendous tensile strength and it is very resilient when dried. It is marginally extensible and elastic there by making it less flexible and ultimately, less comfortable effect on the skin as its drapery effect is limited.

Tools, Equipment, and Materials
Like the corn husk, tools, equipment, and materials adopted were veneer callipers, metal tape, apair of shears, digital camera set, bucket, pen, sketch pad, tensile testing machine, and broad table. The materials were **corn husk braids, banana stalk braids, and water at room temperature.** Tests for the banana stalkalmost immediately followed that of the corn husk and the first was the test for braid (non-adjoined) immersed in water for five minutes. With the same conditions of the former pertaining, the observations made were – the material stretched from 100mm to 123mm where it also broke under the weight of 12lbs. Next is the adjoined, which revealed a stretch of 120mm from 100mm that broke under the weight pressure of 9lbs.Subsequently, the non-adjoined that had been immersed in water for ten minutes now became the focus and after the conduction of the test, the interesting disclosure found were it stretched to 135.5mm from 100mm and broke at 13lbs from 0lb. Similarly, the adjoined stretched from 100mm to 134mm and then broke at 9lbs upon stretching from 0lb.The last test in this section involved dried braids of both non-adjoined and adjoined banana stalk. Upon subjection to pressure, the non-adjoined showed a tolerant stretch from 100mm to 120mm where it broke at 11lbs. The adjoined stretched to 118mm from 100mm and then broke at 12lbs from 0lb.

The data collated from the tests that were run have been organised and provided in Table 8. To a large extent, the banana stalk has better resilience and stability in and out of water than the corn husk. It is equally extensible and elastic unlike the corn husk as moisture virtually has no impact on it. Even stretch and breakage points differed slightly, in contrast with the corn husk; the differences showed that

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the differential margins of the corn husk were high when dry and low when wet. On the contrary, regardless of the state (dry or wet), the banana stalk remained strong and stable indicating virtual maintenance of form. As noted earlier, findings from the test indicated further that the banana stalk braid has greater tensile strength than the corn husk and it is equally resilient when dried. It is marginally extensible and elastic thereby making it less flexible and ultimately, less comfortable effect on the skin as its drapery effect is limited just like the corn husk.

Absorption Test

Following the tensile test, the absorption test followed. Together with the tensile test, these two broad experiments revealed vital properties relating to the other essential properties and care and maintenance. The absorption test was vital in that it was to find out the capabilities of the braids regarding the absorption or repellent of water (fluids) and dye affinity.

Tools, Equipment, and Materials

With the conditions of the tensile test pertaining as well, the absorption test however, utilized the following: water receptacle, veneer callipers, tape measure, apair of scissors, gas cooker, saucepan, and cup. The materials involved were braided corn husk, braided banana stalk, and water.

It should be re-iterated through the disclaimer that the conditions that abounded for the previous tests applied here likewise that the laboratory temperature and humidity were not controlled and also, sensitivity of the equipment and applications were not automated and/or computerized because of the nature of the materials under review.

Corn Husk

The first exercise performed was the construction of braids each of which had a dimension of 3mm at the diameter and a length of 45mm and placed in containers. The containers were separated; one represented room temperature and the other represented boiling point. To start, 5ml of ordinary water under room temperature was put into the first container and the corn husk braid (45mm in length) was immersed in it. No sooner than that, the corn husk began to unravel.By the tenth minute when the experiment ended, the corn husk had almost become completely dishevelled. The water level of the corn husk dropped from 0.5ml to 4.95ml.

Following this, the second test was forwarded where water of 5ml boiling point was poured into the receptacle. The amazing experience was the moment the yarn was put in the hot water; the corn husk got completely dishevelled. The corn husk maintained its length but the water level dropped to 3.80ml from 5ml. The experiment has been represented in Table 5 below:

Table 5 – Data Chart for Absorption Test for Corn Husk

Data Chart for Absorption Test							
	Diameters		Lengths		Time durations	Water levels	
Temp-eratures	Before	After	Before	After		Before	After
Room temp-erature	3mm	Unravelled	45mm	45mm	10min	5ml	4.95ml
100 c	3mm	Unravelled	45mm	45mm	10min	5ml	3.80ml

Source: Field Data, (2010)

Banana Stalk

Actually, the tests were carried out concurrently for relative observation and analyses. Like the corn husk, banana braid of the dimension 3mm × 45mm was immersed into water of room temperature for 10min.

After exhaustion of the 10min, the banana stalk virtually maintained its form and shape through the period under review and after. Additionally, it (braid) increased in diameter to 3.3mm. It maintained the length but the water level dropped to 4.95ml. After 15min, the

banana stalk remained as it was but the corn husk totally got dismantled immaculately. Throughout all these period, the banana remained unchanged as well as the lengths of both yarns; however, the water levels showed some interesting changes. After 15min, the banana stalk receptacle reduced by 0.10ml to 4.90ml signifying the extent of relative absorption of the banana stalk over the corn husk regarding immersion in water under room temperature. However, in hot water, the banana stalk absorbed more water as was with the corn husk for the 3.80ml drop attested to that.

By this, it could be concluded that, warm water gets absorbed better by both braids although the corn husk is disadvantaged as the water gets it destabilized through excessive absorption which reduces the ability of the twisted strips to obtain firmer grips during braid formation. This accounted for the reason why water levels in the corn husk receptacles dropped significantly lower than those of the banana stalk. Additionally, the texture of the corn husk also reduces the ability of the material (twisted corn husk strips) to achieve firmer grips during braiding. Another major deduction from the experiments is that both braids have the capacity to absorb colorants as in dyes, printing pastes, and paints. Printing pastes and paints should be ideal for corn husk as dyeing processes on the other hand may end up destroying the whole art piece. Banana stalk should not have any major problem with any of the available media but a blend with corn husk shall make the ultimate artefact vulnerable to the weakness of the corn husk. However, concentrated erratic solvents like caustic soda can ret both braids, especially the banana stalk if not well controlled. For the corn husk, its fragility is exacerbated if contact is made with any powerful solvent. Hence, printing and/or painting should be ideal as colorant for the artefact as sogginess is virtually reduced under such circumstances (printing/or painting). The above is illustrated by the provisions in Table 6, Plates 1, and 2.
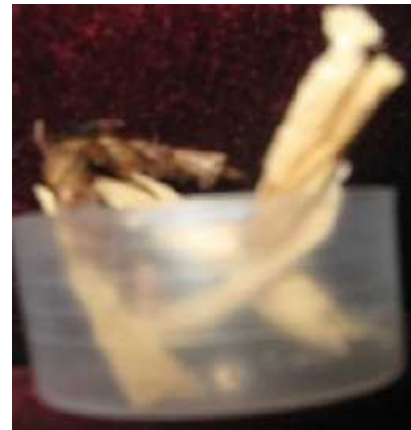

Plate 1: Receptacle of Water (at room temperature) Containing Braided Corn husk and Plantain Leaf

Plates 2: Braided Corn husk and Plantain leaf in water at 100 C

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Table 6 – Data Chart for Absorption Test for Plantain Leaf

Data chart for absorption test							
	Diameters		Lengths		Time durations	Water levels	
Temp-eratures	Before	After	Before	After		Before	After
Room temp-erature	3mm	3.1mm	45mm	45mm	10min	5ml	4.90ml
100 c	3mm	3.3mm	45mm	45mm	10min	5ml	3.80ml

Source: Field Data, (2010)

Care and Maintenance
Processing of textiles and use of textile products always expose them (textiles/apparel) to filth and damage. On the contrary, some textiles may possess some elements that could react with detergents like bleaching agents that could harm practitioners and users of such materials. These assertions bring in the question of health and safety that underlines the essence of this sub-topic which is based literally on the findings of the experiments conducted. Titles to be treated are: washability (hand & machine), bleaching, dry cleaning, pressing, drying, and damage repair.

Bleaching
Bleaching is a noun from the word bleach that has been defined by the Word Web Encyclopaedia, (2008),as: remove colour from, e. g. "the sun bleached the red shirt"; make whiter or lighter, e. g. "bleach the laundry". The fact is that, there are some types of dirt, especially wax-based types that are difficult to cleanse. Often, powerful elements from chlorine or sodium pyrophosphate are used as bleaching agent in cleansing, but for this textile material, bleaching could easily deteriorate it and so it is not advisable to apply such elements for its (textiles) treatment. The Plate 3 represents the international unit indicating that, the textiles should not be bleached (McGuire, 1978).

Plate 3: Braided Corn husk and Plantain leaf in water at 100 C Temperature

Dry Cleaning
Alternative cleansing for hydrophobic textiles is dry cleaning. According to Word Web Encyclopaedia, (2008), dry cleaning is that type of treatment for clothing and textiles where solvent other than water is applied. Dry cleaning should reduce strain and stress associated with washing that has the tendency of deteriorating the over-all attire. However, dry cleaning is also known for adopting some powerful solvents for fabric treatment that could exhume poisonous gases and are capable of hurting not only the launderers but, people leaving quite close to radius where the solvent is applied and the users of the apparel. Plate 4 is the international unit for dry cleaning (McGuire, 1978) shown below:

Plate 4: Braided Corn husk and Plantain leaf in water at Room Temperature

Drying
The tendency of having all clothing getting wet or moisturized to some extent when in use is very high for which reason, textile and garment designers and manufacturers make provision for drying. Drying has been described by the Word Web Encyclopaedia, (2008), as the removal of moisture from and makes dry, e. g. "dry clothes"; "dry hair"; become dry or drier, e. g. "the laundry dries in the sun". As stated earlier, this textile/apparel is a novelty that for now should react badly with water for which reason, immediate drying should not be compromised if wet. Not-with-standing, it does not also need excessive heat especially from the sunshine to dry hence, the symbol below showing that it should not be exposed to direct sunshine but shaded area for drying. Otherwise, the apparel shall become bone and lose its succulence and become brittle, then, fritter off. The International System Unit for indicating not to be dried under direct sunshine is illustrated below
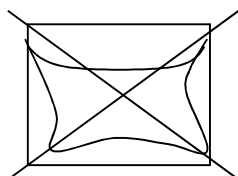
No Drying Under Direct Sunshine
Source: McGuire, (1978)

Damage Repair
Damage has been described by the MS Encarta Dictionary, (2009), as the physical injury that makes something less useful, less valuable, or unable to function. Also, the Britannica Encyclopaedia, (2010), puts it as loss or harm resulting from injury to person, property, or reputation. Repair however, has been defined by the Britannica as: to restore by replacing a part or putting together what is torn or broken; to restore to a sound or healthy state. The World Web Encyclopaedia, (2008), presents it as: Restore by replacing a part or putting together what is torn or broken.

Being a material for display at public places makes the project artefact susceptible to incidents that have the potential of changing status of the item. Should the worst happen either of two possibilities is likely to occur: repairable damage and irreparable damage. Obviously irreparable damage should also connote that the artefact must have been spoilt completely indicative of the fact that the likely damage should have been very severe and intense. On the contrary, repairable damage is a reflection that whatever the situation, there is a chance for restoration. Possible damages that have the propensity for restoration have been organised according to factors indicated – laceration, fluid spillage, gathering of dust, discolouration, over-dryness, and inferno.

Laceration
The Britannica Encyclopaedia, (2010), defines laceration as having the edges deeply and irregularly cut. The World Web Encyclopaedia, (2008), states it as; cut or tear irregularly. Contextually, laceration is being used to mean regular and irregular cuts. Occurrence of laceration could be attributed to unravelling of stitches or cutting the stitches or the braided materials. In all of these, slip hemming could be used to repair upon removing the garment from the statue momentarily.

Fluid Spillage
Fluid is a continuous amorphous matter that tends to flow and to conform to the outline of its container is a liquid or a gas, World Web Encyclopaedia, (2008). The Britannica Encyclopaedia, (2010), makes fluid as having

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particles that easily move and change their relative position without a separation of the mass and that easily yield to pressure: capable of flowing. Spillage is described by World Web Encyclopaedia, (2008), as the act of allowing a fluid to escape. The Britannica Encyclopaedia, (2010), further declares it to be material lost or scattered by especially accidentally or unintentionally falling, flowing, or running out so as to be lost or wasted. To forestall unpleasant experiences as depicted like the above, place the artefact in an airy area or use the hand drier to sip spilt fluids. If the fluid has significant thickness, it may have to be scooped and cleaned before drying. If the artefact gets wetted, truncate the source of the fluid. Immediately mop up the excess water afterwards and dry with drying apparatuses like the hand drier. If such drying apparatuses are unavailable, place the art piece in clean, dry, and airy environment.

Gathering of Dust

Assembling or getting together is the World Web Encyclopaedia, (2008), definition for gathering. It is further defined by MS Encarta Dictionary, (2009), as the collection of objects. It equally presents dust as very small dry particles of a substance such as sand or coal, either in the form of a deposit or a cloud. Adding to it, the World Web Encyclopaedia, (2008), explains dust as fine powdery material such as dry earth or pollen that can be blown about in the air. The possibility of the artefact gathering dust is fairly high especially if the artefact should be showcased in environments that are inclined to dust attraction. Should this happen, a brush with fairly soft bristles could be used to wipe it off or blow it away with hoover machine. The relevance of periodic has been emphasized by Frank, (2012), stating that whether it's a monument in your lawn, at a school or in a cemetery, it is important to clean it every year or so, or as you see fit when the monument collects soil and residue.
Discolouration

The World Web Encyclopaedia, (2008), considers discolouration as act of changing the natural colour of something by making it duller, dingier, unnatural, or faded. The Britannica Encyclopaedia, (2010), sees it as the alteration or changing of hue or colour. Varnishing, painting, dyeing, and/or printing are options that could prevent discolouration.

Non-the-less, if discoloured, all the media stated could still be applied to cover the damage with exception of varnish.

Over-dryness

From the World Web Encyclopaedia, (2008), dryness is the condition of not containing or being covered by a liquid. The Britannica Encyclopaedia, (2010), supports it as free or relatively free from a liquid and especially water; lacking precipitation or humidity. Over is an adverb signifying the excessiveness of dryness to be endured. Over-dryness should make the apparel so dry that it shall become prone to frittering off under little mechanical pressure. To avoid this, varnish and painting with enamel paint can be used for prevention. However, components of the elements of the varnish and the enamel paint should make it dangerous for humans to use the attire directly as some of the chemical components of the paint can be reactive to the skin and pose tragic health conditions. To forestall this, prevention should be the key word.

Inferno

Inferno has been defined by the World Web Encyclopaedia, (2008), as a very intense and uncontrolled fire. The Britannica Encyclopaedia, (2010), also claims inferno to mean an intense fire. For this presentation however, inferno has been adopted as a terminology indicating burning or fire consumption mildly or severely. Actually, both corn husk and banana stalk are combustible but the latter is more volatile. However, the tightness of the spins in the braids hinders free flowing combustion thereby reducing the tendency of burn unless the sparkle is intense and sustained. If finished with varnish or enamel paint, then, obviously the instability and susceptibility to flame should be enhanced. To avoid damage by fire, the artefact should not be located near volatile substances or naked fire as scorching and fire shall cause irreparable damage.

Finishing

In reference to the Britannica Dictionary, (2010), finishing is a noun from finish that signifies the quality or state of being perfected. Enhanced definition by the Britannica Encyclopaedia, (2010), rather describes the term finishingto include all the mechanical and chemical processes employed commercially to improve

the acceptability of product, except those procedures directly concerned with colouring. The objective of the various finishing processes is to make fabric from the loom or knitting frame more acceptable to the consumer. The World Web Encyclopaedia, (2008), simplifies it as a decorative texture or appearance of a surface (or the substance that gives it that appearance).

According to the Britannica Encyclopaedia, (2010), it is frequently necessary to carry out some preparatory treatment before the application of other finishing processes to the newly constructed fabric. Based on that, the braids and constructed costume was subjected to stress to observe effects and flaws and the possible impact on the dress. From the inquests, it was deduced that colour adoption was plausible as the corn husk and the banana stalk were fairly absorbent. Printing therefore could be adopted conveniently as separate medium or joint media to add beauty and lustre likewise painting and spraying. Also, decorative stitches could be applied through varying colours for other exciting effects. Coupled with the above, trimmings and notions could be used for additional embellishment. Where necessary, varnishing becomes the last finishing medium before packaging and presentation. Varnishing in particular enhances the sheen from the various media. In the process, it increases the thickness of the braids and the stitches thereby raising the strength and quality of the corn husk and banana stalk. On the contrary, varnishing should make the apparel more bulky and less porous. Chemical contents and possible health implications make it undesirable for humans to adopt the varnished costume for dressing.

2. CONCLUSION

i.   Fibre structure analysis is a key element for the determination of how far the materials could be considered as textile fibres; better still yarns or braids.

ii.   Banana stalk appears largely feasible for application in textile art and clothing.

iii. Banana stalk could be used for industrial insulators and packaging. Cocoa beans and grains are among some major commodities with tremendous economic importance that banana stalk could package.

iv.   Corn husk could do very well as textiles if mixed with banana stalk.

v.   Chemical treatment can make corn husk independent textiles but will be expensive.

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Challenges in the Processing of Building Permits in Ghana - a Precursor for Development of Illegal Structures

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Abstract
Procuring building permit in Ghana possess a great challenge despite government effort in addressing this blight through the introduction of new land regulations, integration of the land agencies and emergence of the one-stop shop. The delays now serve as a precursor for issuance of false permits by so called middlemen and the development of unauthorised structures by some unscrupulous developers. This paper takes a retrospective look at inherent challenges in the acquisition of building permits in Ghana and how that contributes significantly to mushrooming of illegal structures in most of the major towns in the country. The intrinsic challenges which this paper identified through descriptive research using structured interviews include amongst others: lack of integrated central database management system for permit agencies and analogous institutions involved in the permit processing system, too many processing steps, increased cost of construction and loss of value due to bureaucratic delays, lack of coordination between the land agencies and the local authorities, differing land ownership practices in Ghana, inappropriate feedback systems and inadequate number of staff for the field inspection and monitoring. Redesigning the current permit system by integrating all the agencies involved in the building permit acquisition process to a central database management system for sustainable development is a highly favoured option.

Keywords: Building permit; Permit Acquisition; Processing; Challenges; and Illegal Structures

1. INTRODUCTION

Authorities in Ghana are confronted with the challenge of illegal structural developments. The problem spans from high-rising buildings to the miniature kiosks. These unfortunate developments are taking place every now and then in the night and during the day, on public and on private lands as well. Most at times the city authorities think the only remedial measure is demolition of these illegal structures as recently happened in Tema (Agyei Kwadow) and Kumasi (Adeshiman). The results of these demolitions on the poor developers are quantitatively enormous. However, procuring building permit in Ghana possess a great challenge despite government effort in addressing this blight through the introduction of new land regulations, integration of the land agencies and emergence of the one-stop shop. The delays now serve as a precursor for issuance of false permits by so called middlemen and the development of unauthorised structures by some unscrupulous developers. Ghana currently ranked 151th position in world in the easy of acquiring building permit rankings according to World Bank and IFC (2012). This position is highly unacceptable and unfavourable to attract perspective investors compared with Hong Kong (1st position) and Kenya who ranked best among African countries in the 35th position. This paper takes a retrospective look at inherent challenges in the acquisition of building permits in Ghana and how that contributes significantly to mushrooming of illegal structures in most of the major towns in the country.

1.1 Building Permits Processing

The building permit acquisition process starts with the client picking an application form at the local authority office (District/Municipal/Metropolitan assembly) with the site plan of the parcel to be developed. This site plan is usually reproduced from an existing site plans that contain the parcel in question. This reproduction is done with all inherent errors in the preparation of the original plan. The application form is then completed by draughtsmen (which should have been done by a Licensed Quantity Surveyor). The client submits the completed application forms with the building drawings for processing. The documents are vetted by a committee and necessary field inspection carried out by the building inspectors. Also ownership verification of parcel of interest at the lands commission is

done. If the application passes all these tests, it is then forwarded to the statutory committee for final granting of the building permit.

However, these meetings are either done quarterly or the committee members are called to meet based on the number of applications submitted within two months. If the application fails the whole process has to be restarted but no notification is given to the client. The ownership verification process can also delay the whole process as there is no efficient and modern land record system in the lands commission to fast track the search. The client cannot also monitor the progress of the application. The building permit acquisition process is therefore process oriented and not client oriented. Eventually the client's confidence in the whole process is decreased. Although LAP has been introduced with the passage into law the Lands Commission Act(Act, 767) the mechanical way of doing thing at the various permit issuing agencies is yet to see any change. Fig. 1 is a flow diagram showing the current building acquisition procedure in Ghana.

Fig. 1 Flowchart of the permits acquisition procedure in Ghana (Boamah & Agyeman, 2011)

2. METHODOLOGY

The paper identifies intrinsic challenges in the building permit acquisition process using descriptive research and structured interviews. The study area was the Sunyani east municipality in Ghana. The Sunyani East Municipality is transit town for travellers between northern and southern Ghana and also a place of increased contract and cost management economic activity mostly resulting from the operations of a multinational mining company close to the town, and the presence of two universities and a polytechnic. In coming out with the challenges in the permit granting system, the researchers applied the following key research procedures: Gather and analyze existing datato get a clear understanding of how the work processes currently operate within all the permit agencies in the municipality. The researchers went to Sunyani East Municipality and Lands Commission to
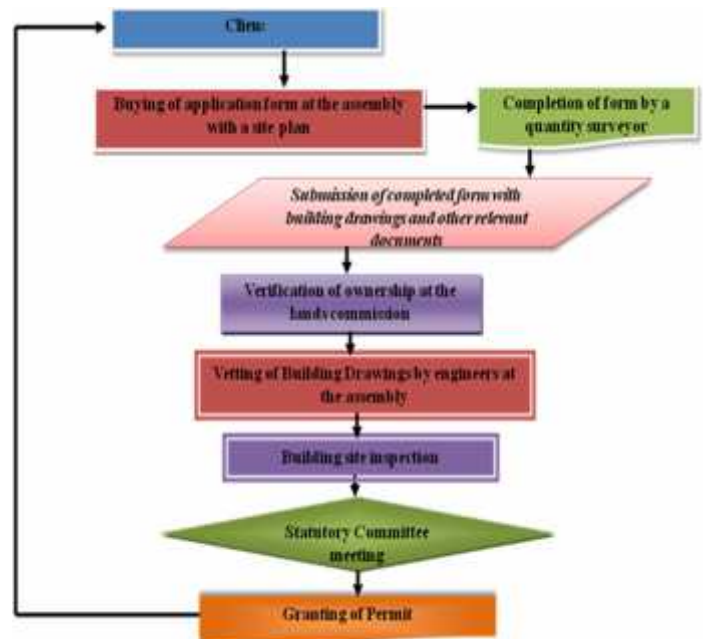
obtained stakeholders' qualitative assessmentof the existing process to assist in identifying process areas of key customer concern. With the aim of ensure the credibility of findings, interviews and personal observations were used to verify records, records and interviews were used to verify observations whereas records and observations were used to verify interviews (Zucker et al. 2008).

The survey instrument used in this research is questionnaire. Data gathering on the building permit acquisition process started with structured interviews with the Municipal Town and Country Planning Officer and the Municipal Engineer for an understanding into the steps and challenges involved in the building permit acquisition process. Further interviews were conducted with 50 applicants (clients, consultants and contactors) who have been involved in the process of acquiring building permits, to verify the information on the permit acquisition challenges obtained previously from the officers of the municipal Assembly. Lastly, field inspection officers from the assembly, two officials from the Lands Commission were similarly interviewed. Purposive sampling technique was used to achieve the research objectives. Records, in the form of reports, forms, policies and regulations were reviewed for

added information on the permit acquisition challenges within the Sunyani Municipality.

The summary of the results of the survey from 2012 to January 2014 are indicated in Table 1.

3. RESULTS

Table 1. Survey Results

Year	Applications Received	Applications Considered	Applications Not Considered	Applications Granted	Applications Deferred
2012	237	184	53	172	12
2013	180	180	0	171	9
2014	30	25	0	Awaiting	5

In the year 2012 from Table 1, the Sunyani East Municipal Assembly received 237 building permit applications. Out of these 184 were considered. The approved applicants were 172 with only applications 12 deferred. In all 53 applications were not considered at all. The numbers of applications reduced drastically to more than 50 % to 180 in 2013. Out of this number 171 applications were granted and 9 deferred. As January 2014, 30 applications have been received. Out of these 5 were deferred and 25 were awaiting decision.

4. DISCUSSION

The average success rate was 84 % for 453 applications. The deferral rate when an application is considered in the Sunyani East Municipality is 6 % in every 380 applications considered.

The results showed high success rate and insignificant failure rate. Prominent reasons cited for the delays and deferrals (Table 1) included, land ownership verification challenges (missing land title registration documents at the Lands Commission, wrong land allocation), re-zoning of existing land sectors, auxiliary documents such as fire permits, environmental permit acquisitions. The extended duration of the permit processing, according to the interviews, could be also be blamed on factors such as missing application documents at the TCPD, delayed meeting of Statutory Planning Committee as well as delay in signing documents by technical officers. Results also indicated inadequate number of staff for the field inspection and monitoring at the Town and Country Planning Inspectorate Division.

The interviews results from officials of the lands commission revealed the following challenges in the agency: lack of data integration for the processing of permits, lack

of co-ordination between the Land Agencies and the Local Authorities, no mechanisms to check the validity of some of the documents submitted by clients, financial constraints, poor feedback systems, technological challenges; and land disputes, land acquisition and land tenure system challenge. The 50 Applicants interviewed also complained of poor feedback systems, bureaucratic delays which lead to increase cost of construction and loss of value, cumbersome application procedures, multiple land sales and land disputes. Most of them believed that re-engineering the whole process will be the most favoured option.

3.1 Key Findings - Challenges in the Building Permit Processing

The following were the problems inherent in the existing building permit processing:

- Bureaucratic delays which lead to increased cost of construction and loss of value
- Data accessibility for the processing is difficult
- Lack of co-ordination between the Land Agencies and the Local Authorities
- No mechanisms to check the validity of some of the documents submitted by clients.
- Search for ownership at the lands commission can be very cumbersome
- Inadequate number of staff for the field inspection and monitoring
- Lack of modern ways (using Information Communication Technology) of keeping and retrieving land records at the lands commission
- Financial constraints
- Poor feedback systems

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3.1.1   Bureaucratic delays

Generally, bureaucratic delays in building permit procurement lead to increased cost of construction and loss of value. According to Eyiah (2004), developers find themselves interfaced with national, regional and district bureaucracies at all levels of a project to obtain building permits. According to Mensah et al. (2003), most delays in establishing business in developing countries like Ghana occurred in securing land and in obtaining building permits. It was surprising that a workshop to review processes and procedures for granting building and development permits by the Town and Country Planning Department (TCPD) under the Land Administration Project (LAP) held in Accra on July 28, 2008 by thirty-eight (38) planners and works engineers of Municipal, Metropolitan and District Assemblies recommended the following: Shortening the time period for granting permits, Reducing the number of signatories needed for permits, Reviewing the law that makes title clearance a requisite for building permits, Developing a single system for granting permits in the country and frequent holding of meetings to approve permits. Currently the permit duration for processing building permit is 220 working days. In other parts of the country apart from the capital city it could go as long as 1-2 years (Hammah, 2010; Kpamma and Adjei-Kumi, 2013). The applicant goes through 18 cumbersome procedures. Some stubborn and impatient developers blatantly ignore or resist development abatement directives citing delays or difficulties in securing the permits to justify their illegal development. Individuals and corporate developers have stories to recount about the level of frustration and cost incurred due to the numerous follow ups and accompanying delays experienced whilst patiently waiting for building permits.

Overly complicated construction rules also can increase opportunities for corruption. World Bank Enterprise Survey data show that the share of firms expecting to give gifts in exchange for construction approvals is correlated with the level of complexity and cost of dealing with building permits (Enterprise Surveys, 2010). According to a 2005 survey conducted in 15 countries by Transparency International, entrepreneurs perceive construction as one of the most corrupt industries, surpassing arms and defence, oil and gas, real estate and mining. More efficient systems can prepare governments to take advantage of a pickup in construction activity. Generally speaking, reducing delays benefit more than just builders and owners. A study in the United States estimates that accelerating permit approvals by 3 months in a 22-month project cycle could increase construction spending by 5.7 % and property tax revenue for local governments by 16 % (Bureau of Labour Statistics, 2010).

3.1.2   Data availability, accessibility and validation

One-stop shop is a data storage bank/unit with various linkages which can be accessed by land agencies and other stakeholders (Boamah and Agyeman, 2011). Though this system is available in Ghana, permit agencies find it difficult to access this data. Either the data is not fully integrated or there is fight for supervising authority as a result of jurisdiction problems faced by Land Commission belonging to Ministry of Lands and Forestry and TCPD on the other hand under Ministry of Local Government. There were also no mechanisms to check the validity of some of the documents submitted by clients. The reproduction of site plans from an existing site plan was not proper a practice because those plans had inherent errors. The application forms are completed by draughtsmen; this should have been done by a Licensed Quantity Surveyor or done under his supervision.

Where the data integration has properly been done and systems are working, data is deployed in Geographic Information Systems (GIS) environment with Geodatabase (Spatial and Non Spatial) having the following themes: layout scheme (parcel information), land use and land cover, land area, topographical maps, cadastral plans, geodetic control network, soil maps, and other relevant field information. In the one-stop shop, institutions such as the Town and Country Planning, Geomatic Department (Survey Department), Office of the Administrator of Stool Lands (OASL), Lands Commission, Municipal Assembly, Environmental Protection Agency (EPA), and etcetera will be hooked to a central data storage unit. That is, an officer in the in any of the above institutions can have access to all land information and other related matters without

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physically moving from one office to another. Take a parcel in Abesim in the Sunyani Municipality in the one-stop shop for example, will have a unique identifier, title holder's name, topographic information of the land, purpose of demarcation, geodetic network information, geotechnical information, Land Area and so on, as first-hand information to the Senior Officer involved in issuing the building permits. Therefore instead of files moving from one institution to another, soft copies will be used instead (Boamah and Agyeman, 2011; Kpamma and Adjei-Kumi, 2013).

3.1.3   Lack of coordination between the land agencies and the local authorities

Before a building plan is approved, appropriate clearances are needed to ensure quality and safety. Often several agencies are involved. To prevent overlap and ensure efficiency, many economies have opted to put the agencies in one location. These one-stop shops improve the organization of the review process - not by reducing the number of checks needed but by better coordinating the efforts of different agencies. That way, more resources can be devoted to safety checks rather than to manual paperwork. Allotted to Hammah (2010), acquisition of lease documents or title, to necessitate the granting of a permit is difficult in Ghana.

Lengthy processing durations and high cost deter developers from applying for permits. Many developers are even unaware of laws on housing. Many old and emerging communities have no planning permission. Certain communities have multiple planning schemes and multiple land sales making plan implementation difficult (Forkuo and Asiedu, 2009). Search for ownership at the lands commission can be very cumbersome because "people" are registered instead of the land. If land parcels are given unique serial numbers like cars and any other products from manufactures, and duly registered duplication or multiplication problems will be greatly minimised. This was the disturbing building permit state in most cities in the country. These problems can be attributed to apparent lack of coordination between land agencies and local authorities in planning land use at various levels of land development. Thus according to building development administration in Kumasi Township 80 % of buildings in the Metropolis were without building permits in

2009. Between 1990 and 2000 only 7.2 % of buildings in the Metropolis had permits.

3.1.4   Inadequate number of staff for field inspection and monitoring

This was the most crucial and yet serious challenge that the permit acquisition process faced in Ghana. The number is woefully inadequate and their capacity is not strongly built, meanwhile, ownership verification of parcel of interest at the lands commission has to be done. Interestingly, this is the last test that the application must go through. Additionally, the monitoring unit of the building inspectorate division was tasked with the responsibility of ensuring that developers comply with building drawings submitted to the assembly during the permit acquisition process, and report any unauthorised structural development within their area of jurisdiction to Municipal Planning Authorities. Since their number is small, most of this field inspection and monitoring activities are haphazardly done, leaving most illegal developments unnoticed. The slow verification also caused unnecessary delays to the granting of the permit by the Statutory Committee. Local authorities have also put forward many justifications for such delays (Hammah, 2010). These challenges are actually serving as precursor for the disturbing springing-up of illegal structures in most cities in the country.

3.1.5 Technological challenges

The lack of modern ways such as using Information Communication Technology (ICT) for keeping and retrieving land records at the lands commission was worrying (Kpamma & Adjei-Kumi, 2013). Effective and efficient use of information technology can reduce the regulatory cost of construction. Jurisdictions across the United States are using information technology to increase efficiency. More than 500 now use an advanced e-permit processing system. Introduced since 2003, the system has reduced the time that professionals in the construction industry spend on permits by 30–40 % (Bureau of Labour Statistics, 2010).

Economies in the Middle East and North Africa that made dealing with building permits easier focused on introducing online services and electronic platforms (World Bank and IFC, 2012). In East Asia and the Pacific, Singapore and Hong Kong SAR (China) converted their one-stop shops for building permits to online

systems in 2008 (World Bank and IFC, 2012). Though Ghana has introduced the one-stop shop, improvements are yet to be seen.

The City Council of Nairobi (CCN) traditionally only accepted building permits applications manually. The system was believed to be cumbersome and time-consuming and that it encouraged evasion and proved detrimental to the overall economy until the implementation of the e-Building Permit system (World Bank, 2011). Key steps in the process include: "submission by architects for design approval; evaluation and approval within the CCN; monitoring status of submitted proposal using SMS and email; and issuance of the building permit. The system includes management reporting at all stages of evaluation as well as archiving of building proposals submitted. The data capture and retrieval functions enabled as part of the new system are vital to potential investors and entrepreneurs. The new system allows investors to access statistics on property development trends in Nairobi. It also provides a platform for the profiling of architects so users can identify those who see development projects to successful completion. Investors will be able to identify growth areas in the city. Because the statistics are online they will be easier to collect and this will foster transparency". The results and impact of the permit automation included: reduction of more than two weeks in time required to obtain building permits, inspections, and occupancy permits, increased industry compliance expected to result in growth of issued building permits beyond the current 400 per month, reduced building permit backlog expected to yield more projects and jobs, eight jobs in local economy are created for every 10 construction jobs, streamlined system will stimulate job growth, increase formalization rates among developers and generate opportunities for greater economic growth.

3.1.6   Financial constraints
Financial resources to develop the agencies capacity, introduce modern technologies, do field inspection and monitoring, purchase logistics, and the like were lacking. Sole funding source over the years has being the government through taxes. Budget allocations to this sector have been inadequate (Bureau of Labour Statistics, 2010; Ghanadistricts, 2006).

Currently the agency is saddled with huge financial drawbacks. Though the land administration project (LAP) was receiving cooperate funding from external donors, fund flows sometimes halts the project derailing the project deadline. To improve the performances of these agencies in service delivery, drastic investments in ICT and capacity building for workers must be carried out. This is because the current state of encroachment on both public and private lands is quiet disturbing. This will save future governments the headache of drafting demolition guidelines or regulations.

3.1.7   Poor feedback systems
The 1996 National Building Regulation L.I. 1630 Section 8 (1 and 2) was fashioned out as follows: "Where a person submits an application for a building permit the District Planning Authority shall notify him within seven days of the receipt of the application and shall within a period of three months thereafter notify the applicant whether the application is granted or refused". It goes on to conclude that "an applicant not informed about the grant or refusal of his/her application may after the expiry of the three months commence development on the basis that the application is acceptable to the District Planning Authority". Clearly this seemly controversial Clause in the regulation seeks to introduce checks and balances by putting permit issuing authorities into action to avoid unreasonable delays whilst keeping applicants abreast with any important matter related to each building permit application (Hammah, 2010). Although this is brightly stated in the L.I. 1630, the implementation has not been effective. Ghana Institute of Architects (GhIA) are of the view that planning committees that consider and approve building permits most often fail to meet local authorities,' but should be made to display every month permit applications received, approved or refused. The Ministry of Works and Housing and the Ministry of Local Government should ensure that Town Development Committees issues out only development permits whilst building permits become the sole prerogative of town and municipal assemblies to forestall the duplication of delays observed (Ghanadistricts, 2006). These are laudable ideas as efficient permit systems elsewhere provide effective feedback systems where applicants are previewed to the status of their permit

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applications with a click of a bottom and at the comfort of their homes.

3.2 Government interventions

Since illegal structures can effect sustainable development, doing business in the country, block waterways thereby contributing immensely to flooding in most cities in Ghana, successive governments have made efforts to improve the permit acquisition process through the introduction of countermeasures and legislations. These include the introduction of the one-stop shop (location where various requirements can be met in one place in this regard, the entire agencies within the land domain have been brought under one umbrella), LAP (reform the land administration system so as make it more efficient), new land legislations, demolition modalities (drafting of guidelines for the demolition illegal structures), and so on.

5.   CONCLUSIONS

The intrinsic challenges in identified in building permit acquisition system include: lack of integrated central database management system for permit agencies and analogous institutions involved in the permit processing system, too many processing steps, increased cost of construction and loss of value due to bureaucratic delays, lack of coordination between the land agencies and the local authorities, differing land ownership practices in Ghana, inappropriate feedback systems and

inadequate number of staff for the field inspection and monitoring. Average success rate for 453 applications is 84 %. The deferral rate when an application is considered in the Sunyani East Municipality is 6 % in every 380 applications considered. The results therefore show high success rate and insignificant failure rate.The following recommendations would be crucial if Local Authorities want to get value for money, beautify and control the springing-up of unauthorised structures in our towns and cities. Redesigning the current permit system by integrating all the agencies involved in the building permit acquisition process to a central database management system (DBMS) is a highly   favoured   option.Other recommendations include:

- Continuous professional training for all the stakeholders involved in building permits acquisition process.
- Identification of all land owners (Root titles or Allodial titles) and preparation of a base map for the identified lands.
- Superposition of the assembly's developmental plans on these base maps.
- The lands commission should update the Local Authorities regularly with land ownership information to facilitate the building permit processing.

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Orienting Polytechnics for Customer Satisfaction and Improved Organizational Performance

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Abstract
Most of the studies undertaken on the subject concentrated more on developed countries and only touch on some areas in the universities instead of polytechnics. This study, therefore, aims to achieve the following: the level of customer orientation among the staff of the polytechnic,the nature of service delivery and procedures at Koforidua polytechnic, the level of customer satisfaction with service delivery at the polytechnic, and the relationship between levels of staff customer orientation and organizational performance at the Students Records office.For the purpose of this study, the quantitative approach was adopted since it helped the researchers to engage in a more rigorous analysis and thus achieved the stated objectives. The population the total sample size for the study was made up of one hundred and fifty (150) students and ten (10) workers of student's records section of the polytechnic. Probability and non-probability sampling techniques were applied together and also, both primary and secondary data were used to gather information for the study.Findings of the study revealed that, there is a positive relationship between (i) market orientation and service delivery process; (ii) market orientation and service quality and (iii) service delivery process and service quality. The study suggests that, management of the Polytechnics should devise another means through which they will be able to make students aware of the services offered at the Students' Records Officeandput in appropriate measures that could spell out the need for personnel at the office to warmly welcome students during service delivery. This could be by way of offering incentives to that effect.It also recommends that, management should be able to organize training sessions and workshops for staffs at the student records office so as to update them on the new measures for effective service delivery.

Key words: Orientation; Customer; Satisfaction; Organization; Performance

1. INTRODUCTION

The higher education market is now well established as a global phenomenon, (Ekwulugo, 2003), where marketisation policies have been gradually introduced, (Jongbloed, 2003). It is widely assumed that in the context of increasing competition, tertiary institutions need to market themselves more explicitly. Market Orientation is a set of beliefs that puts customers' interests first, but at the same time raisesthe awareness of the need to obtain information about competitors and establish cross-departmental activities to satisfy customers' needs, in order to gain a competitiveedge in the turbulent, competitive environment. Based on the works of NarverandSlater (1994) and Oplatka and Hemsley-Brown (2007) the following three relatedcomponents of market orientation are suggested, and are underpinned by shared values and beliefs, which may help tertiary institutions administrators, managers, faculties and students to understand their environment, and may also provide them with norms for behaviour. Thepresent study focuses on market orientation at a faculty level and comprises three dimensions:

Marketing scholars accept that market-oriented organizational change is an importantway of achieving a competitive advantage (Narver and Slater, 1990). From this perspective,organizations that are market oriented are expected to experience superior performancemeasured in terms of return-on-assets, employee satisfaction, and customer satisfaction(see Narver and Slater, 1990; Jaworski and Kohli, 1993), among others. Yet other scholarsposit that market orientation is insufficient to gain a competitive advantage (e.g. Day,1994a; Slater and Narver, 1995; Baker and Sinkula, 1999). Specifically, it is stipulated thatmarket orientation only enhances performance when it is coupled with learning orientation(Slater and Narver, 1995).

Researchers have searched vigorously for empirical evidenceto test the interrelationship between market orientation, learning orientation, andorganizational performance

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(see e.g. Sinkula et al., 1997; Farrell, 2000; Keskin, 2006; Leeand Tsai, 2005; Ferrell et al., 2008). Although the various authors concur in pointing out thenecessary relationship between market and learning orientations in for-profit organizations,this relation is scantly evidenced in the nonprofit sector (Hurley and Hult, 1998). Service or are witnessing constant changes (see Balabaniset al., 1997; Brooks, 2003; Trautmann et al., 2007), with the implication that managersmust "think more strategically, transform insights into effective strategies, and developrationales paramount to the adoption and implementation of selected strategies (Prugsamatz, 2010, p. 244). With these trends, the adoption of market and learningorientations could be crucial for successfully managing the impact of changes in the nonprofit sector. Previous studies have examined, among other things antecedentsand consequences of market orientation (e.g. Wood et al., 2000; Cervera et al., 2001;Vazguez et al., 2002; Shoham et al., 2006; Carmen and Jose, 2008), organizational learning(e.g. Prugsamatz, 2010; Barrett, 2000; Ebrahim, 2005), innovation (e.g. Hurley and Hult,1998; Damanpour et al., 2009), and performance measurement (e.g. Kaplan, 2001;Kolodinsky, 2003).

Again, scholars such as Philip Kotler, (1977) indicated that market orientation includes: a customer centric philosophy, an integrated marketing focused organization, adequate market information, strategic orientation and operational efficiency. Therefore the responsibility of being market oriented is the responsibility of the entire organization. The benefits include good business practices such as operational efficiency and customer satisfaction. Cole et al., (1993) argues that pursuing market orientation has a positive influence on customer service levels.
Kohli and Jaworski (1990) defined market orientation as "the organization-wide generation of market intelligence, dissemination of the intelligence across departments and organization-wide responsiveness to it" According to the authors; the marketing concept is a business philosophy, whereas the term market orientation refers to the actual implementation of the marketing concept. They added that "a market orientation appears to provide a unifying focus for the efforts and projects of individuals and departments within the organization."
Supporting the foregoing, the concept enjoins all managers to work as a team since all departments may directly or indirectly have an impact on both short-term and long term customer satisfaction. Indeed, all organizational members should be market and at the same time customer oriented. In terms of marketing as a function it implies that companies achieve marketing effectiveness by properly integrating all the elements of the marketing mix, namely: product, price, place/distribution, promotion, physical evidence, process, people and productivity and quality.

It appears that having **a** marketing orientation approach is also about being able to focus on limited resources more efficiently to achieve results. If every employee has a consistent understanding of the marketplace and is working toward creating value for the customer, then there will be fewer "quality" issues and organizational efficiency will improve. Costs will be reduced and the time taken to get products to the customer will improve **(**Narver and Slater, 1990).

It has been suggested that market oriented companies are more proficient at releasing successful new products than non-market oriented companies. The notion is that if a company focuses on generating market information, it is more likely to identify relevant latent customer needs and act on market opportunities they identify. This suggests that an organization can be both market-oriented and entrepreneurial simultaneously. Lukas and Ferrell (2000) added their support to this notion by identifying that a customer oriented company is more likely to develop radical new product innovations.

1.1 Research gap
A careful look at available literature on market orientation indicated that several studies have been conducted on issues relating to different industries. The extant literature reveals that most of the studies basically concentrated on areas such as the significance of customer orientation in educational institutions (see Dawkins and Reichheld, 1990; Reichheld and Kenny, 1990;Page, et al., 1996; Marple and Zimmerman, 1999; Fisher, 2001; Cohen et al.,

2006; Liu and Wu, 2007; Mirzaet al., 2009); comparing one institution in a particular country to another. (Colgate and Hedge, 2001; Trubik and Smith, 2000). Others also looked at service quality in some tertiary institutions.(Roiget al, 2006; Petridouet al., 2007; Ganguli and Roy, 2011;Ladhariet al., 2011); a comparative study (Achua, 2008; Mandhachitara and Poolthong, 2011); online survey in some universities (Jayawardhena and Foley, 2000;Sayar and Wolfe, 2007; Callaway, 2011) and market orientation in western schools (Almossawi, 2000; Hayat et al., 2011; Kaynaket al., 1991), just to mention a few. None of the above mentioned studies directly focus on polytechnic education in developing countries such as Ghana.The researchers therefore seek to bridge this knowledge gap by emphasizing on Polytechnic education in Ghana with much attention on Koforidua Polytechnic's students record section.

1.2 Problem statement

Understanding thecontext of market orientation within tertiary institutions is the first stage in attempting to increase organizational performance in polytechnic system. Polytechnics in Ghana play second fiddle to the public universities even though they produce a chunk of manpower needs. As a result of this, the researcher sees market orientation as a major contributing factor for high performance in any organization. In terms of performance, Koforidua Polytechnic is rated among the last since market orientation is not a priority. This all important component of marketing however has been relegated to the background in the Ghanaian tertiary institutions in general and Koforidua polytechnic in particular. Both past and current students of Koforidua Polytechnic complain so much about the activities of the students record office such as collection of certificates and transcripts, registration problems and general reception of customers by the staff of this office,and of course this is a problem that needs to be researched into, hence this study.

1.3 Objectives of the study

The research objectives are to:
- Examine the level of customer orientation among the staff of the polytechnic

- Evaluatethe nature of service delivery and procedures at koforiduapolytechnic

Determine the level of customer satisfaction with service delivery at the polytechnic
- Determine the relationship betweenlevels of staff customer orientation and organizational performance at the Students Records office.

1.4 Literature review and conceptual framework

As Jankowicz (2005) puts it: "There is little point in reinventing the wheel. The work that you do is not done in a vacuum, but builds on the ideas of other people who have studied the field before you. This requires, you describe what has been published, and to marshal the information in a relevant and critical way."

1.4.1 Defining market orientation

In the 1990s, literature suggested two main operational definitions of the marketing concept. One operational concept proposed by Kohli and Jaworski (1990) defined market orientation as composed of three sets of activities: organization-wide generation of market intelligence, dissemination of the intelligence across departments, and organization-wide responsiveness to it. Kohli and Jaworski described market orientation as a set of activities in organizations. Strings of research have been published widely on this topic since 1990 (Jaworski&Kohli, 1993; 1996, Kohli et al., 1993).

As an alternative operational definition of the marketing concept, Narver and Slater (1990) conceptualized market orientation from an organizational cultural perspective. Narver and Slater view market orientation as an organizational culture that effectively and efficiently creates necessary behaviors for the creation of superior value for buyers, and thus continued superior performance for the business. Narver and Slater's definition consists of behavioral components of market orientation, focusing on three elements: customer orientation, competitor orientation, and inter-functional coordination.

Narver and Slater (1990) utilized the term market orientation as synonymous with market-oriented culture. Therefore, conducting

a major review of conceptual literature and empirical studies led them to conclude that a market-oriented culture is comprised of three main behaviors: an orientation toward the customer, a focus on competitors, and co-ordination between functions. The studies conducted by Narver and Slater opened up a proliferation of research studies in market orientation based on behavioral focus or cultural factors (Norburn et al, 1989; Narver et al., 1998; Slater &Narver, 1998, 1999; Desphande& Webster, 1989; Desphande et al., 1993, 2000; Deshpande& Farley, 1999, 2004; Day, 1994, 1999; Harris, 2002a, 2002b).

This study assumes the perspective that market orientation consists of three sets of behaviors: customer orientation, competitor orientation, and inter-functional coordination (Narver& Slater, 1990). Therefore, this study emphasizes the view of market orientation as culture. Desphande and Webster (1989) described organizational culture as shared values and beliefs which help an individual understand organizational functioning and thus provide norms of behavior in organization. The majority of marketing theorists claim a link between market-oriented culture and performance of firms (Atuahene-Gima, 1996; Greenley, 1995). The marketing concept is further defined as a distinct organizational culture, a fundamental set of beliefs and values that put customer at the center of the firms' thinking about strategy and operations (Deshpande& Webster, 1989). This strengthens the argument for investigating cultural factors as effectively and efficiently creating such behaviors (Narver& Slater, 1990).

Two papers present some implications for increasing a market orientation. Jaworski and Kohli (1993) empirically identify some organizational antecedents to a market orientation, and Lichtenthal and Wilson (1992) examine the trans-organizational nature of market orientation. However, neither paper analyzes strategies to create a market orientation. According to Kotler (2003), the marketing concept is supported by four pillars: target market, customer needs (which both are related to customer focus), integrated marketing, and profitability. However, the question arises: which specific activities are needed to translate the philosophy into practice successfully? The question has led several

authors to contribute to the operational definition of market orientation as a construct. So, various conceptualizations of the construct can be found in the literature.

1.4.2 Market orientation in higher education

There has been increasing demands for transparency in public expenditure (e.g.Malaysia) and the necessity to define priorities in higher education in relation to otherdesired social activities. Thus, the higher education policy-makers need to adopt moreformal methodological approaches to provide a guarantee of quality products andservices. Besides, there has also been increased internationalization of thelabor-market, international mobility of teachers or lecturers, researchers, studentsand competitive education programs. Service quality is important to institutions of higher learning for a number of reasons, including competitive advantages, satisfyinggovernment requirements, and meeting the ever-increasing public expectations(Galloway, 1998). Thus, the assessment of market orientation on higher educationservices is essential and this study can potentially contribute to the improvement ofservice quality management in higher education.

Markets in education very much refer to those consumer populations which are themain targets for the marketing of education (Tan, 2002). As far as higher education isconcerned, students are the key stakeholders, and yet there is very little researchliterature on the voices of students (Chapman and Pyvis, 2005). The core business ofinstitutions of higher learning should indeed be serving the students. According toRowley (1997), students can be the agent in the service process and it is important tolook at their roles in the service environment. Therefore, the units of analysis in thisstudy are students, the major customers of the institutions of higher learning. They arethe "daily customers" and informed respondents who can most probably be able to tell theservice beliefs, practices and processes.As the recipients of the various services thus far (one year and above), they areasked about items that they can and are in the position to answer. Moreover, manymarketing and quality management researchers and scholars agree that theassessment of marketing practices from the customer's vantage point is crucial

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andmore appropriate for developing a market-oriented organization (Drucker, 1954;Deshpande´ et al., 1993; Webb et al., 2000). The respondents of the study reported in thispaper were randomly sampled from the public and private institutions of higherlearning in Malaysia.

1.4.3 Market Orientation and customer satisfaction in Tertiary Institutions in Ghana

The discussion in section 2.1 provides understandings to what various authors viewed or are saying in relation to the term "market orientation". There is the need to look at the significance of customer satisfaction and organizational performance in tertiary institutions in Ghana. These form the basis for this section's discussion.

Market orientation has also been reported to be a primary goal in institutions that practice relationship marketing (Covielloet al., 2002). While the precise meaning and measurement of market orientation can vary between industries and institutions (Aspinallet al., 2001) there appears to be a general consensus that focusing on market orientation can yield several economicbenefits (Dawkins and Reichheld, 1990; Reichheld, 1996; Buttle, 2004). Anderson and Narus (2004) also believe that market orientation can be seen as a more effective business strategy.

According to Ahmad and Buttle (2001) the end goal of an institution's marketing activities in the profit sector, irrespective of the way sales are made, whether by transactional encounters or relationships, is making profit. From Relationship Marketing (RM) perspective, Berry and Parasuraman (1991) states that successful institutions are those that manage to turn their customers into clients whereas Vandermerwe (1996) also pointed out that successful institutions are those that 'own' their customers and pursue ongoing values for them.

The relationship among market orientation, marketing and culture is straightforward. A market orientation induces superior marketing—but marketing that incorporates the skills and knowledge of all functional areas in the organization (e.g., Deshpande and Farley (1997); Webster (1994); Narver and Slater (1990); and Drucker (1954) who insightfully observed long ago, identified that, "marketing

is the entire business seen from the customer's point of view" (emphasis added)). In sum, if every individual and function is to remain committed to, and participating in, the creation of superior value for customers, nothing short of implanting the appropriate culture will suffice.

1.4.4 Market Orientation and Organizational Performance

While many scholars have provided abundant evidence in extant literature linking the adoption of market orientation with organizational performance, (Day, 1994, 1998; Jaworski&Kohli, 1993; Narver& Slater, 1990, 1995; Narver, Park & Slater, 1994; Ruekert, 1992; Pelham, 1997, 2000), others postulate that organizational and environmental influences particularly in developing countries can further constrict the market orientation implementation (Sandri& Williamson, 1989; Okoroafo&Russow, 1993; Diamantopoulos &Cadogan, 1996). These later arguments emphasize the need to further explore and understand the challenging tasks of effective market orientation development and strategies implementation in emergent economies undergoing economic and market re-structuring.

Innovation consequences include firms' innovativeness; their ability to create and implement new ideas, products, and processes (Hult and Ketchen 2001); and new product performance i.e; the success of new products in terms of market share, sales, return environment, and profitability (Im and Workman 2004). Market orientation should enhance an organization's innovativeness and new product performance because it drives a continuous and proactive disposition toward meeting customer needs and it emphasizes greater information use. For employee consequences, Kohli and Jaworski (1990) argued that by instilling a sense of pride and camaraderie among employees, market orientation enhances organizational commitment (i.e; willingness to sacrifice for the organization), employee team spirit, customer orientation (i.e. the motivation of employees to satisfy customer needs), and job satisfaction. In addition, market orientation can reduce role conflict; which Siguaw, Brown and Widing (1994) define as the incompatibility of

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communicated expectations that hampers employees' role performance.

1.4.5 Conceptual Framework of the Study
Following the background of theoretical and empirical foundations underpinning this study, the researcher developed conceptual frameworks from the review of extant literature, which focused on factors or antecedents that result to customer orientation as enumerated by previous researchers. specification of the relationships amongst these elements that the researcher needs to consider for diagnostic and prescriptive analysis. Therefore, the conceptual framework for this study identified key elements of market orientation in tertiary institutions.

Marketing Concept Adoption
The adoption of market orientation concept is seen to be a foundation for successful business performance. However, the manifestations of its adoption are rarely researched or specified in a clear way (Diamantopoulous& Hart, 1993). The marketing concept can be adopted not only by people in marketing functions or educational institutions, but also by others in other specializes (e.g. accountants, production staff, designers, etc.). Institutions should not adopt an approach in which it is concerned only with its own capabilities and values. This is usually termed product orientation (Trustrum, 1989). The result of adopting the marketing concept could reflect in activities that translate the philosophy into practice (Diamantopoulous& Hart, 1993).

Traditionally, marketing has played more important role in consumer goods industries than in educational institutions (Homburg, Workman, &Krohmer, 1999). In fact, the practice of market orientation was first found in consumer packaged goods industries (Chandler, 1977). Kohli and Jaworski (1990)noted that despite the strong acceptance of marketing concept by academicians and practitioners, there is a little attention to measurement issues and virtually no empirically based theory. Studies that have attempted to measure the adoption of the marketing concept have often relied on very simple measures (e.g. "to what extent has your organization adopted the marketing concept?"). The answers to such direct questions are almost certainly subject to a strong yea-saying bias, especially in those research situations that relied on single item measures (Deng & Dart, 1994).

Different researchers have developed different market orientation scales. Some scales are based on a set of cultural components (Deng & Dart, 1994; Narver& Slater, 1990), behavioral activities (Kohli&Jaworski, 1990) and organizational strategy (Ruekert, 1992). The research instruments by Narver and Slater (1990) – cultural perspective- and Kohli and Jaworski (1990) –behavioral perspective- have been considered to be the most used research instruments for determining a company's market orientation practices. Nevertheless, Bigne et al. (2003) concluded that while extant literature submits, there does not seem to be one generally acceptable research instrument for measuring market orientation tendencies of companies.

Moreover, different measures and components of the market orientation construct are being used dependingon the sector and country in focus. Nowadays, a call for the integration of the Narver and Slater's (1990) and Kohli and Jaworski's (1990) conceptualizations have appeared because of their homological similarity (Bigne et al., 2003; Cadogan& Diamantopoulos, 1995). Gonzalez-Benito and Gonzalez-Benito (2005) concluded that organizations adopt first, a cultural orientation and then develop consistent behaviors (p.799). Recently, Gotteland et al. (2007) propose integrating existing approaches to market orientation. Similarly, Carr and Lopez (2007) discussed that several studies have debated integrating the two conceptualizations of market orientation – cultural and behavioral-, consequently, their scales. According to them, further studies to examine the integrative framework of the two scales that are foremost to the study of marketing. Accordingly, this study used the concepts of market orientation jointly: behavioral activities used by Kohli and Jaworski (1990)andKohli et al. (1993), cultural perspective proposed by Narver and Slater (1990) and profit orientation dimension used by Deng and Dart (1994). Existing scales are used to allow for cumulative knowledge development and also to allow findings to be explained within the context of extant literature and empiricism.

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Business organizations, including service organizations like universities, create valuefor customers through various market interrelated performances and/or activities.However, these service behaviors and activities need to be market oriented. Themarketing concept and the contemporary market orientation theories and measures areinstrumental in enhancing service quality management and can be incorporated intodeveloping a market orientation construct that is pro-service, and embedded with thenecessary service behaviors and culture. This is because the existing marketorientation conceptualizations and measurements are relatively less service-oriented innature and thus may have less impact, specifically on customer-perceived servicequality. As the service concept consistently emphasizes the customer perspective, thisproposed construct will be conceptualized and developed based on the customers'(students') perceptions in higher education.The proposed extension to market orientation that is more service-oriented istermed service-driven market orientation (SERVMO). It is "the set of beliefs,behaviors, and cross-functional processes that seriously focuses on continuous andcomprehensive understanding, disseminating, as well as satisfying the current andfuture needs of the target customers for service excellence." It serves as an applicationof the market orientation philosophy to service quality management. Theconceptualization and operationalization of SERVMO are mainly based onMSQmarketing literature coupled with the writer's own explorations ofmarket-oriented service practices using the Critical Incident Technique.

2. METHODOLOGY

Research methodology refers to the procedural framework within which a research is conducted (Saunders et al., 2009; Remenyiet al., 1998; cited in Amaratungaet al., 2002). A research methodology also serves as a set of rules for reasoning, whereby the evaluation of facts can be used to draw inferences Eldabiet al., (2002) or the way in which the study investigates and seeks answers to pre-defined research problems (Taylor and Bogdan, 1984). This is about how the entire study is conducted to achieve stated research objectives and seeks answers to the stated research questions. In short, chapter four aimed at discussing the main methodological dimensions of the study, alongside the research paradigm and epistemological assumptions, research approach, research design, sampling technique, issues concerning data collection, data analysis techniques as well as ethical considerations of quality criteria applied to this study and issues of generalization and limitation.

2.1 Research Design

Research can be classified, according to the nature of the research enquiry and the type of evidence it aims to produce into three categories namely, exploratory, descriptive and causal or explanatory (McGivern, 2006). In terms of design, this study employed exploratory research approach using cross-sectional and the survey approach in finding out market orientation culture at Koforidua Polytechnic.

2.2 Research Approach

Generally, there are two main approaches to a research according to some scholars of research methodology (Denzin and Lincoln, 2000; Potter, 1996; McGivern, 2006). These approaches are quantitative and qualitative research. However, some researchers have adopted a combination of both approaches. For the purpose of this study, the quantitative approach was adopted since it helped the researcher to engage in a more rigorous analysis and thus achieved the stated objectives.

2.3 Target Population

Generally, the population of interest in any study is typically a group of persons who poses a certain characteristic or set of characteristics (Frankel and Wallen, 2006). The actual population can be any size and is usually referred to as the target population to which a researcher would like to generalize. For this study, it isnon-teaching staff (staff of student's report office) as well as students of the polytechnic community. However, the entire target population is sometimes difficult to sample so a more narrowly defined population, or the accessible population, is considered. According to Frankel and Wallen (2006), a more narrowly defined population will often save time, effort and even money, but may limit the findings general ability. In addition, they assert that it is important for the researcher to clearly

describe the population and the sample in sufficient detail so interested parties can apply the findings to their own situations. In this study, thepopulation for the study is theKoforidua Polytechnic entire populace.

2.4Sample Frame

Denscombe (1998) enunciates that social researchers are often limited with regard to collecting data from everyone who falls within the research category. Hence, the way out is to depend on material from a section of the group or population with the hope that the results will reflect the entire group. This portion or section is known as a sample frame out of which a sample will be determined. Sampling is therefore, the answer to social enigma facing researchers of social behavior. It presupposes that selection of a sample will be carefully done. In all, the total sample size for the study was made up of one hundred and fifty (150) students and ten (10) workers of student's record section of the polytechnic.

2.5 Sampling Technique

There are two well-known ways of classifying sampling methods, that is, probability and non-probability sampling. Probability sampling according to Stuart (1984) is a kind of sampling in which "every element in the population has a nonzero chance of being selected." Thus, the researchers are aware that a sample is indeed a representative of the sample universe. Non-probability sample on the other hand is carried out without any reference to representation of the sample universe. Under both sampling techniques are various approaches. For the nature of the population coupled with the aim of the study, the purposive sampling technique in the context of non-probability sampling will be used to gather data.

2.6 Sources of Data and Data Collection Instrument

Both primary and secondary data were used to gather information for the proposed study. The primary data included standardized questionnaires that were distributed in order to obtain information related to the study, whereas secondary source of data included literature from books, journals and other scholarly materials.

The main instrument that was used to collect data for the proposed study was a self-developed questionnaire. This was designed using a five-point Likert scale ranging from strongly disagrees to strongly agree.

2.7 Analysis of Data

Primary data collected from the field survey was analyzed quantitatively using Statistical Package for Social Sciences (SPSS) where factor analysis and multiple regressions were used to interpret findings of the study.

3.0 RESULTS

The researchers distributed one hundred and fifty (150) questionnaires to students of which one hundred and thirty were returned.

A. Demographic Data
3.1. Table 1:The Gander Of Students.

GENDER	FREQUENCY	PERCENTAGE %
Male	76	58.5
Female	54	41.5
Total	**130**	**100**

Field survey: February 2014

Among the returned questionnaires,seventy six (76) were male students whiles fifty four (54) were female students. This shows that most of the questionnaires wereanswered by male students. This represents 58.5%and 41.5% respectively.

3.2. The Session of Students.

This table shows the session of such students who answered the questionnaire. One hundred and twenty three (123) students representing 94.6% were in the morning session. Seven (7) students representing 5.4% were also in the evening session. None of the students from the weekend session made it possible in answering the questionnaires. This clearly shows that most of the students population constitute the morning session.

3.3. Students Year Group.

From the table, only one (1) student from year one answered the questionnaire representing 0.8%. Eighty eight (88)students were year two students representing 67.7%. Forty one (41) students constitute year three students representing 31.5%. This clearly shows that most of the questionnaires were answered by year two and year three students respectively.

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B. Evaluation of staff Orientationat the Students' Records office

3.3. Table 2:   Students Are The Most Important Persons in the office.

STUDENTS AS MOST IMPORTANT PERSONS	FREQUENCY	PERCENTAGE %
Strongly agree	6	4.6
Agree	29	22.3
Neither agree nor disagree	20	15.4
Disagree	41	31.5
Strongly disagree	34	26.2
Total	130	100

Field survey: February 2014

From the table, it shows that six (6) students representing 4.6% strongly agree that the student record office treat students as important. Twenty nine (29) students representing 22.3% said they agree. Twenty (20) students representing 15.4% said they neither agree nor disagree. Forty one (41) students representing 31.5% said they disagree on the fact that staff at the students' records office treats students as important. Thirty four (34) students representing 26.2% said they strongly disagree.

3.4. Handling Students Demand With Interest And Enthusiasm.

The issue of whether staff at the students' records office handles students' demands with enthusiasm. Seven students representing 5.4% said that they strongly agree. Twenty nine (29) students representing 22.3% said they agree. Sixteen (16) students representing 12.3% said they neither agree nor disagree. Fifty two (52) students representing forty percent (40%) said they disagree. Twenty six (26) students representing twenty percent (20%) said they strongly disagree. This shows that most student disagree to the fact that the staff at the students records office handles students demand with enthusiasm.

### 3.5. Staff of the Students' Records Officedo Students a Favor by Serving Them.

In reference to the above heading, nine (9) students representing 6.9% said they strongly agree that the office is doing them favor by serving them. Thirty five (35) students representing 26.9% said they agree. Thirteen (13) students representing ten percent (10%) said they neither agree nor disagree. Forty seven (47) students representing 36.2% said they disagree to the fact that the office is doing the favor by serving them. Twenty six (26) students representing twenty percent (20%) said they strongly disagree. This clearly shows that majority of the students population disagrees that the students' records office is doing them a favor.

C. Students' knowledge of service and procedures at the Students Records Office.

3.6. Service offered in the Students records office.

A bar chart showing the services offered by the student records department
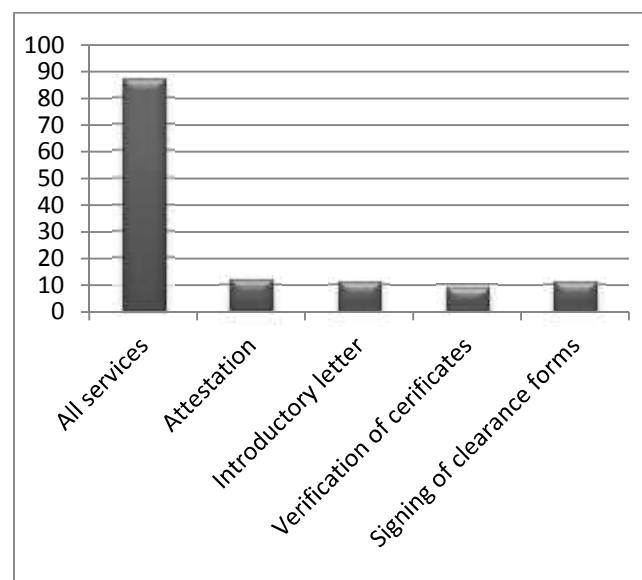
In view of the responds from students, most of them acclaim to the fact that the services that are rendered at the office of the Student's Records include attestation, introductory letter, verification of certificate and signing clearance form.

3.7. How Students Get To Know Of The Service Rendered In The Students Records Office.

In view of how students get to know of the service rendered at the students' records office. Twenty nine (29) students representing 22.3% said they get to know of the service through

interaction with friends. Eighteen (18) students representing 13.8% said they get to know of the service through staff presentation during orientation. Ten (10) students representing 7.7% said they get to know of the service through the student's handbook given to them. Four (4) students representing 3.1% said they get to know of the service by visiting thee polytechnic website. Sixty one (61) students representing 46.9% said they use all the above means to get to know of the service rendered at the office. Eight (8) students representing 6.2% said they get to know of the service by using other means different from what is listed above.

3.8. The Most Used Method In Accessing Service At The Student Records Office.
TABLE 9: Most Method Use in Accessing Service

METHODS	FREQUENCY	PERCENTAGE %
Filling forms for details	49	37.7
Speaking personally to a service personnel	68	52.3
Speaking to service personnel on phone	5	3.8
Posting details of request	8	6.2
Others	0	0
Total	**130**	**100**

Field survey: February 2014

It was found out after retrieving questionnaire issued to students that most of the student's population speak to service personnel personally in trying to access a service from the Student's Records Office. Other also that form part of the majority also answered that they access service from the office by means of filling forms for details. Only a few students access service by way of calling service personnel on phone and by posting of details of request.

D.Customer Service atthe Student Records Office.

3.9. Welcoming students to the office with a smile.
Student's opinion on whether the students record office welcome students with a smile. Nine (9) of the students representing 6.9% indicated that they strongly agree to the fact that the office welcome students with a smile. Eight (8) of the students representing 6.2% said they agree. Twelve (12) of the students representing 9.2% said they neither agree nor disagree. Seventy one (71) students representing 54.6% said they disagree. Thirty (30) students representing 23.1% said they strongly disagree.

3.10. Students are provided with Seats as they wait to be served.
As to whether students are provided with seats as they wait to be served, twelve students representing 9.2% said that they strongly agree that students are provided with seats as they wait to be served. Thirteen (13) students representing ten percent (10%) said they agree that they are being provided with seats. Thirty one (31) students representing 23.8% said they neither agree nor disagree. Forty two (42) students indicating a percentage of 32.4 said they disagree. Thirty two (32) students representing 24.6% said they strongly disagree. This shows that most of the students neither agree nor disagree to the fact that the students records office provide seats for students as they wait to be served.

3.11. Staff speaks politely with students
With reference to the above heading shows whether the staff at the office speaks to student politely. Six (6) students said they strongly agree. This represents 4.6% Eleven (11) students representing 8.5% said they agree to the fact that staff at the office speaks to them politely. Another eleven (11) students representing 8.5%said, they neither agree nor disagree. Sixty two (62) students representing 47.7% said they disagree. Forty (40) students representing 30.7% said they strongly disagree. This show that most students disagree to the fact that staff at the student's records office speaks to students politely.

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D.   Determine the level of customer satisfaction with service delivery at the students' Records Office.

3.12 Students are sure of having their service needs delivered at a visit to the student records office.

A Bar Chart Representing Students' Opinion on Service Delivery ata Visit tothe Office
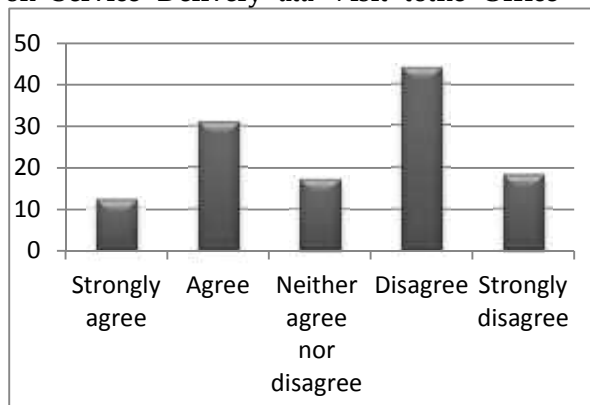
The research also seeks to find out whether students get a responds to the service they need at a visit to the office. It was discovered that most of the students do not get immediate responds to their service needs at a visit to the office. Most of the students disagree to the fact that they receive responds to their service needs at a visit. It means that out of the total number of students that visitthe office within a day only few students get immediate responds to their service delivery.

E. **Determine the levels of staff performance at the Students Records office**

3.13 Student finding error in written documents from the students' records office.

On the issue of students do find error in written documents from the students' records, fifty two (52) students representing forty percent (40%) said Yes they have ever found error in written documents from the office. Seventy eight (78) students representing sixty percent (60%) said No,they have not come across any error in written documents from the students' records office.

3.14 The type of error last identified.

Nine of the students representing 17.3% said such error identified was incorrect index numbers. Twenty one (21) students representing 40.4% of the total population that agree there is an error said such error is wrongly spelt names. Seventeen students representing 32.7% said such error is wrong records of academic achievement. Five (5) of the students representing 9.6% said the error is grammatical.

3.15 Time consciousness

Rating of staff of the students' records office on time consciousness. Nine (9) students representing 6.9% said **excellent** to that effect. Thirteen (13) students representing ten percent (10%) said **very good** to that. Fourteen (14) of he students representing 10.8% said **good** to that. Twenty three (23) students representing 17.7% said **fair** to that. Seventy one (71) students representing 54.6% said it is a poor performance as far as time consciousness of the staff is concern.

3.16 Speed of work

Rating of staff of the student's records office based on speed of work. Six (6) students representing 4.6% said the office is **excellent**when it comes to speed of work. Twenty four (24) students representing 18.5% said **very good** to that. Nineteen (19) students representing 14.6% said good to that. Thirty three (33) students representing twenty five point four percent (25.4%) said **fair** to that. Forty eight (48) students representing 36.9% said it is a **poor** performance when it comes to speed of work.

4.0 DISCUSSION OF FINDINGS

In reference to the orientation of staff at the Students' Record Office, the research found out that the office is not customer oriented as students are dissatisfied with their performanceThis is a general trend and cuts across almost all tertiary institutions in Ghana.

In determining Students Knowledge of service and procedures at the students' Records Office, the research found out that many students know about the services rendered at the office. However they only get to know of a particular service when the need arises. That communications through friend was the most preferred one.

They also access service at the office by being present and speaking directly to the staff or filling forms. There are no telephones or internet facilities through which they could access the services of the office.

The nature of Customer Service at the Student Records Office good or bad

With this most of the students responded that the office does not welcome them to the office with a smile.

Again most students said they are not offered a seat at the office during service delivery. On assessing whether staff at the office talk to students politely, most students said the office does not talk to them politely in their service delivery.

In determining the level of customer satisfaction with service delivery at the students' Records Office most of the student said they are not sure of having their service needs delivered at a visit to the office. With respect to this most of students disagree on the fact that their service needs are attended to at a visit to the office.

To determine the levels of staff performance at the Students Records office, the research found out that the level of staff performance at the office is not one of the best.

It was found out that there are errors in some of the written documents from the office. However the research found out that such errors were not many as it represents only 40%.

It was also discovered that staff of the students' records office are not time conscious as most students said it is a poor performance when it comes to time consciousness.

On the same issue of staff performance, the research shows that staff of the office does not performance their work with speed and accuracy. Most of the students rate the office as being poor when it comes to speed of work.

5.0 CONCLUSION

Management of the Polytechnic should be able to devise another means through which they will be able to make students aware of the services offered at the Students' Records Office.

Management of the Polytechnic should also put in appropriate measures that could spell out the need for service personnel at the office to smile to students during service delivery. This could be by way of offering incentives to that effect.

Management should be able to organize training sessions and workshops for staffs at the student records office so as to update them on the new measures for effective service delivery.

Management should also put in appropriate supervisory roles that could monitor some of the activities that go on at the student's records office.

Management should be able to put in the needed equipments and tools to be able to facilitate the work at the Students' Records Office.

The office should therefore take a look at the other methods that is not accessible to students and to come out with the appropriate measures of intensifying the use of such methods. The methods that remain accessible should also be looked at so as to intensify it

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Analysis of the Over Reliance on Traditional Biomass for Cooking in Tamale North Sub-Metropolitan Area

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Abstract
Traditional biomass energy is an important source of cooking energy for majority of people in the Tamale North Sub-Metropolitan area. It remains the main source of cooking energy for a large proportion of the population in spite of the availability of modern fuels such as LPG. Various reasons account for this phenomenon. This paper analyses the various reasons that account for the over reliance on the traditional biomass for cooking in the Tamale North Sub-Metropolitan area. Simple random sampling technique was applied to sample communities within the study area while stratified sampling in conjunction with availability sampling was used to collect data from a total of 300 respondents consisting of heads of households and food vendors. The study established among other things that, firewood and charcoal were heavily relied on due to its perceived low cost and easy accessibility (44.9 % and 23.7 % respectively). While kerosene, LPG and electricity are consumed because of their convenience to use (66.7 %, 64.4 % and 9.3 % respectively) and environmental friendliness 11.0 % (LPG) Also, various categories of cooking energy consumers were seen to have varying reasons for relying on traditional biomass as their main source of cooking energy in the Tamale North Sub-Metropolitan area. A chi-square analysis indicated that, the relationship between consumer's main source of cooking energy and the reason for the choice of a particular source of cooking energy is statistically significant($\chi^2 = 1.267, p - value = 0.000$).

Keywords: Cooking Fuel; Modern fuel; Traditional biomass; LPG

1-INTRODUCTION

Studies have shown that until the middle of the 19th century the use of biomass continued to dominate the global energy demand with over 70% share, being used for a myriad of needs including energy for cooking (Grubler and Nakicenovic, 1988). In spite of its dwindling share in global energy demand, due to the rapid shift to modern fuels such as kerosene, LPG and electricity, biomass energy still contribute up to 14% of global energy consumption and 38% of energy in developing countries (Woods and Hall, 1994). According to the IEA (1998) an estimated 2.5 billion of the population in developing counties still rely on traditional biomass to meet their cooking needs. Guta (2012) indicated that up to half of the world's population living in poor countries depends on traditional biomass sources to meet their cooking needs. Between the periods of 1974 to 1994 wood consumption for energy grew at the rate of 2% per annum globally (FAO, 1997).

In recent times firewood consumption constitute up to 24.0% of the energy demand in

Mexico, 52% in Brazil and 63.2% in Ecuador (IARC, 2010; Heltberg, 2003). According to the Food and Agriculture Organization (1997), biomass remain, the primary source of energy in the developing countries in Asia with demand share as high as 75% in countries such as Nepal, Laos, Bhutan, Cambodia, Sri Lanka and Myanmar; nearly 50% in Vietnam, Pakistan and Philippines; and nearly 33% in India and Indonesia. In rural Bangladesh, biomass fuels provides for most of the energy demand contributing more than 90% of the total energy supply (Bangladesh, Bureau of statistics, 210), and up to 73% of the population in Sub-Saharan African countries including Ghana, Nigeria, Gabon, South African etc, rely on traditional biomass to meet their energy needs (IEA,2002).

Currently firewood and charcoal accounts for up to 84% and 13%, respectively, of the total energy supply in Ghana (Amissah-Arthur and Amoo, 2004), in spite of the availability of modern fuels such as Kerosene, LPG and electricity; all of which accounts for only less than 3.0% of the total energy demand in the

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country (KITE,2005). This has serious implications on Ghana's sustainable development, especially at a time when Ghana's forest is fast disappearing at the rate of 2.0%per annum and nearly 69% of the land in the country is already lost to soil degradation as against an average of 43% for sub-Saharan Africa (World Bank, 2006).

Studies on the subject have led to the revelation of various reasons behind the tendency to consume one type of energy source over the other. Forinstance, MekonnenA &Kohlin G (2008) view income level as a key determinant of fuel choice such that households with higher incomes are less likely to chose solid fuels as their main source of energy. Jingchao&Kotani, (2010) in a related view indicated that, level of income has a positive impact on the per capita demand for commercial energy sources such as LPG, electricity and coal, but negative effect on per capital consumption of biomass. Indeed, a number of studies have related changes in the energy consumption patterns of people to factors such as economic activities, development; increase in population and demographic changes, suchas the change in age groups, and household size (Song et al, 2002; WEAO, 2004; TWAS, 2008, UNDESA, 2004; etc). The situation, however in respect of the fundamental reasons behind the choice of one source of fuel for cooking over the other seem to continue in oblivion about the Tamale Metropolitan area where the primary source of energy for cooking is biomass. Hence this study analyses the reasons behind the over reliance on traditional biomass for cooking in the Tamale North Sub-metropolitan area with due attention to food venders who contribute substantially to the demand share of cooking energy in the area.

2-METHODS

2.1-About Tamale Metropolitan District

Tamale is a citylocated on the coordinates 09° $24'27"N$ $00^{\circ} 51'12"W$. The city has a total land size of 750 km², and home to about 537,986 inhabitants whose main economic activities revolve mostly around farming and trading. The average annual rainfall is 1100mm within 95days of rainfall in the form of tropical showers with the mean day temperatures ranging from 28 ℃ to 43 ℃. The people are predominantly Muslims (58%) and of the Mole-Dogbane ethnic group (55.8%) with average household size of 5.5.Even though the city is

the fourth largest in the country, the inhabitants are among the poorest and most residents do not have access to the basic urban services.Figure 1.
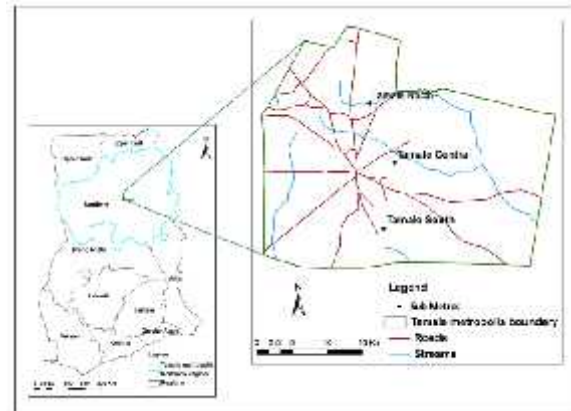

Figure 1: Map of the study area (Researchers' own construct)

2.2-Research Design

Explanatory research, which according to Marlow (2000) "aims at providing explanations of events in order to identify causes" is the research design adopted for the study. This is because the researchers were confronted with cause-and-effect problem which lends itself well to the explanatory research design. Also explanatory research design is one that could guide the researchers towards unraveling the relationships that exist between choice of fuel and factors such as age, gender, occupation and level of education. A positivist approach to science is the most appropriate to use when carrying out explanatory research (Marlow, 2000). And for a positivist approach, quantitative data is usually collected and analyzed even though qualitative data is sometimes used to add depth and detail to the findings. Having adopted the explanatory research design, the positivist approach to science was used to collect quantitative data and analyzed.

2.3-Population and Sampling

The population for the study comprised of three hundred (300) heads of households and food joint operatives in the Tamale Metropolis; andup to 95% of the households which were sampled for the study was covered.

2.4-Sampling of Sub-Metropolis

Before the respondents were sampled, Tamale was considered per the three sub-metropolitan areas (Tamale North, Tamale Central and

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Tamale South sub-metropolis) making up the city. These three sub-metropolitan areas were then balloted andTamale North sub-metro was selected for the study. Then also, the Tamale North sub-Metropolitan area was sorted out into its constituent communities according to low, average and high socio-economic status. This was done with due consideration of the amenities in the communities and the socio-economic life style or characteristics of households in those communities after the researchers and their assistants conducted an observation tour through the communities to explore the various socio-economic disparities among them. The criteria used include, type of housing (i.e., bungalow/ self contained flat, block-compound house, mud house etc), estimate of the number of educated people, general economic activities, type of schools (private or public), etc. There were no official figures on the proportion of households, and for that matter, communities under the three socio-economic categories in the research area, but the tour around the communities by the researchers and their assistants offered them the opportunity to assess and apportion estimates of households under the various categories of socio-economic status within the research area.Through the observation tour it was realized that majority of households (about 50%) were under low socio-economic conditions whiles their counterparts under average and high socio-economic conditions represented about 35% and 15% respectively. Using simple random sampling technique, Fuo, Ward 'k' and SSNIT flats were selected from the lists of communities, which were developed using the same wealth criteria as for households, to represent communities with low, average and high socio-economic status respectively.

2.5-Sampling of Households and food joint operatives

The study was under taken between the periods of August to December, 2013.

Respondents for the study were selected by way of stratified sampling technique. This technique was applied because respondents from the three communities mentioned above have different characteristics whose impact on the research problem was very significant for which reason they must have been represented in their right proportions. Marlow (2000) put it that "sometimes you need to ensure that a certain proportion of the elements are represented, and

stratified random sampling provides a greater chance of meeting this goal..." After an observation tour round the study area was conducted, it was realized that food joint operatives, due to the enormity of their share of the demand for cooking energy in the study area, represented up to 20% (60) of the population. This 20% (60) was, yet again, stratified into 10 each for 'heavy food joint', 'fast food joint' and restaurants; and then 30 for petty way-side food vendors, in view of their varying demand for energy resources by virtue of their commercial activities. The remaining 80% (240) of the population which was apportioned to households was also stratified further into 50% (120) for households under low socio-economic status, 35% (84) and 15% (36) for households under average and high socio-economic status respectively - in view of the results as obtained from the observation tour conducted around the study area by the researchers and their assistants. After households within the sample communities were selected to participate in the study by way of simple random sampling technique, availability sampling was used to include food vendors in the study.

2.6-Data Collection Instrument

The instrument used in collecting information from respondents was the questionnaire. And the method adopted was self administered and face-to-face questionnaire. Respondents who could read and write were given the questionnaire to respond to questions by themselves and those who could not were guided but not directed by the researchers to respond to the questionnaire. The questions were closed-ended and all possible categories were included so that quantitative data could be obtained from respondents.

2.7-Data Analysis

The quantitative data drawn from the study was analyzed with the aid of statistical package for the social sciences (SPSS). Having pre-coded all the categories on the questionnaire, the quantitative data was edited and entered in a computer on SPSS software programme after which the data was analyzed using simple descriptive statistics and Pearson chi-square test. In so doing, cross tabulations were used to study the association or relationship between two or more variables after chi-square values along with their respective probability values were obtained. For this particular study, the

level of significance was determined as against a significance level of P=0.005.

3-RESULTS
3.1-Reasons for preferred source of cooking fuel

Analysis of the reasons why consumers preferred certain sources of energy for cooking to others indicated that, those who were of the opinion that firewood was easily 'accessible/available' were more likely to use the fuel (52.0%) than their counterparts whose reasons for their preferred sources of cooking energy were; 'cheaper in cost'(44.9%), 'convenient' to use (3.1%) and 'not harmful to

human life' and 'the environment' (0.0%). The reasons for charcoal consumption also followed the same trend, with people who were more likely to use charcoal for its 'accessibility/convenience' than their counterparts constituting up to 43.0% of the population. Those whose preferred source ofcooking energy was based on 'convenient' were more likely to consume Kerosene (66.7%), LPG (64.4%) and electricity (100%) - table 1. The relationship between preferred source of cooking fuel and reasons for the preference of one energy source over the other was seen to be statistically significant following a chi-square test (χ^2=1.267, p-value=0.000

$$\chi^2=1.267, \text{p-value}=0.000$$

Table 1: Reasons for choice of cooking energy

Reasons	Main source of cooking energy					
	Firewood	**Charcoal**	**Kerosene**	**LPG**	**Electricity**	**Total**
Cheaper in cost	44 (44.9%)	27 (23.7%)	0 (0.0%)	2 (2.7%)	0 (0.0%)	73 (24.6%)
Easily accessible	51 (52.0%)	49 (43.0%)	1 (33.3%)	16 (21.9%)	0 (0.0%)	117 (39.4%)
Convenient	3 (3.1%)	36 (31.6%)	2 (66.7%)	47 (64.4%)	9 (9.3%)	9 (32.7%)
Not harmful to human & environment	0 (0.0%)	2 (1.8%)	0 (0.0%)	8 (11.0%)	0 (0.0%)	10 (3.4%)
Total	98 (33.0%)	114 (38.4%)	3 (1.0%)	73 (24.6%)	9 (3.0%)	297 (100%)

3.2-Gender and reasons for preferred source of cooking fuel

Male consumers of cooking energy had higher tendencies to choose a particular fuel base on the reason that it is 'convenient' to use (44.9%) than their female counterpartswho were likely

to use one fuel type over the other by virtue of its 'accessibility/availability' (43.5%) - figure 2. A chi-square test indicated that an association between gender and reason for choice of cooking fuel is statistically significant (χ^2 =13.6003, - Value = 0.000)

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Gender and reasons for choice of fuel

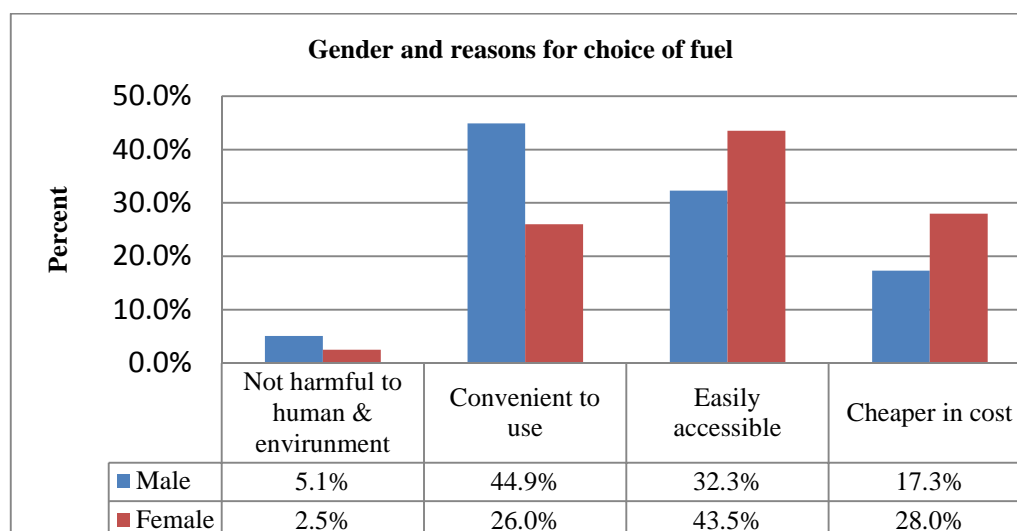|	Not harmful to human & envirunment	Convenient to use	Easily accessible	Cheaper in cost
Male	5.1%	44.9%	32.3%	17.3%
Female	2.5%	26.0%	43.5%	28.0%

Figure 2: gender and reason for preferred source of cooking fuel

3.3-Level of education and reasons for preferred source of cooking fuel

Analysis of respondents' level of education and reasons for which respondents choose one source of cooking fuel over the other indicated that, respondents with no educational background and people with basic level education background based their reason for the choice of cooking fuel on easy 'accessibility/availability' (49.5% and 39.2%). Those with secondary education background were split in their reasons for the choice of one source of cooking fuel over others, (42.9%) for easy 'accessibility' and (38.8%) for convenience. Interestingly, people with tertiary education (58.5%) rather choose to use a particular source of cooking fuel baseon its convenience to use (figure 3). Analysis of a chi-square test indicated that an association between level of education and preferred source of cooking energy is statistically significant (χ^2 =58.122, P - Value = 0.000)

Level of education & reasons for choice of fuel

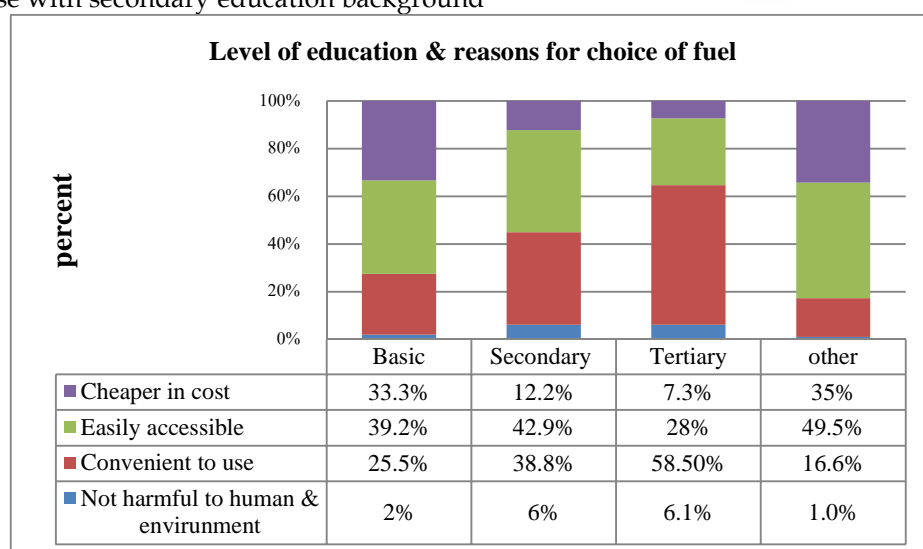|	Basic	Secondary	Tertiary	other
Cheaper in cost	33.3%	12.2%	7.3%	35%
Easily accessible	39.2%	42.9%	28%	49.5%
Convenient to use	25.5%	38.8%	58.50%	16.6%
Not harmful to human & envirunment	2%	6%	6.1%	1.0%

Figure 3: level of education and reason for preferred source of cooking fuel

3.4-Age and reasons for preferred source of cooking fuel

When analysis of reasons for respondents' preferred source of cooking fuel with respect to age was studied it was indicated that the major reason that govern the choice of fuel by respondents under 35years was 'convenience' (i.e., 38.5% for respondents within the ages of 26-35 years, and 42.9% for respondents under 25 years of age). However the choices of their older counterparts were governed by reason of easy 'accessibility/availability' (figure 4). An association between the two variables were

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statistically insignificant after a chi-square
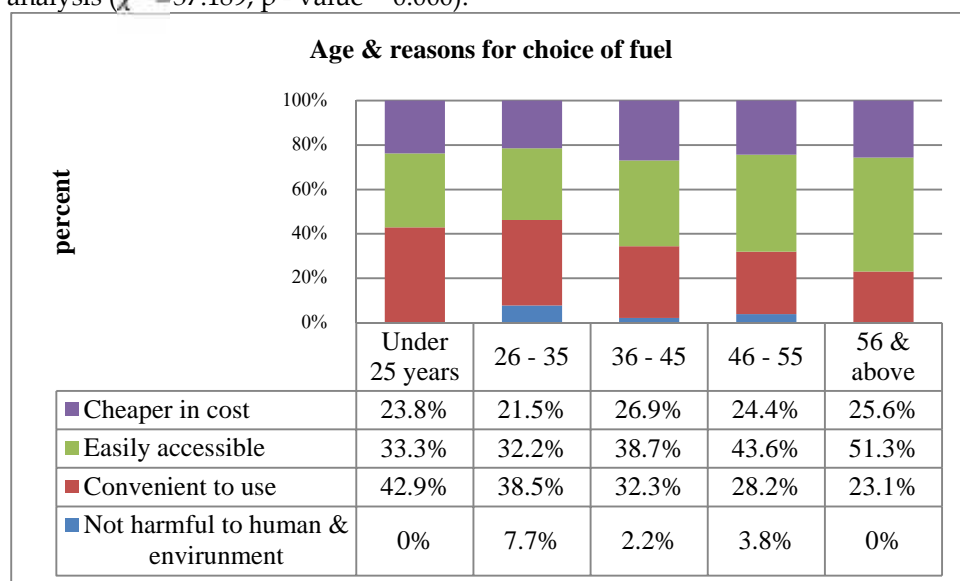analysis (χ^2 =37.189, p - value = 0.000).

Age & reasons for choice of fuel

	Under 25 years	26 - 35	36 - 45	46 - 55	56 & above
■ Cheaper in cost	23.8%	21.5%	26.9%	24.4%	25.6%
■ Easily accessible	33.3%	32.2%	38.7%	43.6%	51.3%
■ Convenient to use	42.9%	38.5%	32.3%	28.2%	23.1%
■ Not harmful to human & envirnment	0%	7.7%	2.2%	3.8%	0%

Figure 4: age and reasons for preferred source of cooking fuel

3.5-Occupation and reasons for preferred source of cooking fuel

Analysis of respondent's occupation with respect to the reasons governing their preferred source of cooking fuel indicated that the unemployed and, generally, people in low earning jobs such as petty-trading and subsistence farming, are likely to choose cooking fuel based on easy 'accessibility/availability' (figure5). Such people are also likely, to some extent, to choose cooking fuel base on their cheaper cost. Respondents who were more likely to choose cooking fuels by reason of 'convenience' were the business folk who were, somewhat, equally likely to choose

cooking fuel which was easily accessible (41.8% for 'convenience', 45.5% for 'accessibility'). Those in civil/public service interestingly chose to consume fuels that are cheaper in cost as compared to other fuel sources (54.1%), as well as their counterparts who are tradespersons such as tailors and mechanics (68.2%). Hence, it is worthy of note that, fuels that are easily accessible and cheaper in cost are the ones generally used by cooking fuel consumers .A chi-square test indicated that an association between occupation and reason for choice of cooking fuel in statistically significant (χ^2 =97.803, P - Value = 0.000).
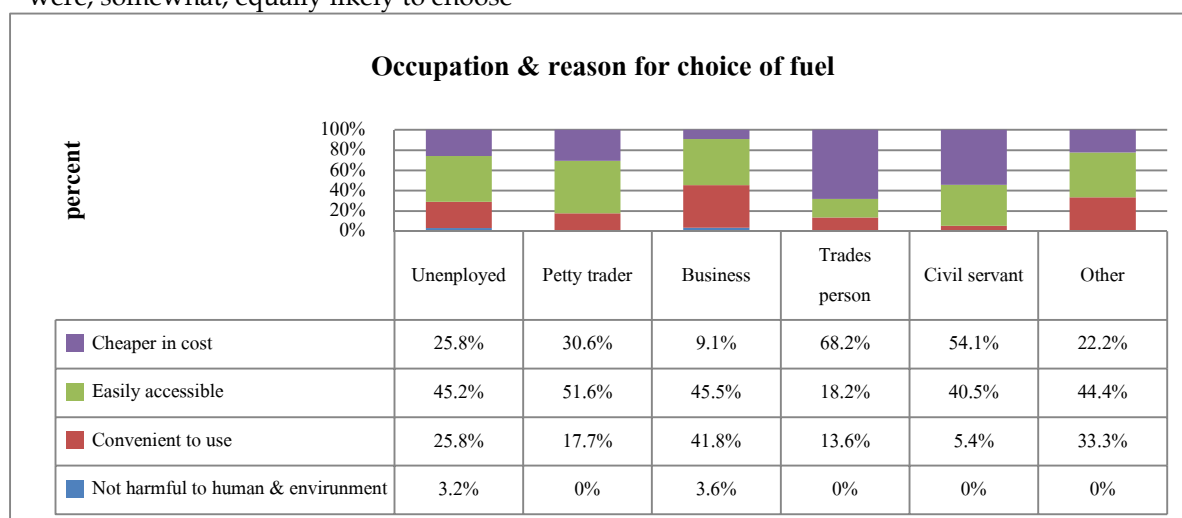
Occupation & reason for choice of fuel

	Unenployed	Petty trader	Business	Trades person	Civil servant	Other
■ Cheaper in cost	25.8%	30.6%	9.1%	68.2%	54.1%	22.2%
■ Easily accessible	45.2%	51.6%	45.5%	18.2%	40.5%	44.4%
■ Convenient to use	25.8%	17.7%	41.8%	13.6%	5.4%	33.3%
■ Not harmful to human & envirunment	3.2%	0%	3.6%	0%	0%	0%

Figure 5: occupation and reasons for preferred source of cooking fuel

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3.6-Level of income and reasons for preferred source of cooking fuel

It was not surprising to observe that people with income levels of between under GH¢ 50 – GH¢ 350 per month- were likely to choose cooking fuels by reason of easy 'accessibility/availability' [under GH¢50-150 (43.6%), above GH¢150-250 (43.3%) and above GH¢250-350 (40.0%)] (figure 6). Criticalanalysis of figure 6 also indicates that, to a large extent, this category of cooking fuel consumers werealso likely to choose a particular cooking fuel based on its cheaper cost as compared to other cooking fuels. However, those who earned more than the above category of consumers at the end of the month were more likely to base their choices on 'convenience' [above GH¢350-450 (48.0%), above GH¢ 450 (59.0%)]. A chi-square test indicated that there is a significant association between income levels of respondents and their choices of cooking fuels (χ^2 =37.189, P - Value = 0.000).
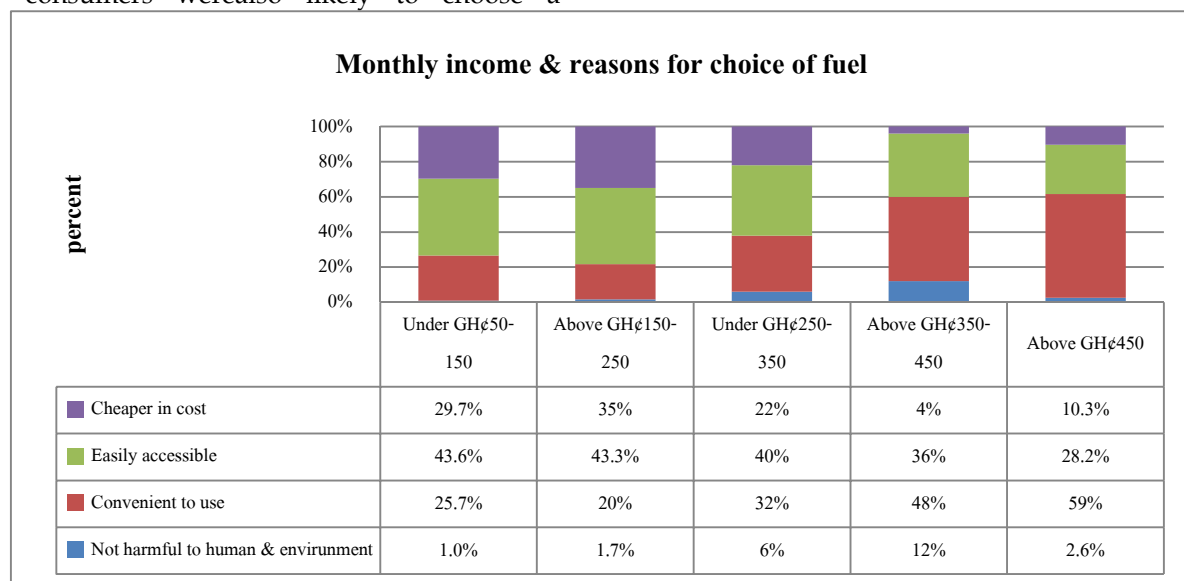
Monthly income & reasons for choice of fuel

	Under GH¢50-150	Above GH¢150-250	Under GH¢250-350	Above GH¢350-450	Above GH¢450
Cheaper in cost	29.7%	35%	22%	4%	10.3%
Easily accessible	43.6%	43.3%	40%	36%	28.2%
Convenient to use	25.7%	20%	32%	48%	59%
Not harmful to human & envirunment	1.0%	1.7%	6%	12%	2.6%

Figure 6: monthly income and reasons for preferred source of cooking fuel

3.7-Type of food joint and preferred source of cooking fuel

Operatives of typical Ghanaian food joints such as small food vendors (53.1%) and chop bars (61.5%) appeared more likely to choose cooking fuel base on its 'accessibility/availability', (figure 7) while their counterpart operatives of fast food joints (63.6%) and restaurants (60.0%) were more likely to choose cooking fuels by reason of 'convenience'. An association between the type of food joint and reasons for choice of cooking fuel is statistically significant (χ^2 =22.041, P - Value = 0.009).
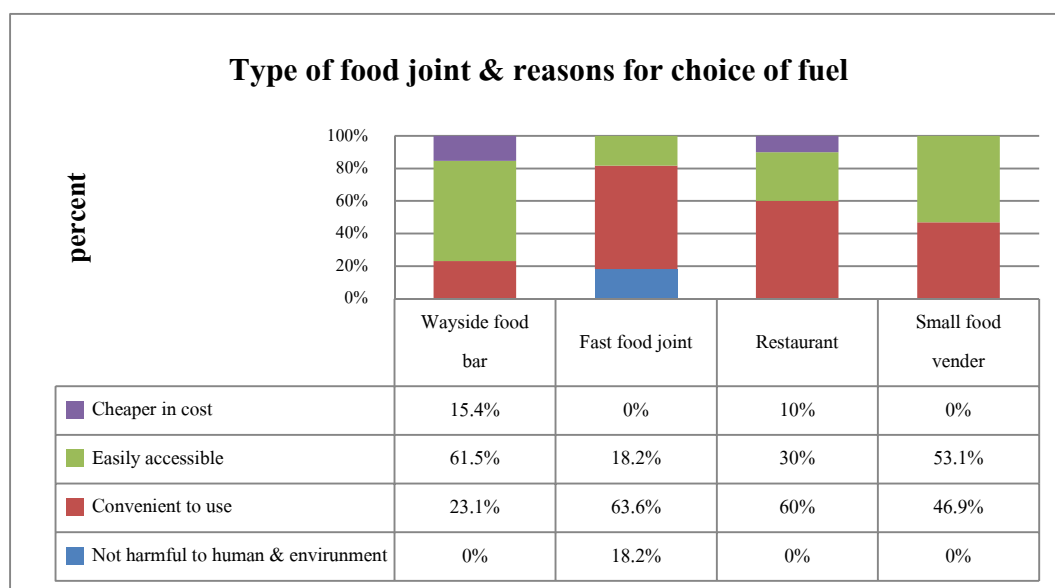
Type of food joint & reasons for choice of fuel

	Wayside food bar	Fast food joint	Restaurant	Small food vender
■ Cheaper in cost	15.4%	0%	10%	0%
■ Easily accessible	61.5%	18.2%	30%	53.1%
■ Convenient to use	23.1%	63.6%	60%	46.9%
■ Not harmful to human & envirunment	0%	18.2%	0%	0%

Figure 7: type of food joint and reason for preferred source of cooking fuel

4-DISCUSSION

It is important to point out the various reasons for which consumers will choose one energy source for cooking over the other in the Tamale north sub-metropolitan area. Generally, consumers in Tamale North Sub-Metropolitan area choose to use firewood and charcoal because, in their view, these sources of cooking energy are cheaper (44.9% and 23.7% respectively); and easily 'accessible/available' (52.0% and 43.0% respectively), while kerosene, LPG and electricity are consumed because of their 'convenience' to use (66.7%, 64.4% and 9.3% respectively) and 'environmental friendliness' 11.0% (LPG) (table 1). It can be seen that this finding has a relationship with the fact that traditional biomass fuels are being used by people with low income levels and the least educated/uneducated since they are of the view that - unaware of the negative environmental consequences - it is affordable and also obtainable from nearby bushes or fields (figure 3 & 6). Conversely, people who are more educated and those with high income levels are inclined towards the use of clean fuels for cooking in view of its positive environmental impact and the fact that they can afford it while benefitting from their convenience to use. This is in line with Sokona's (n.d) notion that a number of factors influence the choice of energy source by a household, the most significant being household income. Thus, the higher the income the more likely it is

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that a household will use modern fuel source. Households with higher socio-economic status and level of education consume more energy and electricity. Lower income households are the least consumers of energy and the total energy consumption increase with income. Sokona, (n.d) added that the trend is manifest largely in urban areas. In rural areas, the same trend can be observed, although blurred by the degree of social homogeneity, the non-diversification of energy use, the inaccessibility of alternative energies and the unchanged dominance of fuel wood.

Analysis of respondents' reasons for their preferred cooking energy source with respect to various factors as gender, level of education, age, occupation, level of income and type of food joint as against 'cost', 'convenience', 'accessibility/availability' and impact on environment was also conducted. First, it was discovered that while male consumers want to use cooking fuel because ofits 'convenience' (44.9%), their female counterparts look for cooking fuel which is easily 'available/accessible' (43.5%) - figure 2. Thus, men will generally want to use modern fuels such as LPG and electricity while their female counterparts will rely on biomass which they usually pick from nearby bushes. This has bearing on the findings of the Kumasi Institute for Technology and Environment (KITE), 2005, which reported that the majority of Ghana's

energy use is from bio-mass in the form of firewood and charcoal which accounts for about 59% of the total energy consumption in Ghana.

Second, while people with higher levels of education choose fuel base on 'convenience' [38.8% for consumers with secondary education and 58.5% for consumers with tertiary level education], their counterparts with lower levels of education choose fuel base on 'availability/accessibility' [49.5% for illiterate consumers and 39.2% for consumers with basic level education] (figure 3). This is an indication that people who are formally educated will be inclined to the use of LPG and or electricity as cooking fuels while the least or uneducated will usually rely on traditional biomass such as wood, straw, dung etc. for cooking energy.

Third, while the younger consumers choose their cooking fuel base on 'convenience'[42.9% for consumers under 25 years and 38.5% for consumers between the ages of 26 – 35] their older counterparts choose their cooking fuel for the sake of 'availability/accessibility' [38.7% for consumers between the ages of 36 – 45, 43.6% for consumers between the ages of 46 – 55, and 51.3% for consumers within 56 years and above] (figure 4). Hence, the younger consumers are more likely to use modern fuels such as LPG and electricity than their older counterparts who prefer to use firewood and charcoal due its availability in nearby fields.

Fourth, while the unemployed and petty traders choose cooking fuel for its easy 'accessibility' (45.2%) and 51.6% respectively, their counterparts who are tradesmen/women and civil servants are interested in cooking fuels which are cheaper in cost [54.1% for consumers in the civil services and 68.2% for consumers who are trades men/women]. This is in line with the views of various scholars that level of income of households as well as economic activities has positive impact on the consumption patterns of cooking energy sources (Mekonnen&Kohlin, 2008; Jingchao&Kotani, 2010; Song et al, 2002; WEAO, 2004; TWAS, 2008, UNDESA, 2004).

Finally, low income earners tend to consume the cheapest and less convenient fuels [47.1% (firewood), 43.2% (charcoal) for consumers earning within GHC50 – 150, and 36.8%

(firewood), 18.9% (charcoal) for consumers earning within GHC150 – 250] while their counterpart 'high-income earners' use the commercial fuels which are cleaner and more convenient to use [25.8% (LPG) and 11.1% (electricity) for consumers who earn within GHC250-350, 21.2% (LPG) and 11.1 (electricity) for consumers earning within GHC350-450, and 34.8% (LPG), 22.2% (electricity) for consumers who earn above GHC450]- figure 6. The UNDESA (2004) related that as incomes increase, the use of modern energy becomes more widespread in rural households. Also, Karekezi et al, 2002 indicated that while low income households rely mainly on biomass fuels for cooking, high income households use modern fuels such as kerosene, LPG and electricity.

Operatives of typical Ghanaian food joints such as the local food bazaars, way-side food venders etc, choose to use fuels which are easily accessible/available (figure 7). This means that this category of consumers are being inclined to the use of traditional biomass fuels for cooking due to their easy accessibility/availability while their counterparts who are operatives of restaurants or fast food joints are inclined to the use of modern fuels in view their convenience to use. This is because operators of the local food bazaars and way side food joint operatives usually have little or no education background which renders them afraid to operate the LPG which they find to be sophisticated and dangerous to use. Apart from this, they are also of the belief that by using LPG or electricity they will run at a loss due to increase in their operational cost. For the operatives of fast food joints and restaurants, their main focus is on the convenience they find in using LPG or electricity hence the cost of the fuel is of no or little importance to them.

5-CONCLUSION
Generally, in the Tamale north sub-metropolitan area, firewood and charcoal are heavily relied on due to their perceived low cost and easy accessibility while kerosene, LPG and electricity are consumed because of their convenience to use and environmental friendliness. Also, being related statistically; cost, accessibility/availability, convenience to use and environmental friendliness vis-à-vis

individual characteristics suchas level of education, gender, age, level of income and occupation, govern consumers preference of one source of energy for cooking over the other and, thus, lead to over reliance on traditional biomass for cooking in the Tamale north sub-metropolitan area.

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The Impact of Macroeconomic Variables on Gross Domestic Product: Empirical Evidence from Ghana

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Abstract

Macroeconomic variables such as interest rates, inflation and exchange rates play a vital role in the economic performance of any country. The main objective of this paper was to investigate the effect that changes in the inflation and interest rates have on the Gross Domestic Product (GDP) in Ghana over a period of thirty one (31) years from 1980-2010. Data were collected from Bank of Ghana publications and bulletins, Ghana Statistical Service, the Institute of Statistical, Social and Economic Research (ISSER). The paper employed multiple linear regressions to establish that there exists a fairly strong positive correlation between GDP, Interest rate and Inflation, but Inflation and Interest rate could only explain movement in GDP by only 44 percent. The paper further established that, there existed positive relationship between inflation and GDP, but interest rate and GDP relates negatively. It is recommended among others that the Government together with the Bank of Ghana should develop and pursue prudent monetary policies that would aim at reducing and stabilizing both the micro and macroeconomic indicators such as inflation targeting, interest rate, so as to boast the growth of the economy.

Keywords: Ghana; Inflation; Interest Rate; Gross Domestic Product; Regression Analysis

1. INTRODUCTION

For all countries, both developed and developing, one of the fundamental objectives of macroeconomic policy is economic stability. In Ghana, monetary and fiscal policies are aimed at sustaining high growth rates in terms of Gross Domestic Product (GDP) together with low inflation by way of price stability. Ghana has been targeting a single digit average inflation rate. The monetary policy committee (MPC) of Bank of Ghana on 15th may, 2011 reduced it policy rate from 13.5% to 13% as a result of improvement in the economy. This was expected to trigger a reduction in the interest rate of the commercial banks and consequently make the cost of borrowing cheaper.

According to Frimpong and Oteng 2010, a high rate of inflation beyond 14% will always hurt GDP, the reason for Bank of Ghana monetary planning committee always targeting a single digit rate. Macroeconomic variables such as inflation, interest rate, exchange rate etc. have been established by considerable research to be of great determinants of GDP elsewhere in developed countries. Successive governments in Ghana had initiated several fiscal and monetary policies aimed at bringing inflation and interest rate down with the view to boosting economic growth as measured by GDP. Whiles these policies might be good, the effects of these macroeconomic variables on the economies of developing countries has not been well established. Literature on these variables is sparsely available and scattered. We are not sure of the exact correlation between some of these variables especially inflation and policy rate and GDP. To what extent should the government pursue its objective of single digit inflationary target? Are inflation and Policy rate determinants of GDP in Ghana? These and many more are the macroeconomic problems that ought to be answered in Ghana. The general objective of the study was to investigate the effect of changes in the inflation and policy rates on the Gross Domestic Product (GDP) of Ghana over the period.

1.1 Relationship between Inflation and GDP

Lupu D. V. (2007) established that there is a positive relationship between inflation and GDP growth in Romania in the short run. This implies that, as inflation increases GDP must also increase in the short run. However, when

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inflation decreases, GDP should also decrease. Drukker et al (2005) established that, if inflation rate is below 19.16%, increases in inflation do not have a statistically significant effect on growth, but, when inflation is above19.16%; further increases in inflation will decrease long run growth. This affirmation is in line with Lupu D. V. (2007) but only that, it establishes a threshold beyond which the assertion of Lupu D. V. (2007) will not hold. Mallik et al (2001) established a long run positive relationship between GDP growth rate and Inflation among four South Asian Countries. However, Kasim et al (2009) was able to establish the non-linearity between inflation rate and GDP growth rate in Malaysia. His study analysed the relationship between inflation rate and economic growth rate in the period 1970-2005 in Malaysia. A specific question that is addressed in this study is what the threshold inflation rate for Malaysia. The findings suggest that there is one inflation threshold value exist for Malaysia. This evidence strongly supports the view that the relationship between inflation rate and economic growth is nonlinear. The estimated threshold regression model suggests 3.89% as the threshold value of inflation rate above which inflation significantly retards growth rate of GDP.

1.2 The Relationship between Interest Rate and GDP

Obamuyi T.M. (2006) established that lending rates have significant effects on GDP; this implies that there exists a unique long run relationship between GDP growth and interest rates and that the relationship is negative. This means when interest rate reduces, GDP in the short run will increase, but when interest rate declines GDP will increase.

2. METHODOLOGY

2.1 Source and Data Collection Procedure

Since the source of the data collected was secondary, the procedure for the data collection was relatively simple. More specifically, data relating to GDP, interest rates and inflation rates were collected from available records, publications and bulleting of the Bank of Ghana, the Ghana Statistical Service, the Institute of Statistical Social and Economic Research (ISSER) –Ghana, and also from the internet (from www.indexmundi). There was

however no differences in data obtained from these sources. The data collected with regard to GDP, interest rate and inflation rate covered the period 1980 to 2010 which gives thirty one (31) data points which is statistically large to be used for the study.

2.2 Model Specification

The model used in this study is multiple linear regression models. This attempted to look at the effects or the relationship between a dependent (responsible) variable and number independent (explanatory) variables.

With regard to this study, the dependent variable is Gross Domestic Product (GDP) and the independent or explanatory variables are inflation and interest rates.

The model specified is therefore:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + V_{ij}$. Letting GDP = Y, Inflation = X_1, and Interest rate = X_2. The model is re-specified as GDP = $\beta_0 + \beta_1$Inflation rate + β_2Interest rate, where β_0, β_1 and β_2 are the regression coefficients which are estimated from the sample data. The V_{ij} is the random error term.

2.3 Method of Data Analysis

All information (data) collected from the secondary source were sorted out, edited and collated with the aid of simple tables to enable the overall perspective of the data to be determined quickly and easily as well as enabling interpretations and meaningful conclusions to be drawn. Furthermore, in order to substantiate the effectiveness of the information presented in the tables, line graphs have been used to display the data.

Statistical computer software programme was used to conduct the inferential statistical analysis. Specifically the Statistical Package for the Social Scientist (SPSS) has been used to analyze such data.

2.4 Model Adequacy Checking

This is done first by testing for individual regression coefficients. The dependence of Y and X_j can be assessed by testing the significance of β_j. The hypothesis is

H_0: $\beta_j = 0$ and

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H_1: $\beta_j \neq 0$.

The test statistics is:

$t = \frac{\beta_j}{S(\beta_j)}$ where, $S(\beta_j) = \frac{S}{\sum_{i=1}^{n}(X_i - \bar{X})^2}$ the test statistics has the student's t-distribution in

with n-k-1

degrees of freedom.

Secondly, tests for a set of regression coefficients are also carried out. Here the hypothesis is

Again, a plot of residuals in the sequence must show no pattern or be structuralless as well as plot of residuals against fitted values.

3.0   EMPIRICAL   RESULTS   AND DISCUSSIONS

Table 1: Regression coefficients

Model	Unstandardized Coefficients		T	Sig.
	B	Std. Error		
(Constant)	14.988	1.945	7.706	.000
Inflation (X_1)	.055	.024	2.285	.030
Interest (X_2)	-.305	.072	-4.244	.000

From Table 1 above, the exact regression model that can be developed is thus

because, during the period of inflation, especially the demand pull inflation, could lead to increase in demand for goods and services, this could lead to increase in productivity and for that matter increasing the GDP consequently. During the period of mild inflation or decrease in inflation, it could lead to decrease in demand for most goods and services and for that matter, a decrease in productivity of factors of production and consequently decrease in Gross Domestic

H_0: $B_{y+1} = B_{y+2} = \ldots.. = B_k = 0$

H_1: at least one of the Bs is not equal to 0.

The test statistics is F which is derived with the help of the ANOVA Table from output.

Finally, graphical display of the residual is further examined. A histogram plot of the residuals must look like a sample drawn from a normal distribution centered at 0.

Also, a probability plot of the residuals must resemble a straight line.

3.1 Model Formulation

The linear regression model is developed as follows using the output results (coefficients) displayed in Table 1.

On the other hand the coefficients of x_1 (i.e. inflation rate) of 0.055 implies how much or the magnitude by which GDP would change (in this case would increase) per unit change in x_1 (inflation rate). This of course shows that there is a positive relationship between GDP and inflation rate given the data for the period under consideration. This means that both GDP and inflation rate behave or move in the same direction. As inflation rate increases GDP also increase. Inflation and GDP move together

$Y = 14.988 + 0.055X_1 - 0.305X_2$, where Y, X_1 and X_2 denote their usual meanings. The model is thus interpreted as follows:

The constant value of 14.988 is the intercept which represent total output of the Ghanaian economy in terms of its Gross Domestic Product (GDP) given that inflation rate (x_1) and interest rate (x_2) are zero, all other factors held constant.

Product (GDP). Also, the coefficient of x_2 (i.e. -0.305) imply how much GDP would change (would decrease) by if there is a unit increase in the interest rate. It further indicates a negative or inverse relationship between GDP and interest rate. This means that interest rate and GDP move in opposite directions. That is as interest rate also decreases GDP increases and vice versa. Also, this relationship is supported by literature as reviewed above that if inflation is rising the central bank raises the interest rate,

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meaning that the cost of borrowing increases so the amount of money borrowed by individuals and companies decreases which in turn decreases the amount of money in the economy (money supply) resulting in low economic output and for that matter GDP. The above arguments are corroborated by the line diagram below using the data for Inflation, Policy Rate and GDP from 1980 to 2010 for the Ghanaian economy as used in the study.
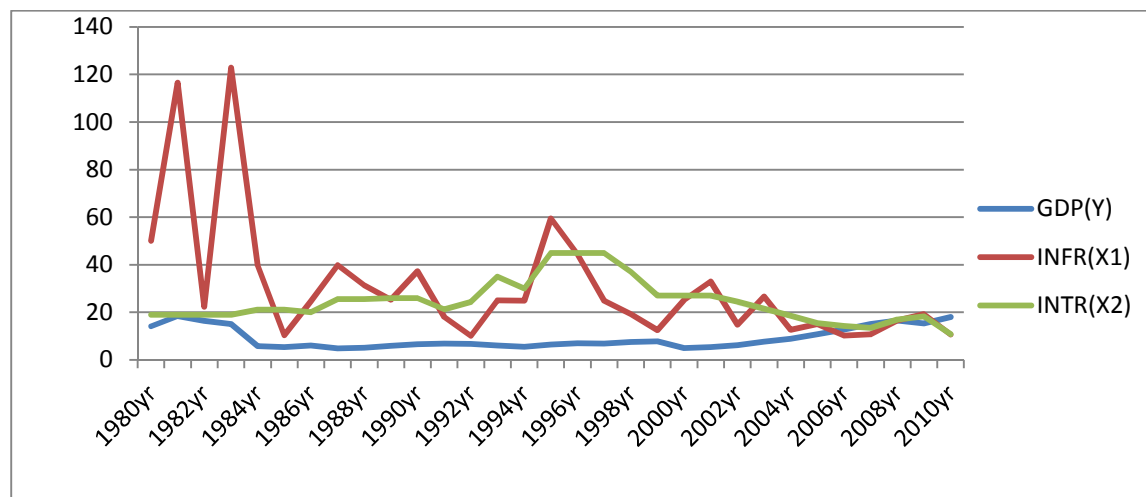
Figure 1: Line graphs of GDP, Inflation and Policy Rates from 1980 to 2010

The Figure 1 shows the performance of the Ghanaian economy in terms of the GDP, with regard to inflation rates and interest rates from the year 1980, 1981, 1982, through to 2010. The graph shows that the performance of the Ghanaian economy in terms of GDP, with regard to inflation rates and interest rates have not remained constant over the period, but rather have been growing steadily with moderate fluctuations especially during the periods of 1983, 1984 and 2000. As can be seen in Figure 1, some years recorded high figures whilst others recorded very low figures.For instance inflation rates were high during the periods of 1980, 1981 and 1983. This could be attributed to drought and wide scale bush and forest fires that engulfed the country around the period and thus created severe nation-wide famine especially in 1983.

Table 2: Model summary of other regression coefficients

Model	R	R²	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.660	0.435	0.395	3.497	0.406

The multiple linear regression model developed in Table 2 can confidently be used after having been satisfied with the assumptions if it is found to be adequate. The model adequacy checking is done using the statistics in Table 2. The R and R² represent the multiple correlation and coefficient of determination respectively. The R (0.66) shows that there exist a strong positive relationship between GDP as the dependent variable and

interest and inflation rates as the independent variables. This therefore also implies that the behavioral patterns of interest and inflation rates did influence Ghana's GDP. As inflation rises, GDP increases and so on. This is corroborated by the coefficient of inflation rate in the regression model developed above in table 2. Also, this relationship is supported by literature as reviewed above that if inflation is rising the central bank raises the interest rate, meaning that the cost of borrowing increases so the amount of money borrowed by individuals and companies decreases which in turn decreases the amount of money in the economy (money supply) resulting in low economic output and for that matter GDP. Furthermore, Mundell tackled the old Fisherian law on the constancy of the real rate of interest, i.e. where $r = i - \pi$ where if inflation (π) rises, then nominal interest rate (i) will rise one-for-one to keep real interest rates (r) constant. However, Keynes (1936) disputed Fisher's assertion and Fisher (1930), was reluctant to make too much out of it empirically. Mundell's reasoning was as follows: the nominal rate of interest is set by inflation expectations and the real interest rate, $i = r + \pi^e$. Now, suppose we have two assets, money and equity, where r is the real return on equity. By Keynes's theory of liquidity preference, money demand is inversely related to the return on alternative assets, i.e. L(r, Y). We know, of course, that in equilibrium M/p = L(r, Y), as money supply rises, the rate of interest falls, so we can trace out an money market (MM) equilibrium locus in interest/money supply space as in the Figure below. Now, a particular MM curve is conditional on a particular level of inflationary expectations (π^e). If inflationary expectations rise, then, for any given amount of money supply, the real interest rate, $r = i - \pi^e$, falls and thus the MM curve shifts down. The intuitive logic is that we must remember that the negative of inflation is the real rate of return on money. Thus, if there are inflationary expectations, agents who hold money are receiving a negative expected return on their real balances and thus will attempt to get rid of them by purchasing equity. As a result, money demands falls and the price of equity rises - and consequently the real rate of return on equity, r, and falls. On the contrary, the relationship between interest rate and GDP is such that they move in opposite directions. As interest rate increases, GDP decreases and vice versa. This relationship is corroborated by the negative coefficient of interest rate in the regression model developed in 3. This relationship is also supported by the literature reviewed above. As GDP increases, interest rates (policy) rate falls. This is because a sustained increase in Gross domestic product (GDP) is having a tendency of lowering inflationary rate, and would lead to a decrease in the policy rate; this is consistent to the monetary policy committee (MPC) of the bank of Ghana (BOG), the committee, reduced the policy rate from 13.5% to 13% as a result of a reduction risks of inflationary rate increase and improvement in economic growth. Furthermore, the R^2 (coefficient of determination) value of 0.435 or 44% means that approximately 44% of the proportion of variations in GDP are explained by both inflation and interest rates. It can simply be put as inflation and interest rates accounted for 44% of the changes in GDP with regard to the data for the period under review. Moreover, the adjusted R^2 (coefficient of determination adjusted for the degrees of freedom) value of 0.395 (approximately 40%) is in line with the R^2 value already explained above. This also implies that interest and inflation rates account for 40% of the changes in GDP.

Table 3: Analysis Of Variance (ANOVA)

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	264.001	2	132.001	10.792	.000
	Residual	342.480	28	12.231		
	Total	606.481	30			

a. Predictors: (Constant), Inflation(X2), Interest(X1)

b. Dependent Variable: GDPY

The analysis of variance (ANOVA) table above is used to test the overall significance of the model developed and for that matter whether the beta coefficient are the same or not.

The hypothesis that is tested here is:

Null hypothesis (H_0): The overall model is not significant, i.e. $H_0: \beta_j = 0$

Alternative hypothesis (H_1): The overall model is significant, i.e. $H_1: \beta_j \neq 0$.

The level of significance selected is $\alpha=0.05$. The decision rule is do not reject the null hypothesis if the F calculated is less than the F critical, or if the significant value is less than the level of significance ($\alpha=0.05$). The decision and conclusion, is that since the significant value of 0.000 is less than 0.05, therefore the null hypothesis is rejected. Thus it can be concluded that at least one beta coefficient is not zero and for that matter the overall model is significant. Finally, the significant values recorded in the last column of Table 3 also indicate that all the individual beta coefficients are significant.

3.2 Relationship between GDP and Inflation

In addition to the relation developed for GDP, in terms of inflation rate and interest rate, the relationship between GDP and inflation rate is also examined as follows.

Figure 2: Line graph of GDP and Inflation rate from 1980 to 2010
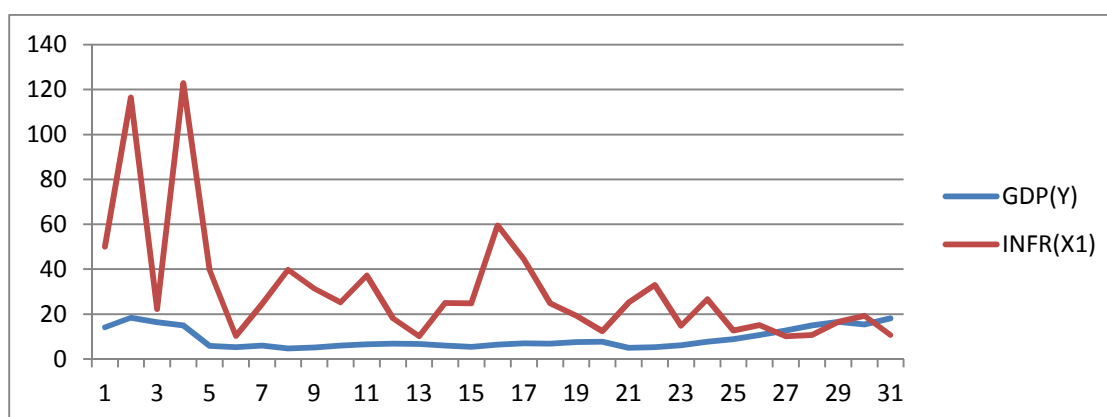
The pattern of trend of GDP and inflation rate obtained in the figure 2 above is not different from that obtained in figure 1 above over the thirty-one (31) year period under study. It shows clearly that the GDP for the Ghanaian economy has grown steadily over the years under study with a few moderate declines between 1983 up to 1985 with corresponding high increases in inflationary rates. The figure further shows that there has been serious fluctuations in the inflationary rates with only moderate movements in 2007 up to 2010. These movements in the line graphs shows that there has been a relationship between GDP andinflation rates over the period under study.Where inflationary rates were high, GDP was high and where inflation is low GDP is also low.

Table 4: Regression Statistics of GDP and inflation

Multiple R	**0.248476**
R Square	0.0617403
Adjusted R Square	0.0282311
Standard Error	4.4134103
Observations	31

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With regard to the nature of the relationship between GDP as a dependent variable and inflation as the independent or explanatory variable, it can be said based on the correlation coefficient (R=0.248476) that there exists a weak positive relationship between GDP and inflation. Also based on the coefficient of determination value (R square=0.0617403) it can be concluded that inflation could explain or account only approximately 6% of the changes in GDP over the period. This therefore implies that there about 94% of the changes in GDP that rather accounted for by other macroeconomic variables.

Table 5: Regression coefficients

	Coefficients	Standard Error	t Stat	P-value
Intercept	7.7978165	1.216943561	6.407706	6.2E07
Inflation rate	0.0411398	0.030308217	1.357382	0.1855

Based on the regression coefficients in Table 5 above, a simple linear regression equation that can be modeled is Y=7.7978+0.04114X, where Y is the dependent variable that is GDP and X being the independent variable representing inflation. This relationship shows that GDP will increase with a corresponding increase in inflation. However, this increment may not be significant since the P-value for the coefficient is not significant. This could better be improved if additional variables are added to the model. For instance in the model developed for GDP as the dependent variable using inflation and interest rates as the explanatory variables, the constant term is 14.988 which is about twice of that obtained for this model.

Table 6: Analysis of Variance

Source variation	Df	SS	MS	F	Significance F
Regression	1	35.88827652	35.88828	1.84249	0.18550085
Residual	28	545.3893298	19.47819		
Total	29	581.2776063			

The analysis of variance is at this juncture used to test the overall significance of the linear regression equation developed between GDP and inflation. It can be seen from the sum of squares values that the residual sum of squares of 545.3893298 is far bigger than the regression sum of squares of 35.88827652. This goes a long way to affect the reliability of the model. The decision rule is do not reject the null hypothesis if the F calculated is less than the F critical, or if the significant value is less than the level of significance ($\alpha=0.05$).   The decision and conclusion, is that since the significant value of 0.18550085 is greater than 0.05, therefore the null hypothesis is not rejected. This thus confirms the high sum of squares residual value of 545.3893298 out of a total of 581.2776063. Therefore, it can be concluded that the model developed for GDP in terms of inflation is not significant.

3.3 The Regression Statistics between GDP and Policy Rate (Interest Rate)

Table 7: Regression Statistics of GDP and policy rate in Ghana from 1980 to 2010

Regression Statistics	
Multiple R	0.566729794
R Square	0.321182659
Adjusted R Square	0.296939183
Standard Error	3.753956575
Observations	31

With regard to the nature of the relationship between GDP as a dependent variable and policy rate as the independent or explanatory variable, it can be said based on the correlation coefficient (R=0.566729794) that there exists a moderate positive relationship between GDP and policy rate. Also based on the coefficient of determination value (R square=0.321182659) it can be concluded that policy rate is able to explain or account for only approximately 32% of the changes in GDP over the period. This therefore implies that there about 68% of the changes in GDP that rather accounted for by other macroeconomic variables.

Table 8: Regression coefficients

	Coefficients	Standard Error	t Stat	P-value
Intercept	15.97346453	2.025556189	7.885965	1.37E-08
Interest rate	-0.281298738	0.077283928	-3.63981	0.001094

Based on the regression coefficients in Table 4.9 above, a simple linear regression equation that can be modeled is Y=15.97346453+(-0.281298738)X, where Y is the dependent variable that is GDP and X being the independent variable representing policy rate.

This relationship shows that GDP increases with a corresponding decrease in policy rate. This increment is also significant since the P-value for the coefficients are significant. The reliability of the model is tested below using the analysis of variance table below.

Table 9: Analysis of Variance

Significance	Df	SS	MS	F	F
Regression	1	186.6962872	186.6963	13.24821	0.001093836
Residual	29	394.5813191	14.09219		
Total	**30**	**581.2776063**			

The importance of the reliability of the model developed above for the relation between GDP and policy rate cannot be over ruled, since it would go a long way in informing its usage in

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estimation and forecasting. Since the calculated F of 13.24821 is far greater than the F significance, the null hypothesis is not rejected. It therefore can be concluded that the model developed for GDP in relation to policy rate for Ghana using the data covering these two variables from 1980 to 2010 is quite significant.

4.0 CONCLUSION

It can be concluded from the findings that there exist a strong positive correlation (relationship) of 0.66 between GDP, interest rate and inflation rates over the period under study. This therefore also implies that the behavioral patterns of interest and inflation rates have had some influence on GDP. Furthermore, the study revealed an R^2 value of 0.435 (44%); this implies that an approximately 44% of the proportion of variations in GDP are explained by both inflation and interest rates. It can simply be put as inflation and interest rates accounted for or explained only 44% of the changes in the GDP of Ghana with regard to the data for the period 1980 to 2010. Therefore there are about 56% of the changes in the GDP of the Ghanaian economy that could not be explained by inflation and interest rates that need to be investigated. It can also be concluded from the findings that indeed there exist some relationship between GDP, inflation and interest rates as already established and this is given by the linear multiple regression model: $Y = 14.988 + 0.055X_1 - 0.305X_2$, where Y is the GDP; X_1 is the inflation rate; and X_2 is the interest rates over the period 1980 through to 2010.

Furthermore, it was revealed that there is a positive relationship between GDP and inflation rate given the data for the period under consideration and it therefore means that both GDP and inflation rate behaved or moved in the same direction. As inflation rate increased GDP also increased and vice versa. However, it indicated a negative or inverse relationship between GDP and interest rate. This means that interest rate and GDP move in opposite direction. That is as interest rate increases, GDP decreases and vice versa. Also, the test of hypothesis with the analysis of variance table have revealed that overall multiple regression model developed for GDP, interest rate and inflation rate was significant with the individual parameter estimates also being significant. Therefore given any projected interest and inflation rates for a given period, the projected corresponding GDP can be estimated but with a precision of only 40% or 44%. Finally, it can be concluded based on the individual examination of the relationship between GDP, inflation and policy rate that there exists some relationship between GDP and inflation rate as well as GDP and policy rate. It is recommended that the Government together with the Bank of Ghana should develop and pursue prudent monetary policies that would aim at reducing and stabilizing both the micro and macroeconomic indicators such as inflation targeting, interest rate, so as to boast the growth of the economy.

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Securing Generic Routing Encapsulation with Internet Protocol Security (IPSEC) for Institutional Wide Area Networks.

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Abstract
The Internet is a worldwide, publicly accessible IP network. Due to its vast global proliferation, it has become a viable method of interconnecting remote sites. However, the fact that it is a public infrastructure has deterred most enterprises from adopting it as a viable remote access method for branch and SOHO (Small Office Home Office) sites. The paper discusses Generic Routing Encapsulation (GRE) over Internet Protocol security (IPSec) Virtual Private Network (VPN) as a concept that describes how to create a private network over a public network infrastructure while maintaining confidentiality and security. A simulation of two network nodes over an ISP network was used to allow packet flow from one network node through the Internet Service Provider (ISP) to a destination network. This operation allowed packets sent from a source host through the ISP's network to a destination network to be critically examined. Packet loss, packet length, Input/output (I/O) graph, service response time and flow graph are some parameters used to examine packet flow from a source host to a destination host over the ISP network.Open source Network Protocol Analyzer was used to capture traffic traversing over the Service Provider network for analysis and interpretation.Analyzed data revealed that all Transmission Control Protocol (TCP) packet session were encapsulated with Encapsulated Security Payload (ESP)Protocol.The encapsulation makes it impossible for the service provider to detect multicast traffic over the service provider's network and also crackers inability to decrypt the encapsulated data over the internet.

Keywords: GRE; ISP; TCP Packets; ESP; VPN

1 INTRODUCTION
GRE tunnels are stateless. Each tunnel endpoint keeps no information about the state or availability of the remote tunnel endpoint. This feature helps Internet Service Providers (ISPs) provide IP tunnels to customers who are not concerned about the internal tunneling architecture at the ISP end. Customers then have the flexibility to configure or reconfigure their Internet Protocol (IP)architecture but still maintain connectivity. It creates a virtual point-to-point link to routers at remote points over an IP internetwork.Generic Routing encapsulation (GRE) over Internet Protocol Security- Virtual Private Network (IPSEC-VPN) and IP-based physical security are best practice to overcome the mentioned problems. GRE over IPSEC-VPN is a scalable technology, so it is a good solution for wide area network communications. It also reduces the routing lookups in which case communication between different nodes becomes faster. Virtual private network technology is used in order to provide simple management, low cost and more flexibility for establishing Wide Area Networks.

GRE is a tunneling protocol defined in RFC 1702 and RFC 2784. It was originally developed by Cisco Systems for creating a virtual point-to-point link to Cisco routers at remote points over an IP internetwork, (Farinacci & Li, 1994).

GRE supports multiprotocol tunneling. It can encapsulate multiple protocol packet types inside an IP tunnel. Adding an additional GRE header between the payload and the tunneling IP header provides the multiprotocol functionality. IP tunneling using GRE enables network expansion by connecting multiprotocol sub-networks across a single-protocol backbone environment. GRE also supports IP multicast tunneling. Routing protocols that are used across the tunnel enable dynamic exchange of routing information in the virtual network (Farinacci& Li,1994).

Securing Generic Routing Encapsulation (GRE)
The main function of GRE is to provide powerful yet simple tunneling. GRE supports any Open System Interconnection (OSI) Layer

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3 protocol as payload, for which it provides virtual point-to-point connectivity. GRE also allows the use of routing protocols across the tunnel, (Christian, 2001).

The main limitation of GRE is that it lacks any security functionality as it only provides basic plaintext authentication using the tunnel key, which is not secure, and tunnel source and destination addresses. However a secure VPN requires characteristics such as;

- Cryptographically strong confidentiality (encryption)
- Data source authentication that is not vulnerable to man-in-the-middle attacks
- Data integrity assurance that is not vulnerable to man-in-the-middle attacks and spoofing.

that are not provided by GRE:

IPSec will provide the tunneling characteristics that GRE lacks:

- Confidentiality through encryption using symmetric algorithms (for example, 3DES or AES)
- Data source authentication usingkeyed-hash message authentication code (**HMAC**)(for example, message-digest algorithm(MD5) or Secure Hash Algorithm(SHA-1)
- Data integrity verification using HMACs

IPSec, however, was primarily intended to provide the above services to IP traffic only. Development of Cisco IOS software is focused on removing the limitations, but multiprotocol support will always require an additional tunneling protocol. Using crypto maps does not provide a virtual interface that you can configure an address on, and a routing protocol can be run to dynamically exchange routing information, (Christian, 2001).

Internet Protocol Security (IPSec)
Internet Protocol Security (IPSec) is an Internet Engineering Task force (IETF) standard (RFC 2401-2412) that defines how a VPN can be configured using the IP addressing protocol. IPSec is not bound to any specific encryption, authentication, security algorithms, or keying technology. IPSec is a framework of open standards that spells out the rules for secure communications. IPSec relies on existing algorithms to implement the encryption, authentication, and key exchange.

IPSec works at the Network Layer, protecting and authenticating IP packets between participating IPSec devices (peers). As a result, IPSec can protect virtually all application traffic because the protection can be implemented from Layer 4 through Layer 7. All implementations of IPSec have a plaintext Layer 3 header, so there are no issues with routing. IPSec functions over all Layer 2 protocols, such as Ethernet, ATM, Frame Relay, Synchronous Data Link Control (SDLC), and High-Level Data Link Control (HDLC).

The IPSec framework consists of five building blocks.

- The first represents the IPSec protocol. Choices include ESP or AH.
- The second represents the type of confidentiality implemented using an encryption algorithm such as Data Encryption Standard (DES), Tripple Data Encryption Standard (3DES), Advance Encryption Standard (AES), orSoftware-Optimized Encryption Algorithm (SEAL). The choice depends on the level of security required.
- The third represents integrity that can be implemented using either MD5 or SHA.,(Madson& Glenn,1998).

The fourth represents how the shared secret key is established. The two methods are pre-shared or digitally signed using Rivest-Shamir-Adleman(RSA).

- The last represents the Diffie-Hellman (DH) algorithm group. There are four separate DH key exchange algorithms to choose from including DH Group 1 (DH1), DH Group 2 (DH2), DH Group 5 (DH5), and DH Group 7 (DH7). The type of group selected depends on the specific needs.

IPSec provides the framework, and the administrator chooses the algorithms that are used to implement the security services within that framework. By not binding IPSec to specific algorithms, it allows newer and better algorithms to be implemented without patching the existing IPSec standards.(Karn& Metzger,1995).

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Rivest-Shamir-Adleman(RSA) Signatures - The exchange of digital certificates authenticates the peers. The local device derives a hash and encrypts it with its private key. The encrypted hash is attached to the message and is forwarded to the remote end and acts like a signature. At the remote end, the encrypted hash is decrypted using the public key of the local end. If the decrypted hash matches the recomputed hash, the signature is genuine. Each peer must authenticate its opposite peer before the tunnel is considered secure. Figure 3 depicts a pictorial view of RSA signature exchange between a local host and a remote host, (Cisco systems, 2009).

IPSEC Secure Key Exchange
Encryption algorithms such as DES, 3DES, and AES as well as the MD5 and SHA-1 hashing algorithms require a symmetric, shared secret key to perform encryption and decryption. The shared secret keys between the routers are shared through Internet Key Exchange (IKE) protocol or Internet Security Association (SA) and Key Management Protocol (ISAKMP).Email, courier, or overnight express can be used to send the shared secret keys to the administrators of the devices. But the easiest key exchange method is a public key exchange method between the encrypting and decrypting devices.

The Diffie-Hellman (DH) key agreement is a public key exchange method that provides a way for two peers to establish a shared secret key that only they know, even though they are communicating over an insecure channel, (Madson& Glenn,1998).
Variations of the DH key exchange algorithm are known as DH groups. There are four DH groups: 1, 2, 5, and 7.

- DH groups 1, 2, and 5 support exponentiation over a prime modulus with a key size of 768 bits, 1024 bits, and 1536 bits, respectively.
- Cisco 3000 clients support DH groups 1, 2, and 5. DES and 3DES encryption support DH groups 1 and 2.

- AES encryption supports DH groups 2 and 5.
- The CerticommovianVPN client supports group 7.

Group 7 supports Elliptical Curve Cryptography (ECC), which reduces the time needed to generate keys, (Prafullchandra&Schaad, 2000).

IPsec Security Protocols
IPSec is a framework of open standards. IPSec spells out the messaging to secure the communications but relies on existing algorithms. The two main IPSec framework protocols are AH and ESP. The IPSec protocol is the first building block of the framework. The choice of AH or ESP establishes which other building blocks are available:

Authentication Header (AH) - AH, which is IP protocol 51, is the appropriate protocol to use when confidentiality is not required or permitted. It ensures that the origin of the data is either R1 or R2 and verifies that the data has not been modified during transit. AH does not provide data confidentiality (encryption) of packets. All text is transported unencrypted. If the AH protocol is used alone, it provides weak protection (Atkinson & Kent 1998).

Encapsulating Security Payload (ESP) - ESP, which is IP protocol 50, can provide confidentiality and authentication. It provides confidentiality by performing encryption on the IP packet. IP packet encryption conceals the data payload and the identities of the ultimate source and destination. ESP provides authentication for the inner IP packet and ESP header. Authentication provides data origin authentication and data integrity. Although both encryption and authentication are optional in ESP, at a minimum, one of them must be selected, (Atkinson & Kent 1998). Figure 4 below depicts the recommended security protocol process.
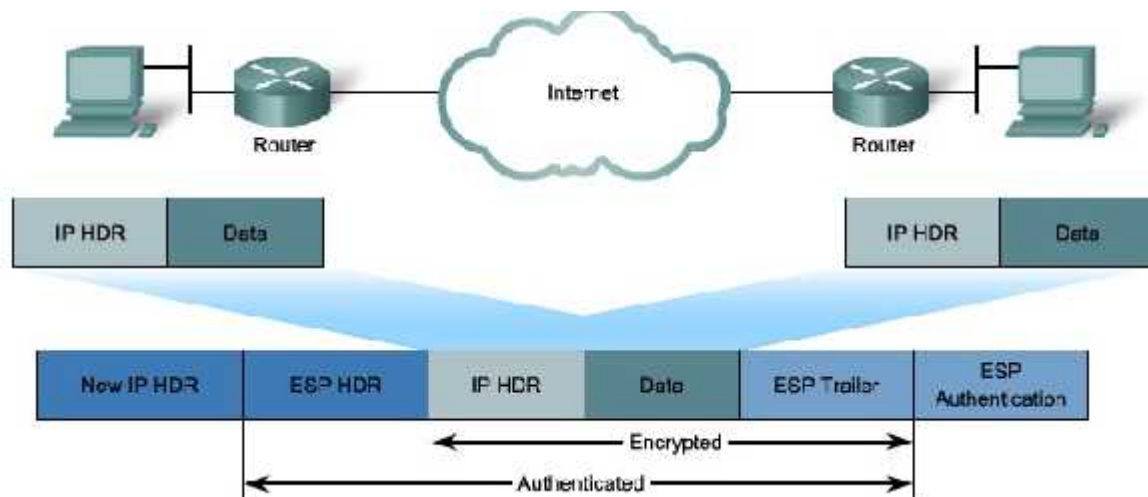
Figure 1:ESP Header (Adapted from Cisco Systems,2010)

Figure 4 shows how IPSec protocol header is encapsulated in an IP header for communication between two peers. The encryption header (IP HDR) and authentication protocol all encapsulates the packet (data) before been transmitted over the internet to the remote router. This ensures a high level of security payload for a packet to be transmitted over the internet.

Internet Key Exchange (IKE)

IKE is defined in RFC 2409. It is a hybrid protocol, combining the Internet Security Association (SA) and Key Management Protocol (ISAKMP) and the Oakley and Secure Key exchange Mechanism (SKEME) key exchange methods. ISAKMP defines the message format, the mechanics of a key-exchange protocol, and the negotiation process to build an SA for IPSEC. ISAKMP does not define how keys are managed or shared between the two IPsec peers. Oakley and SKEME have five defined key groups. Of these groups, Cisco routers support Group 1 (768-bit key), Group 2 (1024-bit key), and Group 5 (1536-bit key), (Harkins & Carrel,1998).

To implement a VPN solution with encryption, it is necessary to periodically change the encryption keys. Failure to change these keys makes the network susceptible to brute-force attacks. IPsec solves the problem of susceptibility with the Internet Key Exchange (IKE) protocol, which uses two other protocols to authenticate a peer and generate keys. The IKE protocol uses the DH key exchange to generate symmetrical keys to be used by two IPsec peers. IKE also manages the negotiation

of other security parameters, such as data to be protected, strength of the keys, hash methods used, and whether packets are protected from replay. IKE uses UDP port 500, (Harkins & Carrel,1998).

IKE negotiates a security association (SA), which is an agreement between two peers engaging in an IPsec exchange, and consists of all the parameters that are required to establish successful communication, (Harkins & Carrel, 1998).

IPsec uses the IKE protocol to provide these functions:

- Negotiation of SA characteristics
- Automatic key generation
- Automatic key refresh
- Manageable manual configuration

A security association (SA) requires the following:

- **Internet Security Association and Key Management Protocol (ISAKMP):** ISAKMP is a protocol framework that defines the mechanics of implementing a key exchange protocol and negotiating a security policy. ISAKMP can be implemented over any transport protocol. The reference document for ISAKMP is (Simpson, 1999).
- **Skeme:** A key exchange protocol that defines how to derive authenticated keying material with rapid key refreshment.
- **Oakley:** A key exchange protocol that defines how to acquire authenticated keying material. The basic mechanism for OAKLEY is the DH key exchange algorithm. The reference document is

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RFC 2412: The OAKLEY Key Determination Protocol.

IKE automatically negotiates IPSec SAs and enables IPSec secure communications without costly manual preconfiguration. An alternative to using IKE is to manually configure all parameters required to establish a secure IPSec connection. This process is impractical because it does not scale, (RFC 2412).

IKE includes these features:

- Eliminates the need to manually specify all of the IPSEC security parameters at both peers.
- Allows specification for a lifetime for the IPSECSecurity Association (SA)
- Allows encryption keys to change during IPSEC sessions
- Allows IPSEC to provide anti-replay services
- Permits certification authority (CA) support for a manageable, scalable IPSEC implementation
- Allows dynamic authentication of peers,(RFC 2412).

Internet Key Exchange (IKE) Process

To establish a secure communication channel between two peers, the IKE protocol executes two phases:

- **Phase 1** - Two IPSec peers perform the initial negotiation of SAs. The basic purpose of Phase 1 is to negotiate IKE policy sets, authenticate the peers, and set up a secure channel between the peers. It can be implemented in main mode (longer, initial contact) or aggressive mode (after initial contact).
- **Phase 2** - SAs are negotiated by the IKE process ISAKMP on behalf of IPSEC. The second exchange creates and exchanges the DH public keys between the two endpoints. DH allows two parties that have no prior knowledge of each other to establish a shared secret key over an insecure communications channel. The two peers run the DH key exchange protocol to acquire the keying material that is needed by the various encryption and hashing algorithms upon which IKE and IPSec will ultimately agree.

The purpose of IKE Phase 2 is to negotiate the IPSec security parameters that will be used to secure the IPSec tunnel. IKE Phase 2 is called quick mode and can only occur after IKE has established the secure tunnel in Phase 1. SAs are negotiated by the IKE process ISAKMP on behalf of IPSec, which needs encryption keys for operation. Quick mode negotiates the IKE Phase 2 SAs. In this phase, the SAs that IPSec uses are unidirectional; therefore, a separate key exchange is required for each data flow(Simpson, 1999).

2 METHODOLOGY

The method adopted in this paper is the structural design and the simulation of GRE tunnel network. Graphical Network Simulator (GNS3) software was used to simulate the network with Cisco routers running original Internetwork Operating System (IOS). GNS3 is software used to simulate complex advances network. Network device configuration and penetration testing can be established when using GNS3. Routers used in the simulation are Cisco routers. Comparative analysis and penetration testing was done to check the security level of a GRE tunnels.Network Protocol Analyzer (wireshark) was used to capture traffic traversing over the Service Provider's network for further analysis and interpretation.Below includes details of methods used to simulate the tunnel.

Simulated Virtual Lab

In the simulated virtual lab, a site-to-site GRE tunnel VPN was configured. Once configured, the VPN traffic between Router 1 on interfaces Router 1 and Router 2will be captured using wireshark for further processing and analysis.Each of the simulated networks connects to an Internet Service Provider (ISP).The Internet Service Provider only provides internet subscription to the client (institution).The simulated network will provide institutional connectivity to remote sites over the internet. A study into Service Providers network architectural design outline certain configuration parameters which allows internet subscription from client and other IP services hosted by the Service Provider. In the process architectural designs of Service Providers to were simulated to allow connectivity to client. Figure2 below depicts the simulated network
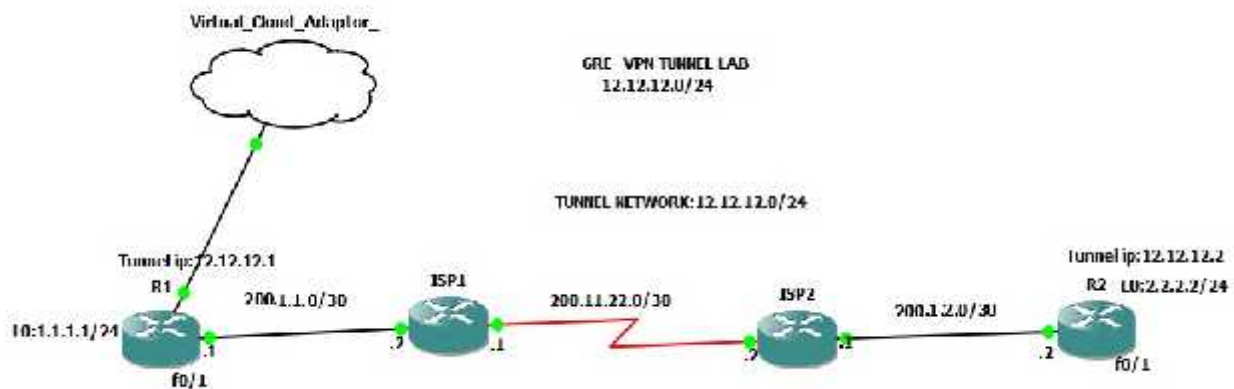
Figure 2Simulated GRE over IPSec VPN tunnel Lab

Figure 2 illustrates thetopological simulateddesign used to simulate thenetwork architecture. The ISP has two routers (ISP1 and ISP 2).ISP 1 connects router 1 and ISP 2 connects router 2. Router 1 and 2 are considered as the edge routers and a client to the ISP.The ISP has a serial connection from ISP 1 to ISP2.ISP 1 connects its edge router through a fastethernet 0/0 interface and ISP2 connects its edge router through a fastethernet 0/0 interface.The ISP provides only internet access to router 1 and 2(edge devices).

A virtual cloud adaptor from figure 2 was used to virtualized the physical interface of a laptop network adaptor to a Loopback adaptor interface. This virtualization enabled a laptop adaptor to be part of the simulated network.

Configuring Network Interface Addresses
A loopback and a tunnel interface was configured on router 1 and router 2 fastethernet and the serial interfaces.Fastethernet 0/0 on router 1 was configured with the IP address 200.1.1.1 and a subnet mask 255.255.255.0.The IP address configured on fastethernet 0/0 is the out bound interface connected to the service provider (ISP1) for internet access. Loopback interface 0 was configured with the IP address 1.1.1.1 and a subnet mask 255.255.255.0.The loopback interface represent all internal hosts connected to router 1.

Router 2 was also configured with the same parameters. The loopback interface was assigned the IP 2.2.2.2 and a subnet mask 255.255.255.0.Fastethernet 0/0 connects to Internet Service Provider (ISP2) for internet

access. Fastethernet 0/0 was assigned the IP 200.1.2.2 and a subnet mask 255.255.255.0.A "no shutdown" command was issued on each of the configured interface to activate the interfaces.

A tunnel interface (tunnel 0) on router 1 and router 2 which will be used to transport GRE packets from router 1 and router 2 was configured with the IP 12.12.12.1 and 12.12.12.2 respectively.Tunnel 0 was virtualized with the physical interfacefastethernet 0/0 totransport packets flow through the physical interface connected to the   Internet Service Provider (ISP). The command "tunnel source 20.1.1.1 and a tunnel destination 200.1.2.2" was issued on both routers to connect the tunnel (tunnel 0) interface to the physical interface to transport packets to the ISP. Configured tunnel 0 on router 1 and router 2 will be the transport medium to forward all VPN traffic through the ISP's network.

ISP (Internet Service Provider) network as shown in figure 14was simulated with two routers, ISP1 and ISP2. ISP 1 has two interfaces, interface fastethernet 0/0 and interface serial 1/0.Interface fastethernet 0/0 connects router 1 and interface serial 1/0 connects ISP 2. Fastethernet 0/0 was configured on ISP 1 router with the IP address 200.1.1.2 and a subnet mask 255.255.255.0,interface serial 0/0 also configured with the IP address 200.11.22.1 with subnet mask 255.255.255.25.Each configured interfaces were issued with the command "no shut down" to activate the interfaces.

ISP2 router has two interfaces,interface fastethernet 0/0 and interface serial 1/0.Interface fastethernet 0/0 connects router 1 and serial 1/0 connects ISP2 serial interface 1/0. Interface fastethernet 0/0 was configured with the IP address 200.1.1.1 with a subnet mask 255.255.255.0 and interface serial 1/0 with an IP address 200.11.22.2 subnet 255.255.252.A "no shut down command" was issued on each interfacesto activate the interface.

Configuring Routing Protocol On Client Routers.
In order to maintain connectivity between remote networks, EIGRP was configured to route packets between all networks in the diagram. All connected subnets were added into the EIGRP autonomous system on every router. The command:
Router eigrp 1
Network 10.0.0.0
Network 12.0.0.0
Network 192.168.0.0
The command "router eigrp 1" enables and activates Enhanced Interior Gateway Routing Protocol (eigrp) under one (1)Autonomous System on router 1, the command network 10.0.0.0,12.0.0.0.192.168.0.0 advertises the network which is directly connected torouter 1, to the ISP1 network.
The command "router eigrp1
Network 12.0.0.0
Network 2.0.0.0
Network 192.168.0.0
The command "router eigrp 1" enables and activates Enhances Interior Gateway Routing Protocol under one (1) Autonomous System on router 2, the command network 12.0.0.0, 2.0.0.0 , 192.168.0.0 advertises the network which is directly connected to router 2, to the ISP2 network. Configuring autonomous system enables EIGRP to be under one administrative control.

Configuring Routing Protocol On ISP Routers.
The simulated network has two routers which establish connectivity to both clients (router 1 and router 2). Routing Information Protocol version 2 (RIP,v2) was configured on the ISP's routers. This enables the ISP router receives network advertisement from router 1 and router 2 network.ISP1 router has two main interfaces, interfacefastethernet 0/0 and

interface serial 0/1.Interface fastethernet 0/0 is directly connected to router 1and interface serial 0/1 connected to ISP2 network. ISP 1 router was configured with the command;
Router rip version 2
Network 200.1.1.0
Network 200.11.22.0

ISP 2 router has two main interfaces,interface fastethernet0/0 and serial 0/1.Interface fastethernet 0/0 is connects router 2 and interface serial 0/1 connects to ISP 2 network.
ISP 2 router was configured with the command;
Router rip version 2
Network 200.1.2.0
Network 200.11.22.0
Networks advertised on ISP's router are networks which are connected to interface fastethernet 0/0to router 1 and interface serial 0/0 to ISP2 interface. Networks advertised on ISP2 router are networks which connected to interface fastethernet 0/0 to router 2 and interface serial 0/0 to ISP1.

A ping command was issued from router 1 to the various configured interface to verify that connectivity across local subnets using the pingcommand was reachable. All ping commands sent were all successful.
Step one (1) to step three (3) are the processes used to simulate the GRE tunnel from router 1 through the ISP's network to router 2.

Securing Generic Routing Encapsulation (GRE) Tunnel With IPSec
Configuring IKEPolicies
There are two central configuration elements to the implementation of an IPSec:
1. Implement Internet Key Exchange (IKE) parameters
2. Implement IPSec parameters
The exchange method employed by IKE is first used to pass and validate IKE policies between peers. Then, the peers exchange and match IPSec policies for the authentication and encryption of data traffic. The IKE policy controls the authentication, encryption algorithm, and key exchange method used for IKE proposals that are sent and received by the IPSec endpoints. The IPSec policy is used to encrypt data traffic sent through the VPN tunnel. Internet Security Association Key Management Protocol (ISAKMP) was used to enable IKE on the client router (router 1).

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The exchange method employed by IKE is first used to pass and validate IKE policies between peers. Then, the peers exchange and match IPSEC policies for the authentication and encryption of data traffic. The IKE policy controls the authentication, encryption algorithm, and key exchange method that is used by IKE proposals that are sent and received by the IPSEC endpoints. The IPSEC policy is used to encrypt data traffic that is sent through the GRE tunnel.

To allow IKE Phase 1 negotiation, an Internet Security Association and Key Management Protocol (ISAKMP) policy was created and a peer association involving that ISAKMP policy was also configured. An ISAKMP policy defines the authentication and encryption algorithms and hash function used to send control traffic between the two VPN endpoints. When an ISAKMP securityassociation has been accepted by the IKE peers, IKE Phase 1 has been completed. The command configured on router 1 must match the command configured on router 2. Router 1 and router 2were configured with the commands:
R1(config)# crypto isakmp policy 5
R1(config-isakmp)# authentication pre-share
R1(config-isakmp)# encryption aes 256
R1(config-isakmp)# hash sha
R1(config-isakmp)# group 5
R1(config-isakmp)# lifetime 3600

R2(config)# crypto isakmp policy 10
R2(config-isakmp)# authentication pre-share
R2(config-isakmp)# encryption aes 256
R2(config-isakmp)# hash sha
R2(config-isakmp)# group 5
R2(config-isakmp)# lifetime 3600
The different priority numbers refer to how secure a policy is. The lower the policy number is, the more secure a policy is. Routers will check to verify which security policies are compatible with their peer, starting with the lowest numbered (most secure) policies.

Configuring Router Pre-Share Keys
Since I chose pre-shared keys as our authentication method in the IKE policy, I configure a key on each router corresponding to the other VPN endpoint. These keys must match up for authentication to be successful and for the IKE peering to be completed. For simplicity Iused the key "MYKEY". Router 1

and router 3 were configured with the command:
R1(config)# crypto isakmp key MYKEY address 200.1.2.2
R2(config)# crypto isakmp key MYKEY address 200.1.1.1

Configuring Router IKE Phase two (2)
Router 1 and router 2 was configured with the command:
R1(config)# crypto ipsec transform-set LABesp-aes 256 esp-sha-hmac ah-sha-hmac
R2(config)# crypto ipsec transform-set LABesp-aes 256 esp-sha-hmac ah-sha-hmac.
R1(config-crypto-map)# match address KNUST

IKE phase 2 is configured using the IPSec transform set. TheIPSec transform set is another crypto configuration parameter that routers negotiate to form a security association. Routers will compare their transform sets to the remote peer until they find a transform set that matches exactly.

Configuring Interesting Traffic
Now that most of the encryption settings are configured,wedefined extended access lists to tell the router which traffic to encrypt. Like other access lists used to define "interesting traffic" rather than packet filtering, permit and deny do not have the usual meaning of a filtering access list. A packet which is permitted by an access list used for defining IPSec traffic will get encrypted if the IPSec session is configured correctly. A packet that is denied by one of these access lists will not be dropped; it will be sent unencrypted. Also, like any other access list, there is an implicit denialat the end, which in this case means the default action is not toencrypt traffic. If there is no IPsec security association correctly configured, then no traffic will be encrypted, but traffic will be forwarded as unencrypted traffic. Router 1 and router 2 were configured with the following command:
R1(config)# ip access-list extended KNUST
R1(config)# permit ip 12.12.0.0 0.0.255.255 12.12.0.0 0.0.255.255
R1(config)# ip access-list extended KNUST
R1(config)# permit ip 12.12.0.0 0.0.255.255 12.12.0.0 0.0.255.255

In this configuration, the traffic l want to be encrypted is the GRE tunnel traffic which was

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configured with the IP address 12.12.12.0/24.The access-list was configured with a name KNUST to only allow traffic going through the GRE tunnel 0 encrypted with IPSec.

Configuring AndApplying Crypto Map
Router 1 and router 2 were configured with the following commands:
R1(config)#crypto map VPN_MAP 15 ipsec-isakmp
R1(config-crypto-map)# set peer 200.1.2.2

R1(config-crypto-map)# set transform set LAB
R1(config-crypto-map)# lifetime 900
R2(config)#crypto map VPN_MAP 15 ipsec-isakmp
R2(config-crypto-map)# set peer 200.1.1.1
R2(config-crypto-map)# match address KNUST
R2(config-crypto-map)# set transform set LAB
R2(config-crypto-map)# lifetime 900
A crypto map is a mapping that associates traffic matching an access list (like the one I created earlier) to a peer and various IKE and

IPsec settings. Crypto maps can have multiple map statements, so you can have traffic that matches a certain access list being encrypted and sent to one IPsec peer, and have other traffic that matches a different access list being encrypted towards a different peer. After a crypto map is created, it can be applied to one or more interfaces. The interface(s) that it is applied to should be the one(s) facing the IPSec peer.The name of the configured crypto map is known as VPN_MAP. This name will be applied to the interface to secure VPN traffic.

Applying Crpto Map To An Interface
The interface that need to be secured is the GRE tunnel interface.The crypto map was applied to the tunnel (tunnel 0) interface to secure traffic from router 1through ISP's network to router 2. Router 1 and 2 were configured with the following commands:
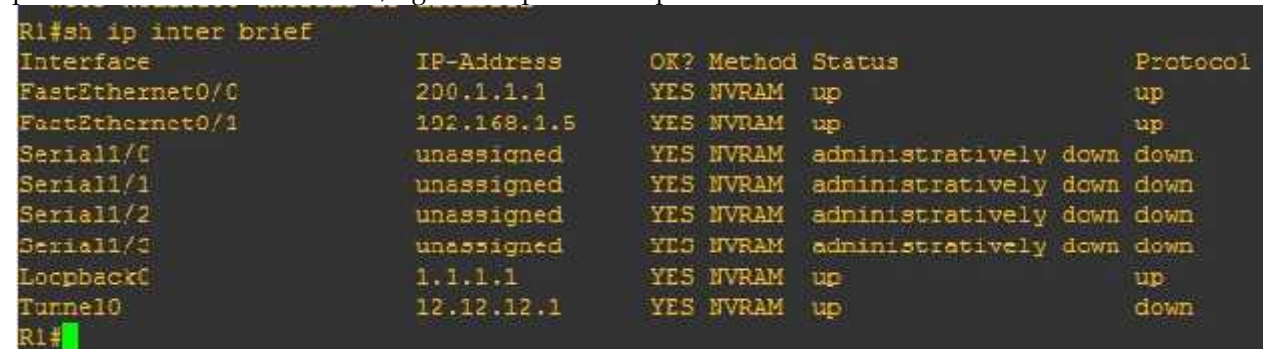R1(config)# interface tunnel 0
R1(config)#crypto map VPN_MAP
R2(config)# interface tunnel 0
R2(config)#crypto map VPN_MAP

3.   RESULT AND ANALYSIS
Verification OfInternet Protocol (IP) VPN Tunnel Interfaces
The command 'show ip interface brief was issued on router one (1) to verify IP address configuration parameters and interface status, figure 3 depict the output of the command.

Figure 3: Simulated GRE tunnel interface verification

Figure 8 depicts the connectivity between router one (1) and the ISP's network. Fastethernet 0/0 with an IP address 200.1.1.2 connects to the ISP two (ISP 1) network which shows that the interconnectivity between the client router and the service provider is active (up) whiles the protocol supporting the interface is also active (up).Interface tunnel 0 configured for Generic Routing Encapsulation (GRE) over Internet Protocol Security Virtual Private Network (GRE/IPSec-VPN) is also

active (up).Clients connected to router one (1) can tunnel through (tunnel 0) the ISP's network to router two (2).Hence the tunnel connectivity between router one (1) and router two (2) has being established through the tunnel interfaces.

Secured GRE Over IPSec Tunnel Operations Status
A continuous Internet Service Control Messaging Protocol (ICMP), service command "ping 12.12.12.2" was executed on a laptop

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with an IP address 19.168.1.2 attached to the Local Area Network connected to router 1, through the ISP network over to the destination tunnel network on router 2.

A web server hosted on router 2 was also accessed by the laptop with an IP address 192.168.1.2 connected to the simulated network. All Hypertext Transmission Protocol (HTTP) traffic were sent over the VPN tunnel (tunnel 0).A Network Protocol Analyzer software (wireshark) was used to capture packets moving through the ISP network to router 2.Figure 3 displays the outcome of the output command from router 1 through the ISP network to router 2.
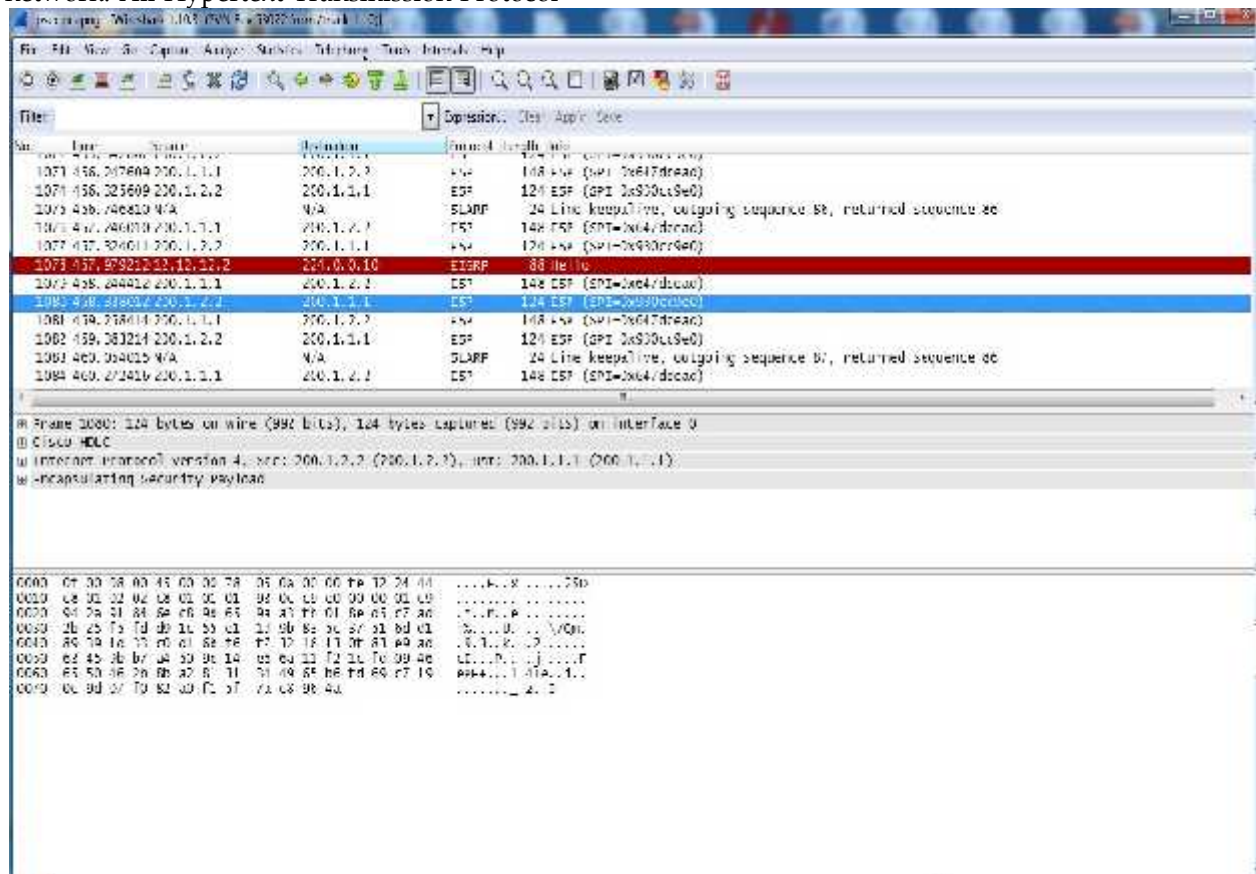

Figure 4: Captured GRE over IPSec-VPN Packets using wireshark

Wireshark was used to capture traffic between the clients connected to router one (1) through the ISP's network. The highlighted session in green depicts packet sent from a source tunnel network with an IP address 200.1.2.2 to a destination network 200.1.1.1 has being secured by the Encapsulation Security Protocol (ESP).The highlighted session in red is the interior routing protocol configured on the ISP network to exchange "hello" packets among the router for a best path selection. Any conversation between the two routers through the tunnel network traversing over the ISP's network cannot be seen or intercepted by a third party.ESP protocol are the only packets being exchanged on the ISP's network.ESP encapsulates all TCP packets before transporting the packets through the tunnel network (tunnel 0)
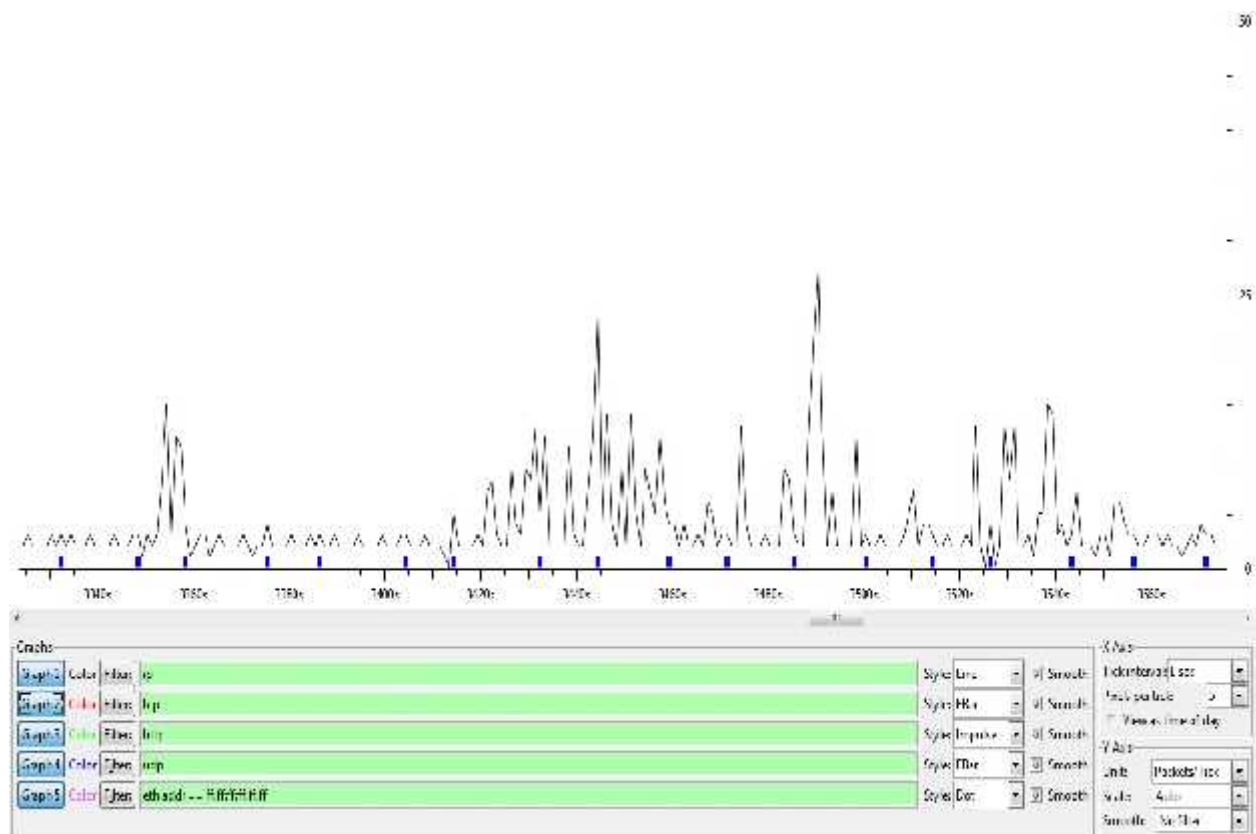
Figure5: SimulatedIPSEC-VPN Input/output (I/O) graph

Figure 5 depicts the analysis of packet captured over the ISP network. Traffic sent over the VPN tunnel includes web traffic (HTTP:80), IP traffic, User Datagram Protocol (UDP),Transmission Control Protocol (TCP) and Ethernet broadcast address (ffffffffff).

Graph 1 has the color black which has an IP filter witha style'line', Graph 2 has the color red which has a TCP session filter with a style 'Fbar',graph 3 has the color green which has an HTTP filter with a style 'impulse', graph 4 has the color blue which has a User Datagram Protocol (UDP) filter with a style 'Fbar', and graph 5 has the pink color which has a broadcast IP (ffffffff) with a style 'dot'.

The output of figure 5 indicates that only IP and UDP traffic traversed over the VPN tunnel.TCP and HTTP traffic were not captured within the tunnel.This analysis prove that all HTTP requests and TCP sessions were all encapsulated by the IPSec protocol (ESP) within the IP(Internet Protocol) header,which means efforts to capture any TCP or HTTP traffics will prove futile because TCP packets have being encapsulated within the tunnel by Encapsulated Security Payload (ESP), hence TCP traffics cannot be captured over the tunnel network.

4 CONCLUSION
The use of GRE over IPSec VPN technology can further be used to establish Network connectivity instead of establishing Wide Area Connection through satellite medium or outsourced to service providers. Internet Protocol Security (IPSec) VPN(Virtual Private Network) mainly supports unicast traffic but a simulated study on this paper revealed that multicast traffic can operate securely over the Generic Routing Encapsulation (GRE) tunnel network when secured with Internet Protocol Security (IPSec).HTTP and any other TCP packets can securely be sent through a secured VPN tunnel without the Service provider knowing the type of packets being sent across their network because the service provider only see Encapsulated Security Payload (ESP) packets on their network but not the content of the ESP packets traversing over their network.

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Evaluation of Benchmarks for Assessing the Performance of Construction Contractors in Ghana

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Abstract
The construction industry often acts as a catalyst to stimulate the growth of a nation's economy. The industry is often referred to as an engine of growth. However, numerous government reports have criticized the industry's poor performance, especially in terms of productivity, quality and timely delivery. Several property owners have been awarding contracts based on a financial consideration with little regard for technicalities involved. Contractor performance can be defined by the level and quality of projects delivered to clients.This research was aimed at identifying factors that can be used to assess the performance of construction contractors in Ghana. The study used interviews, site meetings and questionnaires as well as literature reviews to obtain information and relevant data. The data obtained was analysed and conclusions and recommendation drawn. Previous studies have indicated that the development of a set of measurable criteria is key to any performance measurement system.The contractors interviewed admitted to significant problems in their own organizations. Including late payment of claims and without compensation for late payment. The findings of this study also helped in understanding the impacts of critical factors affecting the performance of Building Contractors in Ghana. These factors included standard of workmanship, site management practices, labour relations on site, relations with subcontractors and statutory authorities, appropriateness of organizational structure, employee development and client satisfaction. The study recommends criteria for performance assessment of contractors in Ghana.

Keywords: Performance; Satisfaction; Technical; Workmanship

1. INTRODUCTION

The construction industry plays an essential role in the socio- economic development of the country. In 2006 and 2007, the industry contributed 0.7% and 1.0% respectively to Gross Domestic Product (GDP) (ISSER, 2007). The activities of the industry include the construction of schools, hospitals, domestic houses and office complexes, etc.

According to Frimpong-Manso (2008), the construction industry deals with economic activities such as renovations, extensions, repairs, refurbishments, creation of new structures, etc. The industry is noted for being a major employer of both skilled and unskilled workmen (Owusu Tawiah, 1999).

Owusu Tawiah (1999) assessed the operations of building contractors in Ghana and identified two major factors that affected their performance. These factors are the financial capacity and the managerial structures instituted by the construction firms.

The performance of construction contractors has become a major concern for all stakeholders of all economies. Despite the fact that there is the need to evaluate the performance of building contractors, the mechanism for rating the contractors is absent. This has led to the allegation that the building contractors (especially local contractors) are incompetent.

This research therefore seeks to provide a framework that can be used to effectively evaluate the performance of construction contractors. A set of criteria would be outlined that can help in the assessment process.

The following objectives were set-out to aid the research:

1. Analysed the criteria used for selection of construction contractors in Ghana;
2. Identified the factors that affect the performance of construction contractors in Ghana;
3. Identified the challenges encountered by construction contractors in the performance of their activities

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4. Recommend a set of criteria that can be used to evaluate the performance of construction contractors in Ghana

Several countries at different levels of socio-economic growth have recognised the need and importance of taking measures to improve the performance of their construction industry in other to meet the aspirations of its developmental goals (Ofori, 2000).

The development of the construction industry promotes:

i. Increased value for money to industry clients as well as environmental responsibility in the delivery process

ii. The viability and competitiveness of domestic construction enterprises.

This has become necessary because of the poor performance of the construction industry due to problems and challenges including those having to do with its structure characterised by fragmentation, institutional weakness and resource shortages (Ofori, 2000; Beatham et al., 2004; Latham, 1994; Egan, 1998).

Du Plessis (2002) advised developing countries to avoid the development mistakes of the developed world and to take steps to intervene on behalf of sustainability today than to wait and change things after they have occurred. According to the World Development Report (1994), even though there is high investment in infrastructure in developing countries, the corresponding impact has been very low.

Performance Measurement in the Construction Industry

The absence of measurable targets in the construction industry has led to lack of progress and the persistence of problems in the construction industry (Ofori, 2001).

According to Beatham *et al* (2004), five problems were identified from the performance and improvements assessments in the construction industry using performance indicators. The five problems identified are:

1) They focus on post-event lagging key performance outcomes at a very high level that offered little opportunity to change

and were not used by businesses to influence managerial decisions.

2) The key performance indicators did not provide a holistic and company-wide representation of the industry.

3) The key performance indicators were sometimes not aligned to the strategy or objectives of the construction industry.

4) The key performance indicators were not incorporated into measurement systems.

5) The performance indicators were designed for cross-industry benchmarking purposes and lacked certainty in data collected and validation of results.

According to Fewings (2005:97) benchmarking is a method of improvingperformance in an organised and logical way by measuring and comparing your performance against others and then using lessons learnt from the best to make targeted improvements.

The idea behind benchmarking is to compare the performance with another of a known standard. These benchmarks may be based on industry, national or global standards

Fewings (2005:97) identifies the following as the basis for measuring performance in construction:

1) Financial performance, for example, by comparing the profitability or turnover growth ratios against others;

2) Internally set targets which are often based on continuous improvement between projects or on a time line or issued as a target for best practice in the business;

3) Standard targets across industries which represent excellent management achievements, such as the levels of training, business results, and customer satisfaction, and

4) Benchmarking against other competitors in the construction industry who are carrying out similar activities, and who are the best in class.

1.2 Contractor Selection and Evaluation

Kwakye (1997) posits that the methods used during the selection of contractors can be described as either by competition or by negotiation. In either case, the decision taken

should reflect the client's development aims – i.e. the completion of his or her construction project economically, safely, quickly to the required quality and at a profit.

Contractor selection is a major project success factor. Owners would be able to clearly identify their requirements and select the builder that is best qualified to complete the project. The competencies of the contractor have been identified as very critical. This is an issue of extreme importance to the construction industry because a qualified contractor can ensure delivery on time, within budget and meeting the owner's expectations (Sidik, 2010).

The contractors' financial capabilities, effective implementation of project planning, design and construction within a build environment are crucial elements that should be considered by owners when procuring for a building project.

According to Mbugua *et al.*, (1999), performance indicators specify the measurable evidence necessary to prove that a planned effort has achieved the desired result. In other words, when indicators can be measured with some degree of precision and without ambiguity they are called measures. However, when it is not possible to obtain a precise measurement, it is usual to refer to performance indicators.

In response to calls for continuous improvement in performance, many performance measurements have emerged in management literature. Some examples include: the financial management measures (Kangari *et al.*, 1992; Kay 1993; Brown and Lavenrick1994; and Kaka *et al.*, 1995), client satisfaction measures (Walker, 1984; Bititci,1994; Kometa, 1995; Harvey and Ashworth, 1997; and Chinyio *et al.*, 1998),employee measures (Bititci, 1994; Shah and Murphy, 1995; and Abdel-Razek, 1997),project performance measures (Belassi and Tukel, 1996) and industry measures(Latham, 1994; Egan, 1998; Construction Productivity Network, 1998; and Construction Industry Board, 1998); as cited in (Mbugua *et al.*, 1999).

To the client, Nassar (2009) mentioned that best value for money would be achieved since the project stands the chance of being delivered on

schedule to and to quality standards as spelt out in the contract specifications. Also, performance measurement provides the client with an objective and consistent means of implementing pre-qualification process since performance information of different contractors would be available for comparison and selection.

To the consultant, Nassar (2009) mentioned that performance measurement will help the consultant to know specific areas of the contractor's performance to focus during construction supervision to ensure a smooth implementation of the project. Performance measurement provides the consultant with reliable, accurate and consistent means to assess contractor performance.

To the contractor, Nassar (2009) again mentioned that performance measurement will provide the contractor with an objective assessment of performance with strength and weaknesses pointed out. Also, the contractor will know which areas need strengthening in order to improve performance.

Furthermore, performance measurement would help the contractor to institute improvement measures which can lead to an increase in quality of work, cost effectiveness and efficiency of operations. Performance measurement has also assisted in productivity measurement and benchmarking (Alfeld, 1988, Alarcon et al, 2001).

2. MATERIALS AND METHODSSTUDY AREA

The research was done in the New Juaben Municipality. The New Juaben Municipality is located in the Eastern Region of Ghana. The main occupation of the economically active population in the Eastern Region is Agriculture and its related activities. Sales, production, transportation etc. are also the account for the employment of the active population.

Within the New Juaben Municipality, Professional and Technical Services, Sales, Production, Construction etc. form the dominant occupation of the economically active part of the population. The Association of Building and Civil Engineering Contractors of Ghana (ABCECG), Koforidua Branch has

forty (40) members who undertake works in the related fields.

2.2 Research Methodology

In this research work both primary and secondary sources of data collection were used. The various methods used were based on field survey, structured questionnaires, site meetings and personal interviews.

a)   Literature Review

Works done by other researchers in the field of contractor performance in the construction industry and other relevant documents were reviewed. This guided the research team in selecting the best methods for the research from which salient conclusions and recommendations were drawn.

b)   Primary Data Collection

Under the primary method of data collection, information was collected from various contractors, consultants and clients. The primary data collection helped the researchers to get first-hand information. The following methods of data collection were used in the research:

(ii)   Field Survey: the researchers visited various construction sites, offices of consultants and clients to obtain basic information for the work to be done.

(iii)   Structured Questionnaires: Questionnaires were sent out to seek information. The questionnaires survey focused on:
1. Assessment of the criteria for selection of construction contractors in Ghana;
2. Identifying factors that affect the performance of construction contractors;
3. Obtaining information to help develop a framework for assessing the performance of construction contractors;
4. How clients and consultants perceive the performance of construction contractors?
5. What should be the criteria for evaluating the performance of building contractors in Ghana?

(iv)   Interviews: key informants and personnel were interviewed to share their experience and knowledge with the researcher.

3. RESULTS AND DISCUSSION

Data Analysis

Statistical methods were used for the analysis of the data obtained from the tests. This gave a more scientific basis for the conclusions and recommendations derived.

The respondents were made up of consultants, clients, contractors and the general public. The distributions of the number of respondents contacted are shown in table 1 below:

Table 1: Characteristics of Respondents

S/N	TYPE OF RESPONDENTS	NUMBER OF RESPONDENTS CONTACTED	QUESTION NAIRES RETURNED
1	Consultants	9	7
2	Clients	60	45
3	Contractors	45	35
4	Public	60	45

Out of nine (9) consultants who were contacted, seven (7) responded to the questionnaires and returned them. Sixty (60) clients were contacted with a set of questionnaires but forty-five (45) completed the questionnaires and submitted. Out of the submitted questionnaires from the clients, only thirty (30) was useful for analysis.

Forty-five (45) contractors were contacted and thirty-five (35) returned the set of questionnaires. Only twenty-nine of the submitted questionnaires were useful in the analysis. Sixty (60) members of the general public were contacted and forty-five responded to our questionnaires but forty completed questionnaires by the public were very useful.

a.   Experiences of the Respondents in the Construction industry

Consultants

The consultants that were contacted were General Consultants, Quantity surveying consultants and Architectural consultants. Civil engineering consultants were not contacted due to the non-availability of such firms. The representation of the consultants is shown in table 2 below:

Table 2: Consulting Firms

Type of Consulting Firm	Frequency	Percentage (%)
Architectural	3	48.86
Quantity Surveying	2	28.57
General Construction	2	28.57
Total	7	100

The consultants have been operating within the municipality for more than a year. Twenty percent (20%) of the consulting firms have been in operation for a period between 1-5 years, while sixty percent of the consulting firms have been operating between 6-10 years.

However, another twenty percent of the consulting firms have been operating for over twenty-one years. These consultants have a lot of experience on the construction industry in the municipality, considering their years of experience.

About forty percent (40%) of the consulting firms contacted have been working on between 1-5 projects within the last five years. Another twenty percent have been working on between 6-10 projects in the last five years. Within the last five years, twenty percent of the consultants have been working on more than sixteen projects.

Clients
The clients that were contacted were made up of Public sector institutions and the Private Sector. The representation of the clients is shown in table 3 below:

Table 3: Clients

Type of Client	Frequency	Percentage (%)
Public Sector	20	44.4
Private Sector	45	55.6
Total	**45**	**100**

The clients have been using the services of building contractor in the municipality as a means of improving infrastructure. The building contractors have been undertaking

new projects, refurbishment and maintenance of old structures.

The level of usage of the services of building contractors with a set of years have been shown in table 4 below:

Table 4: Clients' Level of usage of Service of Building Contractors

Years	Frequency	Percentage (%)
1 – 5	10	25.93
6 – 10	10	29.63
10 – 20	9	33.33
21 years and above	7	11.11
TOTAL	**45**	**100**

Contractors
The contractors that were contacted do undertake projects in General Construction, Road works and Building Construction. The representation of the contractors is shown in table 5 below:

Table4: Construction Firms

Type of Construction Firm	Frequency	Percentage (%)
General	25	71.40
Road works	5	14.30
Building	5	14.30
Total	**35**	**100**

General Public
All the members of the public that were contacted have observed some construction works going on within their vicinities. The respondents indicated that, about seventy-five percent (75%) of the construction works were being undertaken by private developers.

The observations of the respondents are shown in table 6 below:

Table 6: General Public

General Public	Frequency	Percentage (%)
Public Sector	11	25
Private Sector	34	75
Total	45	100

3.2 Criteria for Selection of Building Contractors

Interviews conducted with the stakeholders (consultants, clients and contractors) revealed that cost is the decisive factor based on which the contractor is selected. Contractors' capabilities to deliver a project on time, within budget and satisfactorily complying with requirements are not highly considered during the contractor selection process.

The findings above is consistent with Marwa (2003), who stated that although the reasoning behind the competitive approach to contractor selection is to allow free market competition and resulting in better value for the client's money, this competitive approach sometimes leads to the acceptance of the lowest cost non-competent contractor.

Construction contractors in Ghana are classified into eight (8) categories. The classification is in accordance with the works undertaken by the contractor. The contractors are classified as A, B, C, D, E, G, K and S. The works undertaken by the contractors are:

(i) Roads, Airports, and Related Structures (A);
(ii) Bridges, Culverts and other Structures (B);
(iii) Labour based road works (C);
(iv) Steel bridges and structures: construction, rehabilitation and maintenance (S);
(v) General building works (D);
(vi) General civil works (K);
(vii) Electrical works (E); and
(viii) Plumbing works (G).

The contractors in each category are grouped into 4, 3, 2 and 1 financial classes in increasing order (Vulink, 2004 as cited in Ofosu and Owusu (2013), Dansoh, 2005). In addition, Dansoh (2005) notes a combined category of AB for road contractors. According to Dansoh (2005) as cited inOfosu and Owusu (2013), Class 4 contractors can tender for contracts up to $75,000; class 3 up to $200,000; class 2 up to $500,000. Class 1 take contracts of all amounts. The two upper classes (D1 and D2) are more organised and hence more stable, taking on both bigger and smaller works.

When selecting a contractor, a client and consultant evaluatethe contractor's qualification (checks whether it meets specified financial, economic, legal and technical requirements) and compares qualification of different contractors (Nerija and Audrius, 2006). Contractor selection involves the making an optimum choice for the best contractor for a given project.

3.3 Assessment of the Performance of Construction Contractors

A) Consultants
About eighty percent of the consulting firms contacted indicated that, they had no knowledge of any performance assessment mechanism for building contractors in Ghana. However, twenty percent indicated their knowledge of a contractor performance assessment mechanism. Further investigation showed that, the contractor classification by the Ministry of Water Resources Works and Housing was taken as a means of assessing the performance of the contractors.

B) Consultants
About eighty-one percent of the clients who responded to the questionnaires indicated that they have no knowledge of any contractor assessment criteria. All the clients however think that there is the need to develop a performance assessment mechanism for contractors in the construction industry.

The clients however indicated that the performance of the contractors on some of their projects was satisfactory. This is because, the contractors were able to construct the structures based on their requirements and the specifications of the consultants and not because there is a set of assessment criteria.

C) Contractors
About sixty percent of the contractors pointed out that there is a contractor performance assessment criteria. Further enquires revealed that the contractors were referring to the classification of contractors. This showed that the contractors contacted did not know of any performance assessment criteria in the Ghanaian construction industry.

D) General Public
The opinions of the public was divided over the performance of construction contractors. In spite of the split opinions, members of the public that were contacted indicated that they

were not aware of any performance assessment mechanism of construction contractors.

3.4 Factors that affect the performance of construction contractors in Ghana

Based on the findings of other research works, the stakeholders in the construction industry were given the opportunity to rank factors that they would use in assessing the performance of contractors.

The stakeholders provided a list of factors that should be used in evaluating the performance of the construction contractor. The ranking of the factors (from most important to the least) differed but the following were within the top five ranks:

- Time management by the contractor;
- Management of site personnel and equipment;
- Management of sub-contractors, consultant, clients and other suppliers;
- Standard and quality of work and
- Environmental management.

The various stakeholders in the construction industry who were contacted gave their opinions on how the performance of contractors can be affected by the factors above.

1.   Time Management by the Contractors

All the clients were of the opinion that if the contractors were able to execute the projects within the set time as required their performance rating can be high. The consultants indicated that if the ability of the contractors to formulate and maintain practical programmes as well as putting creativity and innovation in their project delivery would enhance their performance.

The contractors however said that duration set out by the clients and consultant should be reasonable enough to ensure high quality work done. Also effective risk management should be adopted by the clients and consultants. Management of activities that can lead to delays and financial losses should be reduced to the minimum.

2.   Management of Site Personnel and Equipment

The consultants contacted indicated that a contractor who ensures a better site management practices can be rated as a very

good contractor. Also if the contractor is able to enhance the welfare of the workmen as well as prevent labour strikes and lock-outs on site, that contractor can be noted as good contractor.

The contractors were of the opinion that a very good organizational structure as well as adequate provision for the welfare of the workmen on site as well as proper plant and equipment management would help improve the performance.

The clients and the public were of the view that a very good contractor should have a welcoming site, dexterous workmen and machinery.

3.   Management of Sub-contractors, Consultants, Clients and other Suppliers

All the stakeholders were of the opinion that a very good cooperation between the stakeholders in the construction industry would enhance the performance of contractors. Also, an effective communication line between all the stakeholders is very essential. It helps in reducing delays, friction between stakeholders and ensures information sharing.

The contractors had the opinion that, very good relationship between the sub-contractors, suppliers and access to credit from financial institutions contributes significantly to the performance.

4.   Standard and Quality of Work

The consultants interviewed were of the opinion that the quality of work executed by the contractors depends on the experiences of the workmen. The consultants further intimated that a very good contractor should have minimum defects to correct.

The clients and consultants were of the view that, a contractor who responds promptly in the correction of defective work on structures has a higher performance rating than the contractor who does not correct defects.

According to the contractors, the ability of the contractor to execute projects that meets the satisfaction of clients and consultants is essential in assessing the performance of the contractor.

5.   Environmental Management
All the stakeholders were of the opinion that the adoption of very good environmental management systems on site can be used as criteria for assessing contractors. The environmental management practices should lead to a minimal effect of the construction activities on the environment and therefore should be used as assessment criteria of building contractors.

The contractors shared that a very well kept working environment reduces site injuries. Also proper management of construction materials reduces wastages, saves cost and thereby reduces environmental degradation.

3.5   Challenges that affect the Performance of Construction Contractors in Ghana
Site meetings, discussions and interviews which was undertaken as a follow-up to the questionnaires disseminated, revealed that construction contractors in Ghana encounter a couple of challenges that sometimes inhibit their performance. Some of the major challenges outlined by the contractors are:

1. Access to funds and delays in payments for work done
2. Incomplete project documents especially the drawings
3. Modification of designs at short intervals
4. Access to skilled workmen for a long period of time
5. Rising cost of goods and services in the construction industry
6. Bribery and corrupt practices during the award of contracts.

These challenges were consistent with the findings of Osei-Tutu *et al* (2010) and Laryea (2010).

3.6   Benchmarks for Assessing Construction Contractors in Ghana
It is important for an establishment to compare itself against what is perceived to be best practice in the industry. This benchmarking can be achieved both for a performance metric and for a particular goal or perspective.

The research hence sets the following as benchmarks that can be used for assessing the construction contractor:

a) Client satisfaction with product and services provided by the contractor
b) Defects – reduction in defects during the use of facilities and the rapid response to correct them if the need arises
c) Predictability – the contractors' ability to perform at an agreed cost and time provided variations are reduced or avoided.
d) Safety – the provision of a safe working environment and working conditions for workmen

The assessment of the construction contractor can be implemented using the concept in figure 1 below:
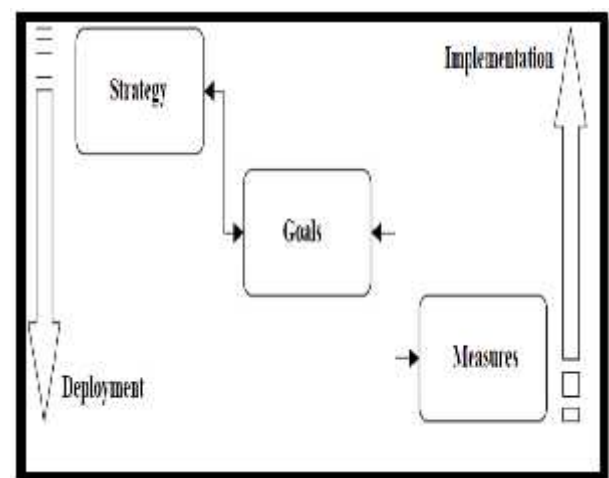

Figure1: Concept for Assessing Construction Contractors

4.   CONCLUSIONS AND RECOMMENDATIONS

4.1   Conclusion
The selection of construction contractors for both public and private projects are dependent on the cost of the project before the capabilities to deliver the project on time, within budget and satisfactorily compliance with requirements are considered.

There is no laid down criteria for assessing the performance of construction contractors in Ghana and the level of acceptable performance is determined by the perception of the individual doing the assessment.

The factors that can influence the performance of a building contractor include:

- Time management by the contractor and consultant;
- Management of site personnel and equipment;
- Management of the interactions between the sub-contractors, consultant, clients and other suppliers;
- Standard and quality of work expected and
- Environmental management.

4.2   Recommendations

Based on the research, the following are recommended to help in the assessment of construction contractors in Ghana:

There is the need for capacity building of the construction contractors and their workmen so that performance can be improved. This can be enforced by various contractor associations and the supervising ministry.

Consultants and clients should ensure prompt payment of contractors for work done. This would help the contractors to improve their cash flow and to maintain skilled workmen.

There should be adequate collaboration between the stakeholders in the construction sector (clients, consultants, contractors and suppliers) to enhance the performance of the construction industry in the provision of the needed infrastructure.

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Pro-social Behaviour of Students of Tertiary Institutions: An Explorative Study Comparing Private and Public Universities

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Abstract

The purpose of this paper was to explore the Pro-social behaviour amongst students, making a comparison between Private and Public Universities in Ghana. A cross-sectional survey of Private university and Public University students was conducted. A total of 600 questionnaires were distributed out of which Private university students (N=125) and Public University (N=146) were returned. Thus the response rate was approximately 45%. The use of a structured questionnaire was used as the tool of data collection. Descriptive and inferential statistics, such as T-test was used in the analysis of the data, using SPSS (4th edition, version 18).The results showed that there was no significant difference in the level of pro-social behaviour among students in Private universities and those in Public universities. Students in the two institutions showed a considerable level of pro-social behaviour. Universities must not always look at the negative sides of students but should look at the positive side as well. Accordingly, interest in this area of study of pro-social behaviour must be enhanced, especially among educational institutions. The promotion of pro-social behaviour among students of tertiary institutions especially will make them adapt progressively to society, including that of tertiary institutions. Some changes in the curricula could be made to include elements of pro-social behaviour. Further research is recommended in the main text. The research is limited based on the fact it only explored the pro-social levels. A more in-depth study to look at what motivates students to act pro-socially and also how and even why they do so would further enrich the study.

Keywords: Pro-Social Behaviour; TertiaryDucation; Students' Education Administration Management; Disaster Management; Culture of Maintenance

1. INTRODUCTION

Zahn-Waxler and Smith (1992), showed that through helping and volunteering, young people can satisfy their own needs, learn about and express their values, understand their world, gain career-related experience, and strengthen social competence and relationships.

Pro Social behaviour refers to any behaviour where interaction occurs between two or more people. It may include, smiling at someone, voluntarily opening a door for someone to pass etc. Pro-social behaviour is positive. Anti-social behaviour is negative .Pro-social behaviour has been linked to national development in Malaysia (Leong, 2003).

A lot of the time we focus on the anti-social behaviour of people. For tertiary institutions the focus is on that of students' anti-social behaviour such as examination malpractices, rioting and destruction of school infrastructure, whether consciously or sub-consciously. There are cost consequences for such actions, such as monitoring and maintenance costs.Tertiary institutions have to

do intensive supervision during examinations in order to avoid examination malpractices, resulting in monitoring costs, such as opportunity cost of staff time and real cost of staff monitoring allowances. They also have to pay for replaced items of destruction,after student rioting. It is therefore not surprising that most educational research has focused on the phenomenon of anti-social behaviour. Anecdotal evidence shows that few of educational research have looked at the other side of the coin: Pro-social Behaviour, especially that of students of Tertiary institutions in Ghana. I have looked through the literature and contacted some professors in Ghana who affirm to this. Where literature exists, most research on pro-social behaviour has been focused in the United States and Europe, to date. There are potential intangible benefits of the pro-social behaviour of students. Pro-social development is closely linked to various positive developmental outcomes for young people including academic success, positive self-worth, positive relationships with

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others, and higher social competence (Penner, Dovidio, Piliavin, and Schroeder, 2005.) Therefore knowing the status quo of undergraduates' Pro-social Behaviour in different situations, analyzing the influencing factors, and exploring the ways of cultivating the undergraduates' Prosocial Behaviour have a very important significance in the moral education of undergraduates and the construction of campus culture, the cultivation of social and spiritual civilization and the building of a harmonious society (Eisenberg et al., 1990).

The aim of this paper was to explore the tendency of students of tertiary to engage in pro-social acts, making acomparative study of students in Private and Public universities in Ghana.The private universities comprised the Ghana Christian Service University, Ghana Christian University and Ahmadiya Muslim University whilst the Public universities comprised The University of Ghana and Kwame Nkrumah University of Science and Technology. The motivation for making a comparison was that the author had sighted a difference in the structure of the module descriptors of the universities: whilst the Christian and Muslim universities had factors such spirituality and ethical values in their syllabus, the public universities had no such factors. Thus, the comparative study is been done in order to show, expectedly, different perspectives on the issue (Creswell, 2007). Spirituality and values are some of the factors that have been identified as having a positive relationship with Pro-social behaviour, as the literature review will show. The remainder of this paper includes the research objectives, the literature review, methods used, discussion and conclusion in that order.

1.1 Research objectives
The research objectives are as follows:
1) To explore the level of pro-social behaviour amongst students of Private Universities and that of Public Universities
2) To make any suggestion for further research.

1.3 Literature review
Pro-social behaviours are actions that aim to fulfil another person's need for support or to promote and sustain a positive benefit for them (Bar-Tal, 1982). It is the voluntary actions that are intended to help or benefit another individual or group of individuals. This definition refers to the consequences of a person's actions, motivations and their behaviour; behaviours which include a broad range of activities: sharing, comforting, rescuing, and helping. There are many different factors that influence this behaviour, that affect one's decision to give, share, and help. However, investigators have shown that there are different types of pro-social behaviours and that these types are related differently to theoretical constructs (Batson, et al, 1991).Eisenberg et al (1999) identifytwo types of pro-social behaviour, namely, altruism and public pro-social behaviour.Altruistic pro-social behaviours were defined as voluntary helping motivated primarily by concern for the needs and welfare of another, often induced by sympathy responding and internalized norms/principles consistent with helping others (Eisenberg and Fabes, 1990). With this kind of pro-social behaviour, because the helper is primarily concerned with the needy others' welfare, this behaviour sometimes incurs a cost to the helper. Although scholars have debated whether altruistic behaviours exist, there are at least three lines of evidence that support the existence of altruism (Eisenberg et al., 1999). First, researchers have presented evidence of the heritability of sympathy(Batson. & Shaw, L. L1991) which is deemed evolutionarily adaptive. Second, there is longitudinal evidence of stability in the tendency to behave in a pro-social manner across childhood and adolescence (Gilbert. and Fisk, (2004). And third, researchers have found significant associations between personality variables and pro-social behaviours across different contexts (Eisenberg and Fabes 1990). Public pro-social behaviour is the type in which people are motivated to behave in a progressive manner when in public, at least in part, moved by a desire to gain the approval and respect of others such as parent and peers and also to enhance one's self-worth (Eisenberg and Fabes, 1990). One common manipulation in research on pro-social behaviour is to alter whether others serve as witnesses to the potential Pro-social act (Penner, Dovidio, Piliavin, and Schroeder, 2005). Researchers have shown that helping conducted in front of others is sometimes associated with self-oriented motives, although other researchers have pointed out that social desirability

concerns are not necessarily incompatible with pro-social behaviour (Bar-Tal, (1992).

1.3.2 Predictors of pro-social behaviour

Authors who have done some work(s) on Pro-social behaviour identified volunteerism as a predictor. Penner, Dovidio, Piliavin, and. Schroeder, (2005) define(s) volunteerism as volunteering which involves pro-social action in an organizational context, which is planned and that continues for an extended period. They continued to say that volunteerism differs from interpersonal helping in many ways, but the most important of these differences is that, relative to interpersonal helping, volunteering is less likely to result from a sense of personal obligation (Eisenberg and Fabes, 1998). That is, whereas most acts of interpersonal helping involve a sense of personal obligation to a particular person, volunteering to work for a charity or service organization is typically not motivated by such considerations.

Another predictor was Empathy. Empathy or emotional perspective-taking is generally defined as our ability to understand other people's feelings (Penner, Dovidio, Piliavin, and. Schroeder (2005). A more specific definition is proposed by Eisenberg.and Fabes(1990).In their view, empathy can be defined by a set of four conditions: we empathize with others when we have (a) an affective state, (b) which is isomorphic to another person's affective state, (c) which was induced by observation or imagination of another person's affective state, and (d) when we know that the other person's affective state is the source of our own affective state. Condition (a) is particularly important as it helps to differentiate empathy from mentalizing, which denotes, instead, our ability to represent others' mental states without emotional involvement, they concluded.

1.3.3 Antecedents of Pro-social behaviour

Various articles have been written on the antecedent factors of pro-social behaviour. For the purpose of this article, I wish to categorize these under the following: Cultural factors, Situational factors, Psychological factors and Gender Factors.
Cultural differences, in relation to pro-social behaviour, are expressed differently between individualistic and collectivistic societies: for instance; someone living in the U.S. is least likely to help someone in need than someone living in Australia, India or Kenya.

Collectivist cultures tend to have extended family structures in which children take responsibility for younger siblings from an early age (Whiting & Whiting, 1988) .According to Whitting and Whitting (1988) individualist and collectivist cultures help others for different reasons. For Individualist society,helping is motivated by personal rewards e.g. feeling good about one self. For collectivist societies' helping is motivated by continued survival of group (possible future reciprocation)

Under Situational Factors, Zahn and Smith (1992) investigated differences between people in two cities and four small towns in Turkey. A variety of methods were used to assess helpfulness, such as willingness to change money or participate in a short interview. It was found that helpfulness was higher for people in small towns than for people in large cities.

Based on his information overload theory, Eisenberg (2006) found out that people in urban environments, e.g. large cities, are exposed to excessive environmental stimulation and are so familiar with emergencies that they treat them as everyday events. To cope with this high level of stimulation, people screen out events that are not personally relevant to them. This results in people in urban areas having a more indifferent attitude to others' needs, causing lower levels of pro-social behaviour. What one learns from here is that people living in the city areas are constantly being bombarded by simulation and that they keep to themselves to avoid being overwhelmed by it. Under Psychological factors Roland and Jean Tirole. (2003) identified
  i. Intrinsic,
  ii. Extrinsic and
  iii. Reputational motivation

Intrinsic motivation is defined as the inner good feeling of the individual associated with pro- social behaviour act. This feeling is represented by the well being of others, such as altruism. Altruism is an example of intrinsic motivation. Extrinsic motivation represents any material reward, such as financial compensation or a tax reduction, that an individual may receive which encourages more

giving(Benabou, Roland and Jean Tirole., 2003). Finally, reputational motivation refers to the aspect of public recognition on the decision of the individual to make a donation. Whether individuals are interested in improving their social image in a community, whether they give expecting something in return, or whether they are ashamed to be perceived as selfish by others, studies emphasize the aspect of striving to signal traits that are deemed as "good" within a community on the decision of the individual to give.

An individual will make charitable contributions only if this action sends the `right' message to his/her immediate network of friends. This action either represents his/her trademark image or improves his/her overall perception in the community. In the same way that individuals learn to be concerned with how others perceive them, they also learn to be concerned with the way they see themselves, according to Akerlof and Kranton (2000). Under Gender Factors,
Gender is one of the most consistent correlates of pro-social behaviour. Across many studies, girls and women have been found to be more pro-social than boys and men (Whiting & Whiting, 1988). For example, peers and teachers have been found to describe preschool-age, kindergarten-age, and elementary school-age girls as more pro-social than boys (Akerlof and Kranton, 2000).

Eisenberg &, Murphy (2008) conducted a meta-analysis of 16 studies. The study found strong, consistent gender differences, with females showing greater empathy. Byrnes, Miller, and Schafer (1999)alsofound that females also typically feel greater guilt feelings than males, and they spend longer thinking about the incident that caused these feelings of guilt. A meta-analysis of 99 investigations found that men are more likely to intervene in an emergency. 62 % of the studies of a stimulated emergency showed that, males were more helpful.
Females have more altruistic tendencies; however, males prefer to behave pro-socially more in public areas (Flynn & Slovic, 1994).
Based on stereotypic gender roles, females generally are expected and believed to be more responsive, empathic, and pro-social than males whereas males are expected to be relatively more independent and achievement oriented (Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972; Parsons & Bales, 1955: ,Flynn, Slovic, & Mertz (1994). Whiting et al (1988) also found that helpfulness and support giving generally were greater for girls than boys across six different cultures, although these differences were significant for older but not younger children. Esienberg (2006) has suggested that women display more empathy and guilt, and men are more likely to intervene in an emergency.

According to Batson & Powell, (2003) men have evolved a 'fight or flight' response to threatening situations, so they take a protective role. This is called nurturing versus heroic altruism. Also, men may behave heroically to fit in with male stereotypes that have been acquired through socialization. Whiting et al (1988) found that men may help because the cost of helping is low and the cost of not helping is high. They are expected to help in an emergency situation and may be negatively evaluated if they do not.

A number of researchers have found gender differences for perceived risk (Flynn, Slovic and Mertz, 1994), and indeed, it has been argued that males are more likely to take risks than females (Byrnes, Miller and Schafer, 1999). In fact, Byrnes et al., (1999) found that males took more risks even when it was obviously a "bad idea to take risks" (p.378). In the context of perceived risk and Environmental issues, Byres et al also found females reported significantly higher perceived risk scores for a range of environmental hazards than males. Given these findings, it seems that the manner, in which people evaluate the risk associated with engaging in positive social issue behaviour, that is social issue exchange, may be related to some extent totheir gender.

Commonly held stereotypes and popular culture suggest that women have a greater capacity for understanding others' thoughts and feelings than do men (Gilbert and Fiske, 2004). Also, empirical researchers have found that gender differences in empathy commonly indicate that women have higher levels than do men (Batson. and Shaw, 1991)Further, research indicates the possibility that these differences may be the result of motivation rather than ability (Batson and Powell, 2003).

2. METHODOLOGY

A survey of Private university (involving a Christian and Muslim institution) and Public University students was conducted. Six hundred questionnaires were distributed outof which Private university students (N=125) and Public University (N=146) were returned. Thus the response rate was approximately 45%.

With the assistance of the students' representative councils of the various universities, the questionnaires were placed at the various halls of residence for over a period of six months. The questionnaires were culled from the works of Donella Caspersz and Doina Olaru.(Donella.Caspersz@uwa.edu.au)
Students were asked to score on a scale 1-6 whether they were unlikely or certainly to engage in pro-social activities. A T-test was used to compare the mean score on the continuous variable of Pro-social activity.A copy of the questionnaire is attached as Appendix A.

3. RESULTS

A descriptive and inferential statistics attached at the end of the script:

3.1 Interpretation of results

The independent –samples t-test showed that there was no significant differences in scores for Private (MEAN=36.8,SD=2.9) and Public(MEAN=3.44,SD3.6). F value was 1.011 with a significant value of .316, which is above the threshold of .05 alpha values.

4. DISCUSSION

The inferential statistics shows that, there is no significant difference between the level of pro-social behaviour between students of Private universities and that of the Public university students. The significant level.316 (which is above the alpha level of .0) confirms this. The curriculum of the private universities which shows such elements, such as values and spirituality (which,partly, prompted the research) might not be making much difference in the pro-social activity of their students as compared to the public universities which do not have these. In our everyday life, we (including the students) engage in such actions like donating, sharing, comforting, expressing sympathy, helping, and providing physical assistance and support to others, often at a cost

to ourselves. Universities must not always look at the negative sides of students but should look at the positive side as well. Accordingly, interest in this area of study of pro-social behaviour must be enhanced, especially among educational institutions. The development of the pro-social behaviour of students can have a decisive impact on the improvement in the tertiary institution activities or task, such as infrastructural maintenance and disaster management.

A major hurdle for most governments in power is the maintenance of the infrastructure in government institutions, including educational institutions. In the March 20, 2012 Edition of the Daily Graphic, Mr Kwesi Ahwoi, Minister of Food and Agriculture then, bemoaned the lack of a maintenance culture in the country which was causing the nation a great deal of resources which could have been channelled into development projects. Mr Ahwoi, an Old Boy, was addressing the 82nd Speech and Prize-Giving Day celebration of the St. Augustine's College in Cape Coast under the theme "The Culture of Maintenance as an integral part of Infrastructural Development"

A high level of culture of maintenance is likely to occur in those students who have a high level of empathy. Female students tend to have that culture because of their high level of empathy compared to male students. The evening student showed empathy for the institution and so decided to act on its behalf in order to reduce cost of electricity and rate of depreciation of fittings. Female students are therefore targets for infrastructural maintenance management. Pro-social behaviour of the public type is likely to occur in male students because of their high level of volunteerism, especially in disaster situations. Video shootings of people engaged in voluntary disaster relief activities, as we see them in the media, show the majority to be men as compared to women. When planning for disaster management, institutions should target the male population of students.

Students on campus are potential assets for tertiary institution. The promotion of pro-social behaviour students of tertiary institutions especially will make them adapt to society, including that of tertiary institutions. In that case knowing the status quo of students'

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Prosocial Behaviour in different situations, analyzing the influencing factors, and exploring the ways of cultivating the students' Prosocial are vital. Pro- social behaviour has a very important significance in the moral education of students and the development of campus culture, the cultivation of social spiritual civilization and the building of a harmonious society. However, it will require a strong organizational cultural leadership to successfully implement this.

5. CONCLUSION

The study explored the level of pro-social activity among students of Private universities and that of the public. Using a survey, which was assisted by statistical software, SPSS17,the author was able to quantify and interpret results of the pro-social activity of the institutions. There was no significant difference in the level of pro-social activity Discussion were made based on the results. of the study. The research has limitations based on the fact that, the use of a survey alone was not able to describe what, how and why students engage in pro-social activities. Further research, delving into the 'what' and 'how' is recommended for future research.

APPENDIX B- Table of results

Table 1: Group statistics

Group Statistics						
	UNIVTYPE	N	Mean	Std. Deviation	Std. Error Mean	
TOTROSOC	1 PRIVATE CHRISTIAN/MUSLIM	125	36.38	2.907	.260	
	2 PUBLIC	146	35.44	2.647	.219	

Source : (Author , 2014)

Table 2: independent Samples Test

Independent Samples Test					
		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	T	Df
TOTROSOC	Equal variances assumed	1.011	.316	2.802	269
	Equal variances not assumed			2.782	253.370

Source(Author,2014)

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Determination of Optimal Premiums and Claims for a Health Insurance Mix

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Abstract
One challenge for a Private Health Insurance Scheme which has a segmented market is to get proper premiums and claims mix for the difference policy options in order that it will attract potential subscribers so that returns will be maximized. This study addresses the above challenge by developing a Linear Programming Problem Model which is tested using five different scenarios. The study revealed that while subscribers in the two lower policy levels are attracted by lowering their premiums, those of the highest policy level are attracted by an increase in their claims and an improved quality of services. It is also found that there is a limit to how much the premiums could be decreased. Beyond this limit diminishing returns will set in. The evidence therefore suggests that the Private Health Insurance Firm should within some limits decrease premiums for lower policy levels and increase claims for higher policy levels in other to expand its clientele based while maximizing returns.

Keywords: Linear Programming; Premiums and Claims Mix; Health Insurance; Policy Options

1 INTRODUCTION

Health insurance is generally used as a form of insurance that caters for medical expenses. It is sometimes provided through governments' social insurance policy or from private insurance companies. It may either be purchased by a group, that is, a company could purchase for all its employees and individual customers could also access this facility.

In all cases premiums or taxes are paid by the group or the individual to help protect themselves from payment of high and unexpected health care bills. Health insurance also works by calculating and taking into consideration the overall risk of healthcare expenses and developing a routine structure for financing the program which will take care of availability of money to pay all health care benefits as specified in the insurance agreement. A central body administers the benefits either as a government agency or as a private profit making or a not- for- profit organization.

The basic concept of insurance is that it balances cost across a large sample of individuals.

There are two main types of health insurance schemes: the Social-type Health Insurance Scheme and the Private Commercial Health Insurance Scheme.

The social type Health Insurance Scheme is social in nature and is not profit based. It may or may not receive subsidies from government. Private Commercial Health Insurance refers the health insurance scheme that is operated for profit based on market principles.

Premiums are based on calculated risk of particular groups and individuals who subscribe to it. Thus those with higher risk pay more.

Private Commercial Health Insurance Scheme companies will play a role in offering the minimum benefit package and supplementary insurance plans as an add on for those who desire and can afford to pay. (NHIS Policy framework 2004)

The case study for this research is Nationwide Healthcare. It is an autonomous not-for profit Health Insurance organization based on solidarity among members. The scheme is segmented by three benefit options which enables the choice of one that best suits members' requirement and means. The options are Standard Care, Executive Care and Primer Care.

Nationwide is essentially a mutual fund into which the contribution of all members are paid, and which is utilized to provide health care services for members who so require. Consequential the cost of health care services

for members who so require is spread over the entire membership.

The objective of the scheme is therefore to moderate the financial impact of illness on its members through the vehicle of insurance and to continually improve the quality of healthcare services being provided to it members at the best possible value.

The insurance company should remain in business by ensuring that claims should not exceed total revenue from premiums and other investments. To achieve this, cost of operation must be lowered and/or all revenue collection must be increase by increasing and maintaining large customer base. Again prices must be affordable enough to attract large clientele and at the same time high enough to sustain the business. There is therefore the need to come out with an optimal price model.

This is a problem of mathematical programming whose decision variables are premium and claims of different policy categories.

The primary objective of this research is to formulate a Linear Programming Model, to solve it for an optimal premiums and claims mix and to make propositions to Nationwide based on the model aimed at helping to improve on profitability through expansion of it client base.

The study could help Nationwide Healthcare and other companies in the health insurance industry to improve on their operations. Hence individuals could get better and cheaper Healthcare services by joining such schemes.

Table 1 shows the number of client in the various policy categories for the various years.

Table1: Number of registered clients in the various policy category for the various years

Year	Standard	Executive	Premier
2004	44	9	43
2005	0	4	113
2006	91	122	524
2007	3,751	95	131

Table2: Annual Premium Per head in the various Policy categories for the various years

Year	Standard(GH¢)	Executive(GH¢)	Premier(GH¢)
2004	150	250	500
2005	150	250	500
2006	150	250	500
2007	150	250	500

Table 3 shows annual maximum claim limit and total claims actually paid out in the various categories for the various years.

Table3: Annual maximum claim limit and total claims actually paid out in the various policy categories for the various years.

Year	Maximum Claim Limit per year (GH¢)			Claims Actually Paid Out (GH¢)			
	Standard	Executive	Premier	Standard	Executive	Premier	Total Claims Actually Paid Out(GH¢)
2004	500	1,000	2,000				
2005	500	1,000	2,000	0	1,720	1,950	3,670
2006	500	1,000	2,000	905.93	5,120	1,862.54	7,888.47
2007	500	1,000	2,000	29,126.14	27,613.03	32,804.04	89,543.25

Table 4 displays the overhead cost in the given years.

Table4: Overhead Cost for the various years.

Year	Overhead Cost (GH¢)
2004	-
2005	31,798
2006	11,3894
2007	17,6335

2 METHOD

Optimal premium/claim mix for a private health insurance firm is formulated. In doing so we use available data to construct and solve models for five scenarios. Each scenario will consist of an estimated annual overhead cost, estimated annual total claim, three premiums

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each for a policy category and corresponding maximum yearly benefit/claim and a specific number of subscribers for every policy category. The main aim is to maximize the returns for each scenario taking into consideration the fact that the annual returns is the difference between the annual total revenue and the annual total cost.

Some Assumptions

We assume that there is sufficient price elasticity in the market pertaining to any increase in subscriber numbers in the standard and executive policy categories. This is because subscribers in the lower income groups tend to respond to more to price changes.

Another assumption is that, there is sufficient benefit elasticity in the market pertaining to any increase in the subscriber numbers in the premier policy category. This is because subscribers in the higher income group tend to respond more to benefit changes.

The objective is to maximize returns in different scenarios and see how clients respond to changes in price and claims in the various policy categories.

The Objective Function of the Model

For the purpose of our modeling we define the Returns P as the difference between revenue R and Total Cost C.

The fixed cost will be taken as the overhead cost and the variable cost will be taken as the cost in respect of claims paid out.

Thus,

$P = R - C$

$$= \sum P_i n_i - \sum C_i \alpha_i n_i - C_F$$

Where n_i = Number of Clients in the ith policy category

α_i = The proportion of clients who collected claims in the ith policy category

C_i = The claim collected in respect of the ith policy category

P_i = The premium in respect of the ith policy category

C_F = Annual Overhead Cost (Fixed Cost)

Note that the decision variables for the model are the P_i's and the C_i's which are the premiums and the claims for the various categories.

Constraints

The total claims is at least an estimated value in each scenario.

$$\sum r_i n_i c_i \geq C_{EST}$$

Total returns is at least an estimated value of the overhead cost for the scenario.

$$\sum (P_i - r_i c_i) n_i \geq R_{est}$$

Each premium per head is at most an estimated price for the scenario.

$$P_i \leq P_{est}$$

Each corresponding claim is at least an estimated cost for the scenario.

$$C_i \geq C_{est}$$

A secondary data is collected on premiums, claims, overhead costs and number of clients

from 2004 to 2007 and the Simplex Algorithm in a MATLAB environment is used to capture model parameter and to compute optimal premiums, claims and maximum returns for each of the five scenario.

Estimation of Parametres of The Model

In order to estimate α_i which is the proportion of clients subscribing to the ith policy category and who actually made claims (i.e. fell sick) we use of table 5

The estimated overheads and claims used in the constraints of the various scenarios are generated by using the values in the year 2007 data as references.

Steady increments of multiples of 5% were used to build a series of controlled overheads and claims.

Table 6 has three columns. The second column is list of estimated overheads for the five scenarios and third column is the list of estimated claims for the five scenarios.

Table 5: Calculation of α_i using data extracted from the current year (2007)

	Standard	Executive	Premier
Number of Claimants (a)	787	172	168
Number of clients (b)	3,751	956	731
α_i = a/b	0.21	0.18	0.23

Scenarios	Overheads (GH¢)	Claims (GH¢)
1	185,151.75	94,020.41
2	193,969.56	98,497.57
3	202,785.25	102,974.73
4	211,602.00	107,451.90
5	220,418.75	111,292.06

Table6: Estimated Overhead Costs and Claims for the five scenarios

3   RESULTS

The table below summaries the trends in the various scenarios

Option	Population	Premium GH¢	claim GH¢	Returns	Percentage increase in returns
Standard	4,386	140	500		16%
Executive	1,097	245	1,000		14%
Premier	731	580	2,000		0%
Total	6,214			254,060	
Standard	5,702	130	500		52%
Executive	1,371	240	1,000		43%
Premier	804	500	2,000		10%
Total	7,877			257,020	
Standard	7,698	120	500		105%
Executive	1,851	235	100		93%
Premier	1,105	500	2,005		51%
Total	10,654			260,200	
Standard	10,392	110	500		177%
Executive	2,499	230	1,000		161%
Premier	1,381	500	2,010		88%
Total	14,272			273,970	
Standard	15,588	105	500		315%
Executive	3,749	230	1,000		292%
Premier	2,002	500	2,020		173%
Total	**21,339**			**258,440**	

4   DISCUSSION

Returns is a function of fixed cost and variable cost.

$R= \sum(P_i – \alpha_i c_i)X-C$ where, c_i is the variable cost and C, the fixed (overhead) cost.

c_i is the claim and depends on the number of subscribers. It increases with increasing number of subscribers. If price continues to decrease without corresponding decrease in claims, there will come a point that the returns to the insurance firm will start reducing.

Table 8 displays a list of premium and number of clients in the standard policy category and the corresponding percentage increases and decreases they represent in the various scenarios. The two values (3,751) and (GH¢150) in the first row are the actual number of clients and premium in the current year (2007) from the data. They are the references from which the values in the scenarios are estimated. They are therefore not in any of the scenarios.

Table8: Number of clients and premiums in their corresponding percentage increases and decreases in the various scenarios for the standard policy

Scenario	No. of Clients (x)	Premium (p) GH¢	Percentage increase in (x) (%)	Percentage decrease in (p) (%)
_	3,751	150	0	0
1	4,386	140	16	6.6
2	5,702	130	52	13.3
3	7,698	120	105	20
4	10,392	110	117	26
5	15,588	105	315	30

Using the data from table 3.4.1 we construct a graph for demand curve for the standard policy.

Table9: Number of clients and premiums and their corresponding percentage increases and decreases in the various scenarios for the executive policy

Scenario	No. of Clients (x)	Premium (p)GH¢	Percentage increase in (x) (%)	Percentage decrease in (p) (%)
_	956	250	0	0
1	1,097	245	14	2
2	1,371	240	43	4
3	1,851	235	93	6
4	2,499	230	161	8
5	3,749	225	292	10

Table9: Number of Clients and Claims and their corresponding percentage   increases in   the various scenarios for the premier policy.

Scenario	No. of Clients (x)	Claims (c) GH¢	Percentage increase in (x) (%)	Percentage increase in (c) (%)
-	731	2,000	-	-
1	731	2,000	0	0
2	804	2,000	9.9	0
3	1105	2,005	51.2	0.25
4	1381	2,010	88.9	0.5
5	2002	2,020	173.9	1

Table10:Number of Clients and returns for the various scenarios for the standard policy.

Population	Returns (GH¢)
4386	254060
5702	257020
7698	260200
10392	273970
15588	258440

Table 10 is a list of estimated number of clients and corresponding returns for the standard policy for the various scenarios.

Table11:Number of Clients and returns for the various scenarios for the executive policy.

Population	Returns (GH¢)
956	200000
1097	254060
1371	257020
1851	260200
2499	273970
3749	258440

5 CONCLUSION

The trends in price and returns in the two lower policy categories; and claim and returns in the premier policy category assumed an elastic behaviour. This model therefore becomes valid. This finding has developed a decision making tool (guide) for a Private Health Insurance Firm for the purpose of determining an optimal premium/claim mix.

It was found that, the health insurance firm could increase the returns by increasing their clientele through reduction of premium in the two lower policy categories while increasing the claim in the higher policy category.

These gains are however, within certain limits. In fact, up to a reduction of 26% of premium and 177% the responses at different policy levels are elastic.

5.1   RECOMMENDATIONS

It is recommended that the insurance firm adopt qualitative model such as this to guide a decision making process. The insurance firm must not lose sight of the fact that competitors like the NHIS offers as low as GH ¢3 (minimum) and GH¢13 (maximum) for premium with no maximum claim limit. This is a threat in the sense that they can attract clients of the insurance firm away.

It is also recommended that the health insurance firm must have its own arrangement with the bankers of clients for collection of premium.

This is because clients sometimes encounter emergency situation in certain months and they may not be able to meet the amount (monthly premium) in those months.

Another reason is that, some of the clients are burden with sending money to the insurance institutions.

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Design And Implementation Of Improve Security "TK" Container Lock System.

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Abstract
About eighty percent of Ghanaians in medium retail trade operate in locally made metallic containers secured using mechanical wheel with padlocks. The benefits of improved mechanical lock coupled with the rate at which padlocks are easily destroyed by thieves in the Koforidua municipality necessitated the research to develop a new mechanical lock called "TK" Container lock, an innovation of the mechanical wheel type developed and evaluated at the Koforidua Regional PWD engineering shop. This work aims to design and implement an improved version of the wheel lock system with additional security feature for containers. The TK lock is a fully mechanical, Fail Secure Mode, Multi-directional lock having three stage shifts with interlocks at each shift. This mechanism prevents the reverse of the push rods once engaged. The typical model has a finish size of about 20 cm length, 14 cm breadth and 5 cm thick while the weight is relative, depending on the material. The unit of a Mechanical Pin Tumbler (MPT) cylinder locks with its key, engaging with the inter-locking mechanism as well as the push rod through the dynamics of a pivoted cam. While further work on the TK container lock is recommended and proposed, the present and subsequent works can be adapted to improve security for containers. Obviously, destroying the padlock never guarantee unauthorised entry unless a duplicate key is used (- additional security). Comparatively, it requires less material, less noisy in operation, and easy to maintain.

Keywords: "TK" Container Lock; Fully Mechanical; Fail Secure Mode; Multi-Directional; Mechanical Pin Tumbler.

1.INTRODUCTION
One of the key needs of man is security. This security need has led to various designs of modern buildings having surrounding walls of tall heights to minimize unauthorized entry. Unfortunately, most of these tall walls rather aid burglars in their notorious activities. Others hire the services of watchmen to over see the security of their big retail stores, public and private organizations, companies, departments, all deploy the services of security watchmen, more especially, during the nights with the intention to protect their valuables but many a time, some of these watchmen team up with robbers in their burglary activities in the very homes they are legally paid to protect.

Big supper markets and many commercial banks deploy the use of security cameras in their operating halls. Unfortunately, the deployment of this security device cannot prevent unlawful entry into these facilities.

The use of Barb wires on fence walls is also a common practice; others go a step ahead by providing electrified fences which burglars easily use crook ways to de-energize these wires.

All these peripheral protective methods do not guarantee adequate security. To provide any effective security; designers of security systems must rather target the main entrances and for that matter, the door locks are the centre of security enhancement in our homes and business environments.

With the emerging number of retail container shops springing by the roadside in the Koforidua Municipality, mechanical door lock has become a paramount security system and it is deployed by majority of shop owner not only in Koforidua but country wide. It is common to see many of these container shops reinforce with mechanical wheel locks couple with padlocks.

1.1 **Earlier works**
The wheel container locking system design consists of three main components namely, a "Fork" shape mild steel push rod, an ear lock and a wheel lever unit as shown in figure 18. With the ear lock in the unlock position; the push rod is free to move in either direction when the wheel is turned.

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Under a Lock Position, the drive wheel is turn anti-clockwise to slide the push rod through the lever arm to the engagement position. The
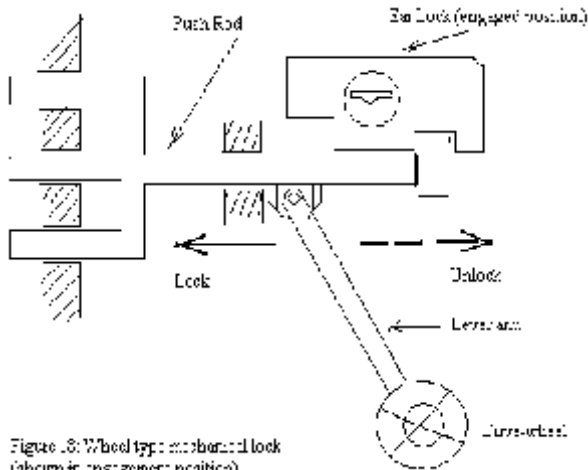
push rod is next secured by turning on the ear

Figure .8: Wheel type mechanical lock (shown in engagement position)

lock unit, which abuts against the end of the push rod to complete the locking process. To unlock the device, the ear lock unit must first be unlocked after which the push rod can be disengaged by turning the drive wheel in the clockwise direction.

The only security feature on this lock design is the ear lock which is easily identifiable from outside which compromise security. An additional enhancement to this is a padlock that locks the hand wheel at rest. The major problem identified with this lock is that it has no internal locking mechanisms and both the padlock and the ear locks are visible from the outside making it more vulnerable.

The 'TK' container lock is Fully Mechanical, Fail Secure Mode, Multi-directional Lock; having four stage shifts with interlocks at each shift to prevent the reversal of the push rods once engaged, and supported with a dynamic cam control unit.

The implementation and adaptation of this improved version of container lock will

provide better security for retail goods sold in container shops, thereby sustaining employment for shop owners and operators as they contribute their quota towards the development of our dear nation.

1.2 Statement of the Problem
The majority of Containers in the municipality are provided with wheel type mechanical locks enhanced with padlocks. While the wheel has no axial internal locking unit to prevent rotation, only an internal ear lock element abuts against the push rod after the shift such that, any destruction of the external padlock render the device unsafe, and therefore more vulnerable. The design therefore lacks 'secrete' security features since both the padlock and ear-lock are easily identified from the outside. This however compromises security, as according to Matt Blaze of (T&T Labs – Research), a good lock design must have 'secrete' security features [1]. The non availability of such features in the wheel lock system is a complete design failure, besides; it is not detachable in design, making it very difficult to repair. Again the bulky wheel defaces aesthetic value but does not connote the intended security.

1.3 Aim
To design and implement a detachable mechanical tumbler container lock system with enhanced security

1.4 Objectives
- To design a lock that incorporates an internal shift mechanism eliminates the use of a push-wheel.
- To incorporate anti-reverse interlock mechanism at each stage shift of the device.
- To ensure that the designed artifact is detachable and maintenance friendly.

3.MATERIAL AND METHODOLOGY
3.1 List of Materials
These are the materials that were selected for the construction of the artifact considering the

fact that under normal condition it will be subjected very minimal load;

1. A piece of 3mm thick Steel Plate
2. A piece of 2mm thick Steel Plate
3. A Compression Spring
4. A piece of 16mm² Steel Rod
5. A Tumbler Cylinder/Key
6. A set of Screws/Rivets
7. Some quantity of Oil Palm

3.2 Tools and Applications

No.	Tool /Equipment.	Applications
1	Engineer's Vice	Holding the pieces of metal during work (cutting/filling)
2	Drilling Machine Bits.	Drilling of holes in plates
3	Bench with filling tool —Tapes, Scribers, Screw Drivers	For marking out of all the plates
4	Hacksaw/Blades.	For cutting poles after marking out.
5	Files.	For filling the cut plates to Shape and Size
6	Hammers	For Punching holes, Straightening, Bending, and Riveting
7	Portable Spraying Gun / Paint	For Spraying the various parts of the Artifact

3.3 Design and Construction

The design and the construction activity were in stages which enabled systematic evaluation of each of the stages; however the design drawings are not to scale. The Design and construction activity was in the following order;

Stage 1: Guide Plate

The Guide plate, was cut to size as specified in the design from the 3mm steel plate and filled to size and shape using the tools indicated in table 1.
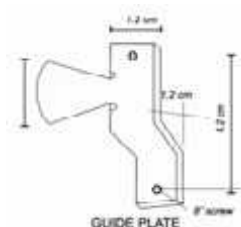

Figure 1 Guide Plate
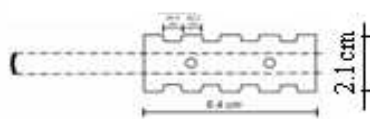
Stage 2: Shift Plate

Figure 2 Shift Plate

The next design was the Shift Plate which was cut to specification from the same 3mm Steel plate and filled to size and shape.

The length of this plate will vary with the number of Shift Stages for the lock. Each slot is at equal distances of 0.6cm, so also are the un-grooved spaces left in-between. The opposite

ends that engages with the tumbler cam was however, further beveled to create 10mm groove which engages with the 6mm tumbler

cylinder cam. The two riveting holes were next created on it using
the drill.

Stage 3: Push Rod and Shift Plate Assembly

The next design was the Push Rod formed from the piece of.

The ''U'' – Shaped bend was formed after cutting the 16mm^2 Steel Rod to the dimensions with the aid of the Vice and a hammer. The arm length is approximately triple the length of Shift Plate. A third arm with the Shift Plate riveted to it was centrally welded to the ''U''- Shape Push Rod.
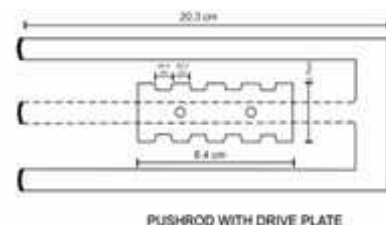

Figure 3. Push Rod


Figure 4. Push Rod with Driver Plate Assembly

Stage 4: Mounting Plate

The next design is the Mounting Plate. This was also constructed from the 3mm steel plate. It

measures about 2/3 of the length of the Push Rod. The length will have to create a clearance of about 2cm with both "U"-arms of the Push Rod, but have three "eye" to locate this three arms of the Push Rod.


Figure 5. Mounting Plate
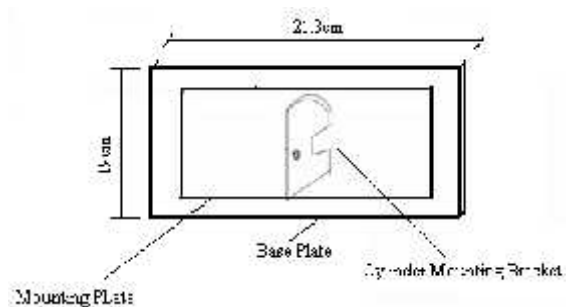
Stage 5. Base Plate

The Base Plate was the next in the design. It was cut from the 2mm steel plate. This should overlap in size, the "**U**"-Shape push rod by approximately 10mm all round and filled to size.

 Figure 6. Base Plate

With the push rod placed at the fully dis-engaged position on the mounting plate, the tumbler cylinder's position is determined as the last beveled shifting groove to the right of the shifting plate. The mounting plate was then grooved at this point to locate the tumbler cylinder.
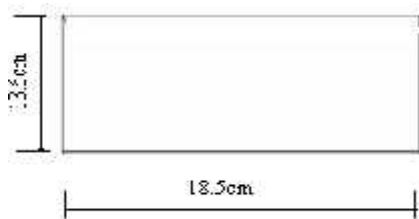
Stage 7: Tumbler Cylinder Mounting Bracket

The Tumbler Cylinder Mounting Bracket shown in figure7 is the next in the implementation. The Tumbler Cylinder mounting bracket is cut to size and formed to shape before riveted next to the groove. The assembled parts on the mounting plate were next screwed onto the base rectangular cover formed from the 2mm steel plate.
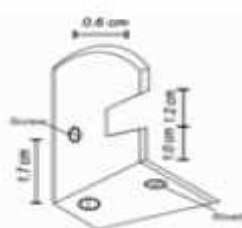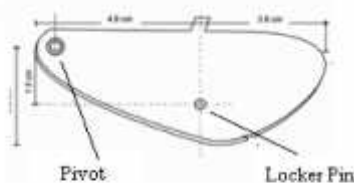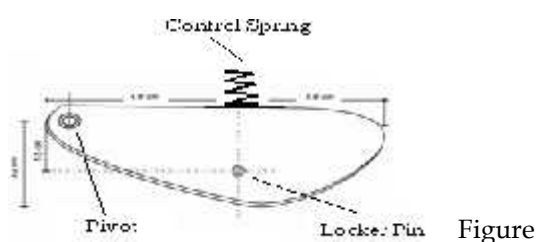

Figure7. Bracket   Figure 8. Parts assembly

Stage 8: The Assembly of Plates

The Tumbler Cylinder Mounting Bracket, the Base Plate and Mounting Plate are shown in a riveted assembly in figure 8.

Stage 9: Interlock Cam and Spring Assembly

Figure

9. Interlock Cam

Figure 9. Complete Assembly of Plates and

The Interlock Cam in figure 9 is cut and formed to shape and size from the 3mm steel plate. It is fitted with a Locker Pin, the position which is such that it locates into the groove of the shift plate. The assembly of the interlock cam is such that it is pivoted at one end, and the free end is subjected to spring force as seen in figure 10. The complete assembly, working together with

the control (compression) spring and the pin operates as a perfect indexing machine. The Interlock Cam therefore locks and un-lock the push rod each time the tumbler cylinder cam disengages or engages with it respectfully.

Stage 9: Tumbler Cylinder/Key
The Tumbler Cylinder/Key acquired for the project is shown in figure 11. This key has been selected among the lot being discussed because

Stage 10: Full Assembly T-K lock
The full assembly drawing of the T-K Tumbler

of the high security required. This is in support of what Sara Robinson said that Pin tumbler locks are very secure and are difficult to pick. [2].This type of key will enhance security and therefore is the most appropriate for adoption in this project work.
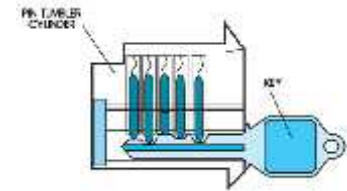

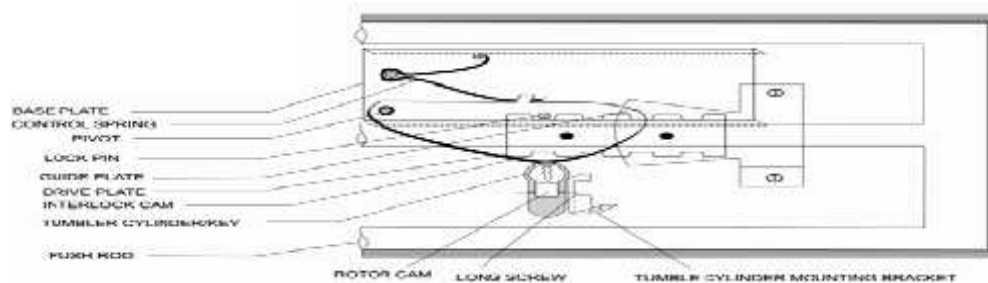
Figure 11. Tumbler Cylinder/Key

Figure 10. Interlock Cam fitted with Compression Spring

Container Lock is as shown in figure 12, while the constructed artifact is shown open in figure 13.

Figure12. Full Assembly of T-K Container lock.

Figure13. Picture of constructed Artifact

4.0: Presentation of Results and Data Analysis

4.1 METHOD
The method adopted to test and evaluate the performance of the completed work was in two stages. The first stage was to subject the push rod at each sifts stage to predetermine vertical

load and evaluate through a thorough observation and physical check the
level of mechanical stress and wear or any deformation it might have undergone. In this

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case, a fully assembled T-K lock was vertically held in a Bench Vice with the
Push Rod shot out to the 1st- stage and a vertical load weighing 40Kg was placed on top of the push rod, for duration of one hour
to observe and evaluate the effectiveness of the anti-reverse mechanism. This was repeated at each shift stage.
The second stage was to subject the lock to a continuous use over a period to under go physical inspection to detect any signs of failures and defects that might occur. In this

case, one year period of observation was considered. The constructed container lock was fitted to a container shop in June 2012 at a location in the Koforidua municipality and has been in use till date. The picture in figure 13 is the container which is locked with the T-K lock. The unit is mounted with hidden screws to butt with the surface of the container. An additional plate with inward hinge at one side is locked with a padlock at the other side such that, it hides the tumbler key slot from public view.

Figure12. A picture of the T-K Container lock in use.

4.2 Observations and Findings
After a thorough observation of the artifact during the first test, the following observations were made:
- Push Pod remained firm without any distortion or any sign of mechanical stress such as bending or dislocation within the assembly.
- The mechanical Interlock remained firm at the engaged position for each of the four shift stages.

During the one year period of use under investigation, the lock has been in continuous use for locking and unlocking the container on daily basis except Sundays and any other days when the shop keeper could not operate the shop. The level of wear and tear that occurred was insignificant that the lock remained effective to date.

5.0 CONCLUSION
The T-K Container Lock designed and implemented had the push rods subjected to a vertical load which weighed 40 kg at each shift stage for all the four shift stages but no sign of any deformation or distortion was detected. The objective of the paper was to improve the existing Mechanical wheel by introducing internal security lock mechanism in addition to a tumbler key lock while eliminating the wheel member that befaces aesthetic value but does not connote the intended security. The tests

conducted by subjecting the lock to a vertical load over a period of time as well as the continuous use of the artifact over a period of one year without any sign of defect has proved that the anti-reverse mechanism has been very effective, a clear evidence that the objectives of this design project are met. Thus, the inclusion of the stage shift interlock has provided adequate secrete security [1] thereby avoiding any self dis-engagement of Push Rod. The artifact is less bulky and maintenance friendly since a damaged key is easily replaceable.

The deployment of this improved version of container lock will provide better security for retail goods sold in container shops, thereby sustaining employment for shop owners and operators as they contribute their quota towards the development of our dear nation.

5.1. Recommendation

The artifact was designed and produced with simple tools using Scrap metals as the base materials which are otherwise classified as waste in many way-side mechanical shops in Ghana. The following are recommendations necessary after evaluations and conclusion;

The technology must be deployed by Government since it will boost the ongoing cottage industry agenda in creating a sustainable economy not only for container shop operators but also the mechanical bench fitters who otherwise, damp these scraps in unauthorized areas for lack of innovative use for such scrap metals. This will go a long way in minimizing the sanitation problem that has engulfed the nation.

Acknowledgement

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Financial Viability of Tomato Irrigation in the Upper East Region of Ghana

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Abstract
The paper assessed the financial viability of irrigation project in Ghana concentrating on tomatoes producers in the UpperEast region of Ghana as a case study. Irrigated agriculture offers opportunities for greater livelihoods security in UpperEast Region of Ghana where climatic conditions do not allow for an all-year-around agricultural production. The financial viability per acre (0.4 ha) of tomatoes over a five (5) year period was estimated, using the Net Present Value (NPV) and Internal Rate of Return (IRR) approaches, where cash flows were discounted to their present values. The Net Present Values are positive indicating that the production of tomatoes in the region is financially viable. The sensitivity analysis performed on the Net Present Values revealed revenue to be the most sensitive and cost of tools and consumables is least sensitive variable. Total value added and value added per unit cost of certified organic tomatoes by farmers, retailers and processers in the region wereassessed using the absorption costing approach. The paper found that the processor (dry processing) is the actor that adds more total value to its primary raw material compared to the other actors. Using Kendall Coefficient of Concordances to test the agreements between ranked constraints, access to cash credit on the whole is ranked the major constraint to certified organic tomatoes production in the UpperEast region of Ghana. A more responsive institutional arrangement inclusive of all pertinent stakeholders is recommended to ensure the effective management and utilization of the irrigation infrastructure; the efficient delivery of farm inputs to farmers; farmer-centered capacity building training for improved performance, and provision of storage facilities, the establishment of agro-industry processing linkages, market search and promotion.

Keywords: Irrigation; Organic Tomatoes; Value Addition; Net Present Value; Internal Rate of Returns

1. INTRODUCTION

Ghana attaining a middle income status with a per capita income of US$1,000 by the year 2013 (IWMI, 2011). To effect this transformation, the government of Ghana has resolved to promote shared economic growth to create wealth and reduce poverty so that the citizenry, irrespective of wherever they are, can have access to the opportunities that will enable them to realize their potential for the betterment of their lives. In Ghana, agriculture accounts for about 35% of the Gross Domestic Product and employs 55% of the country's economically active population (GSS 2012). In addition, the sector contributes an average of 12 and 8% to tax revenue and total revenue, respectively (IWMI, 2006).

Circumstantial to the dictates of the semi-arid climaticconditions in northern Ghana, rainfall is unreliable interms of onset, duration, intensity and amount forproduction. Production is low and variable because of theuse of rudimentary traditional methods and techniques,shifting cultivation farming systems and excessivedependence reliance on rain-fed agriculture. Seasonalfood insecurity is widespread causing outmigration.

Irrigated agriculture is important and unavoidable inpromoting agricultural growth. As a strategic approach toincrease agricultural production and reduce rural povertyin the north, the government of Ghana, community basedand non-governmental organisationshave, hitherto,provided some irrigation facilities in the various regions inorder to increase agricultural production to create wealth and reduce poverty. In the global perspective,irrigation has led to significant increase in food supplyand raised millions out of poverty (Faurès, 2007).

An increase in irrigation generates improved farm incomewhich culminates in an increase in demand for local non-tradablegoods and services. It offers labour opportunitiesto the poorest segments of the population, promotes localagro-enterprises and stimulates the agricultural sector asa whole (Lipton et al., 2003; Smith, 2004; Hussain&Hanijra, 2004).

This paper focuses on the Kassena-Nankana District ofthe UpperEast Region of Ghana. It is one of the poorestand drought prone areas of the country. It is there thatthe Tonoirrigation scheme is located. The paperexplores the conception of an irrigation-centred approachto increased agricultural production and poverty reductionthrough the case paper of the Tono irrigation scheme. Itexamines the impact of the Tono irrigation scheme onagriculture production and rural poverty reduction in theKassena-Nankana District of the UpperEast Region ofGhana. This is achieved through the analyses of theperceptions, views and experiences of the Tono irrigationfarmers and non-Tono irrigation farmers. It also analyzesviews of key informants as well as reports and earlierstudies on irrigation-centred strategies to povertyreduction.

The Tono Irrigation Project is located in the Kassena-Nankana district of UpperEast Region of Ghana. The project is being managed by Irrigation Company of Upper Region Ltd. (ICOUR). ICOUR is a Ghana Government organization established to promote the production of food crops by small scale farmers within organized and managed irrigation scheme.

The Tono dam is one of the largest agricultural dams in West Africa and serves as a place for year round farming. About 2,490 hectares of land is irrigated with water from the 2½ mile long dam which serves seven villages in the Kassena-Nankana District. The dam was built in the late 70's and early 80's by Taysec, a British engineering company.

1.2 Problem Statement
The reduction of state presence in irrigation and the transfer of management from governmentAgencies to farmers or farming communities have become a widespread phenomenon, in response to the dual problem of low irrigation performance and constraints to public funding. The underlying principle is to encourage farmers and local communities to take responsibility for the management of local resources, and thereby limit external interventions to the provision of information and institutional support services. As evidence of successful IMT worldwide still remains

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limited especially in the smallholder context the issue has attracted a considerable attention for understanding the conditionsof successful IMT (Kamara, 2001).

Most of the schemes in question were not primarily designed for farmer management and experiences worldwide show a mixed picture of positive and negative results. The case of Ghana is not different; hence the need to find out whether or not, the transfer of management to farmers yields positive results.Therefore the study seeks to address the following questions:

1. What are the viable options for the proposedagricultural led industrializationdevelopment strategy, and financial viability of existing tomatoirrigation projects in the Kassena-Nankana District of the UpperEast Region?

2. What are the operations and untilization of the Tono irrigation scheme to the benefit of the tomato farmers?

3. What arethe level of value addition by each farmer, retailer, and processor along the tomato value chain?

4. What are the constraints faced by farmers in irrigation projects in the UpperEast Region of Ghana.

2. **METHODOLOGY**
In this section, various concepts within the tomato value chain such as financial viability, value addition and production constraints are discussed. The economic dimension of the food chain highlights financial feasibility, transaction costs, added value, division of chain costs, price-making, the time required to recover the investments, productivity etc. Financial viability is assessed using the net present value (NPV) and Internal Rate of Return (IRR) approaches together with estimating the sensitivity of the cost and revenue elements. Value addition is assessed using the absorption or total cost technique where the relevant cost comprises direct material, direct labor, direct expenses and overheads.

The constraints of organic irrigation projects is identified and ranked using the mean ranking approach of Kendall's Coefficient of Concordance. Kendall's coefficient of concordance is a measure of the agreement

among several judges who are assessing a given set of objects.

A descriptive research method was used in this paper to identify the irrigation facilities needed by rice and tomato farmers in the Upper East Region and to assess the financial viability of the irrigation projects. Descriptive research method is an approach to research to systematically investigate people, group or pattern of behaviours. The main purpose of using descriptive research method is to obtain first hand data from respondents. Also, due to the flexibility of this method it can use either qualitative or quantitative data or both, hence it was considered for this paper. This technique gives a valuable insight into the question under paper.

Meetings were held with tomato farmers and associations representing tomato farmers to determine how they get support from MOFA, and what type and terms of support they might require. In all ninety (90) respondents werecontacted who are made up tomato farmers, from the Tono Irrigation Scheme in the Upper East Region. Separate Semi-structured questionnaires were designed for each of these categories. In addition, there were interviews with some personnel from institutions related to the sub-sector.

2.1 Conceptual Models use in Assessing Financial Viability of Tomato Irrigation

The study adopted the following models in assessing the viability of tomato irrigation in Ghana: The**NPV** is estimated as follows:

$NPV = (Bt - Ct)/(1+r)$ Equation-------**(1)**

Where; NPV denotes Net Present Value, **Ct** denotes costs in each year, **Bt** denotes the benefits in each year, **r** the discount rate and n the number of years. The discount rates and the NPV so determined are then modeled to obtain a discount rate which yields zero NPV as in equation (2) below.

$IRR = L + (H - L)[(NPVL/NPL - NPVH)]$ Equation ---**(2)**

Where IRR denotesInternal Rate of Return, H and L denote the higher and lower discount rates respectively, while NPVH and NPVL denote the NPV of higher and lower discount rates respectively. The sensitivity margin is specified in equation (3) below:

Sensitivity margin = NPV/100 PV Equation --------- **(3)**

Where, **PV** is the present value. Value added per actor is specified in equation (4) below:

Value Added (**VA**) = Total cost **(TC)** – Value of primary inputs (VP) Equation ------ **(4)**

Where;**TC** is the total cost (value) on relevant activities by an actor to generate the end product (fruit, paste, dried tomatoes or sliced tomatoes) and **VP** is the cost (value) of the basic input that a particular actor purchases from the preceding actor. **VA1**: Value added by primary producer or farmer estimates the value that the farmer adds to a tone of tomato fruits. It is specified as:

VA1 = TC1 – VP1 Equation-------- (5)

Where; VA1 denotes value added by farmer, TC1 the total cost (value) for a tonne of fruits from the farmer and VP1 the value (cost) of planting material.VA2: Value added by Retailer of fresh tomatoes.

VA2 = TC2 –VP2 Equation--------- (6)

Where; VA2 denotes total value added by retailer, TC2 the total cost (value) per tonne of fruits sold by the retailer and VP2 the cost of fruit to the retailer's farmers. VA3: Value added by Processor. It is specified as:

VA3 = TC3 –VP3 Equation----------- (7)

The Kendall's concordance coefficient (W) is specified in equation (8) below:

W = 12S/p (n -n) –pT Equation--------(8)

Where W denotes the Kendall's Concordance Coefficient, reason that the same export market offers fairly the same **P** denotes number of constraints, **n** denotes the number of respondents (sample size), **T**denotes correlation factor for tied ranks and **S**denotes sum of square statistic.

3.RESULTS

This section discusses the results of the paper. The researcher interviewed 90 Tomatoin all. All the respondents were drawn from the Tono Irrigation Scheme in the UpperEast region of Ghana.

3.1 The Results of the Financial Viability Analysis

Tables 2 and idea behind this index is to find the sum of the ranks for the table below shows the average cost and revenue per acre of each constraint being ranked.

Table 1: Average Cost and Revenue per acre of Tomato Irrigation in the UpperEast Region.

Activities	Year 1	Year2	Year 3	Year4	Year 5
Cost/Revenue (GH¢)	2008	2009	2010	2011	2012
Certification	50	50	50	50	50
Land Preparation	157	107	126	136	126
Planting materials	1126	528	738	870	1028
Planting	81	82	101	104	115
Maintenance	80	92	93	135	156
Harvesting	42	42	52	53	60
Tools and consumables	21	23	27	30	35
Other costs	30	30	40	50	60
Total cost of production	1587	954	1228	1429	1646
Revenue	0	2392	2998	2194	3082
Net cash flow	-1587	1438	1770	1765	1436

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Average fruit weight = 1.5kg, Average number of fruits /acre = 14,000
Source: Field Survey 2013

Table 2: NPV Estimation for an Acre of Tomato irrigation in the UpperEast Region

Activities	Year 1	Year2	Year 3	Year4	Year 5
Cash flow (GH¢)	2008	2009	2010	2011	2012
Average Cost of Production	1587	954	1228	1429	1646
Average revenue	0	2329	2998	3194	3082
Net cash flow	-1587	1437	1770	1765	1436
Discount factor @30%	1	0.7692	0.59172	0.4552	0.3501
Discount cash flow	-1587	1106.11	1047.34	803.38	502.744

NPV (30%) =1873			1770	1765	1436

	Year 1	Year2	Year 3	Year4	Year 5
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Source: Field Survey 2013

The analyses of the viability of the production of organic tomato in the Upper East Region arepresented as follows. Discounting the five year cash flows of the farmer in the UpperEast Region at 30% (lending rate) recorded an NPV of GH¢ 1,873.00 indicating that tomato irrigation in the UpperEastRegion of Ghana is financially viable using the NPV approach (Table 2). Furthermore, discounting the same cash flow at 90% and 95% gave NPVs of GH¢ 27.59 and GH¢ -46.65 respectively, yielding an IRR of 92% which was higher than the discount rate (30%) and hence the production of tomato using irrigation project in the UpperEast Regionis financially viable using the IRR approach (Table 3).

Table 3: IRR Estimation for an Acre of Tomato irrigation in the Upper East Region

	Year 1	Year2	Year 3	Year4	Year 5
Activities/Transaction					
Cost/Revenue (GH¢)	2008	2009	2010	2011	2012
Net cash flow	-1587	1437	17.70	1765	1436
Discount factor @90%	1	0.5263	0.277	0.1458	0.077
Discount cash flow	-1587	756.82	490.29	257.14	110.1
NPV (90%) = 27.59					
Discounted factor@95%	1	0.5128	0.263	0.1349	0.069
Discount cash flow	-1587	737.41	465.47	238.1	99.37
NPV (95%) = -46.65					
IRR = 92%					

	Year 1	Year2	Year 3	Year4	Year 5
Cash flow (GH¢)	2008	2009	2010	2011	2012
Net cash flow	-1587	1437	17.70	1765	1436
Discount factor @90%	1	0.5263	0.277	0.1458	0.077
Discount cash flow	-1587	756.82	490.29	257.14	110.1
NPV (90%) = 27.59					
Discounted factor@95%	1	0.5128	0.263	0.1349	0.069
Discount cash flow	-1587	737.41	465.47	238.1	99.37
NPV (95%) = -46.65					
IRR = 92%					

Source: Field Survey 2013

Sensitivity levels differ for the different costs/revenue items across the UpperEast Region (Table 4). However, in general, revenue is the most sensitive parameter while cost of tools and consumables is less sensitive parameter inUpperEast Region.
Planting cost with 9.83%, certification with 15.35%, other costs with 16.26%, harvesting cost with 19.24% and costs of tools and consumables with 27.51% being the lEastsensitive for production in the UpperEast Region (Table 9). Further, the same cash flow discounted at 16.5% and 170% gave NPVs of GH¢ 27.87 and GH¢ -7.93 respectively, yielding an IRR of 1.69%.

Table 4: Sensitivity Analysis for Tomato irrigation in the UpperEast Region

Activity/ Transaction	Discounted cashflow (GH¢)	Sensitivity/ Switching value (%)	Rank
Certification	122.04	15.35	7
Land Preparation	289.07	4.26	4
Planting materials	419.69	1.31	4
Planting	44.82	9.83	6
Maintenance	49.64	4.35	5
Harvesting	23.3	19.24	9
Tools and consumables	12.39	27.51	10
Other costs	18.57	16.26	8
Total cost of production	651.11	.65	2
Revenue	948.13	.33	1
NPV = 1,873.00	-1587	1438	1770

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NPV = 1,873.00	-1587	14.38	1770

Source: Field Survey 2013

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Table 5: Value Added by Actors in GH¢ (per tonne of Tomato fruits)

	Farmer	Retailer of fresh tomato	Processor (Fresh)	Processor (Paste)
Primary raw material	50	184	990	300
Total cost	82	281	2394	894
Total value added	32	97	1404	594
Value added per tone	32	81	425	527
Total revenue	154	350	2990	16400
Total value added per day	0.08	11.57	60.71	75.29

Source: Field Survey 2013

On the whole the drying processor incurs the highest cost per tonne (GH¢14051.00) and hence sellsat a higher price to obtain a value of GH¢ 16400.00 torecover cost and make some profit to remain in business compared to the slicing and then tomato paste processor.Among the fresh fruit retailers, the retailers of the UpperEast Region add more value (GH¢81.00) per tonne of freshtomato fruits than the retailers of the other Region.

3.2 Results of the Value Addition Analysis
Table 9 shows the estimates of the value added by the various actors (farmers, retailers and processors in theUpperEast Region). The standard unit here is a tonne of fresh tomato for each actor. The results reveal that the processor adds the highest value (GH¢).The

farmer of the UpperEast Region does not addmuch value to fresh tomato fruit (GH¢32.00).

On a daily basis, the drying processor adds the highest value (GH¢ 75.29) followed by the slicing (GH¢ 66.00). The results revealed that in the UpperEast Region (GH¢ 11.57), the retailer difficulty in accessing labour, higher weed competition, difficulty in accessing farm land, inadequate tractor, bad weather conditions, no premiums paid (GH¢ 0.08).

3.3 Results of the Constraint Analysis
Table 6 below shows the agreement among the rankings. The three different rakings (i.e., all farmers, UpperEast) are all significant as indicated by the asymptotic significance values (i.e., $p < 0.01$).

Table 6: Ranking of Constraints faced by Tomato Irrigation Farmers of UpperEast Region

Constraints	All Tomato farmers		Tomato farmers in U/R	
	Mean Rank	Mean	Mean Rank	Mean
Pest and Diseases	6.66	6	10.20	11
No premiums paid for certified fruits	5.81	5	2.94	3
Inadequate organic production technology	8.68	11	6.80	7
Unreliable market	4.88	3	5.18	5
High post-harvest losses	7.92	9	4.76	4
Inadequate extension services	8.68	12	8.68	10
Difficulty in accessing labour	5.77	4	5.85	6
Bad weather conditions	7.09	8	8.04	8
Difficulty in accessing farm land	6.78	7	8.50	9
High weed competition	4.74	2	2.43	1

Lack of access to cash credit	2.83	1	2.90	2
Inadequate access to tractor services	8.16	10	11.72	12

Source: Field Survey 2013

Table 7: Diagnostics statistics of the Kendall's Concordance Ranking

S/N	Estimate	All farmers in other regions =1,850	All Farmers in U/R= 90
	Kendall's W	0.25	0.7
2	Chi-square	430.5	382.94
3	Degree of freedom	11	11
	Asymptotic significance	0.000	0.000

4.0 DISCUSSIONS

The paper assessed the financial viability of tomato irrigation using Net Present Value (NPV) and Internal Rate of Return (IRR) methodologies taking into consideration cash flows over five years for tonne (GH¢14051.00) and hence sells at a higher price to tomato irrigation farmers in the UpperEastRegion of Ghana.

Discounting the five year cash flows of the farmer in the UpperEast Region at 30% (lending rate) of Agricultural Development Bank, recorded an NPV of GH¢ 1,873.00 indicating that tomato irrigation production in the UpperEast Region of Ghana is financially viable using the NPV approach. Further, discounting the same cash flow at 90% and 95% gave NPVs of GH¢ 27.59 and GH¢ -46.65 respectively, yielding an Internal Rate of Return (IRR) of 92% which was higher than the discount rate (30%), implying that the production of tomato irrigation in the UpperEast Region is financially viable using IRR estimation approach.

In addition, the sensitivity analysis for the farmers in the UpperEast Region shows that the rankings of cost and revenue reveal that revenue is the most sensitive parameter while cost of tools and consumables is less sensitive parameter in the of organic tomato production in the UpperEast Region. Thus, in estimating the NPV, revenue is the most sensitive parameter while cost of tools and consumables is less sensitive parameter in both the UpperEast Regions.

The paper also assessed the value addedby the farmer, retailer and processor. It established that the processor adds the highest value (GH¢) per metric tonne of tomato fruits followed by fresh fruit retailer and then the farmer.

On the average the tomato drying processor adds the highest total value (GH¢ 527.00) per tonne of fresh tomato followed by the slicing processor (GH¢ 425.00) and then tomato paste processor (GH¢ 238.00). On thewhole the drying processor incurs the highest cost per obtain a value of GH¢ 16400.00 to recover cost and make some profit to remain in business compared to the slicing and then paste processor. The farmer of the UpperEast Region adds little value (GH¢ 32.00) per the tonne of fresh tomato fruit.

On a daily basis, the drying processor adds the highest value (GH¢ 75.29) followed by the fresh slicingprocessor (GH¢ 60.71), the paste processor (GH¢ 34.00), the retailer of the UpperEastRegion (GH¢ 11.57).

The paper also identified and ranked the constraints of the UpperEast Region of Ghana. The results revealed that in theUpperEast Region, lack of access to cash credit is the main constraint followed by unreliable market, pest and diseasecontrol, difficulty in accessing labor, higher weed tractor services, bad weather competition, and inadequate organic production technology.

5. CONCLUSION

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Ghana is not self-sufficient in agricultural production,making adequate food and industrial raw material availability all year round a difficulty because of the predominance of rain-fed agriculture. Duringperiods of good rains, agricultural products abound butinadequate storage facilities result in losses of perishable crops. Inadequate agro-processing facilities for products also contribute to the vulnerability of farmers in the country.

Investment in irrigation infrastructure constitutes an important poverty reduction strategy since it can boost agricultural production by reducing the risks associated with rainfall variability and unreliability. Irrigated agriculture comprises an increase in the supply of water by artificial means through the use of water control technology allowing for the drainage to dispose of excess water.

Although some modest gains have been made towards through irrigation, more efforts need to be made. At the Tono irrigation scheme in Kassena- Nankana District, many of farmers had limited access to farm credit, technical assistance, hardly used, insecticides and high yielding seed varieties and inadequate ready market for their produce. Addressing these challenges squarely has the potential of directly contributing to poverty reduction in the Kassena-NankanaDistrict and Ghana in general.

The attendant actions will not only increase the farmers' production and incomes, but will also enhance their opportunities to diversify their income base, to reduce their vulnerability to the seasonality of agricultural production. The district's economy is vulnerable since it is prone to droughts like all elsewhere in the northern Ghana.

Acknowledgement

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A Study into Pre-Design Construction Projects Cost Prediction in Ghana

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Abstract
Prospective clients rely on professionals for the feasibility of their intended project usually in the main areas of initial designs and probable cost of the project. This is to ensure that clients are able to prepare for the development budget. This study investigated into the various cost prediction methods in use by professionals in the Ghanaian construction industry. A field study was carried out by administering twenty-eight well-structured questionnaires to forty practicing building consultancy firms with good standing in five regions in Ghana. The most commonly used predesign cost predicting method was cost per square metre of floor area with 95% rating.The Nature/Condition of site was found to be the number one factor that has the most significant influence on the initial estimated cost, yet 60% of quantity surveyors and architects do not often visit proposed project sites before designs and cost estimating. Consultancy firms should have elemental cost analysis and cost plans of projects executed for easy cost comparisons with proposed ones. There must be cost data publications of all past projects in different regions in the country stating their actual costs of construction and time of completion to serve as a guide when estimating for such similar types of projects.

Keywords: Pre-Design;Cost Prediction Budget;Rates; Ghana

1 INTRODUCTION

Prospective clients rely on building professionals to take the decision as to whether to embark on a proposed construction project or not, by asking for the designs and the probable cost. If this price estimate is too high it will discourage the client from proceeding further with the scheme and if it is too low, it may result in an abortive design, dissatisfaction on the part of the client and shoddy works (Ashworth, 1994).To arrive at this estimate within the shortest possible time, cost predicting methods are used. These methods result in large variations and deficiencies in cost estimates as confirmed by (Marr, 1977), that the error of cost estimation at the design stage may be as high as ±20 to 40 percent of the final project cost. Nicco-Annan (2006) reported that for a limited survey of office buildings in Accra, Ghana, by a non-banking financial institution, cost overruns between 60 to 180%.Laryea (2010), in his paper presented to COBRA, also observed that consultants cost estimates in Ghana overrun on the average by 40%.

Literature Review

The client's budget represents the maximum expenditure or limit on the project he is prepared to spend. This preliminary cost which is normally established before the commencement of the construction process is dependent on the amount of money the client is prepared to spend on the project and the agreed approximate estimate prepared by the design team. It is one of the important factors that influence the client's decision to engage in the project because it establishes the probable financial commitment prior to final designs and documentation. Unfortunately this preliminary estimate is generally prepared on scanty cost information; yet its accuracy, to a large extent, depends on the availability of reliable historical cost data. Most often than not any client who wants a building erected would want to know his financial commitmentsupon which the feasibility of the project depends. The accuracy of this initial estimate is important because it serves as the budget limit for the client base on which planning and fund sourcing are done and helps the design team in controlling cost to avoid over design and to ensure that the eventual tender figure can be predicted with a degree of certainty.

Preparing cost estimates normally requires the use of historical data on construction costs. Historical cost data will be useful for cost

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estimation only if they are collected and organized in a way that is compatible with future applications and must be updated with respect to changes that will inevitably occur. Construction cost data should be published in various forms by organizations. These publications are useful as references for comparison (Berthouex, 1972).Since historical cost data are often used in making cost estimates, it is important to note the price level changes over time (McNeil, 1981).

During the first half of the twentieth century, six methods of initial price estimating were developed, which are still much the same today (Brook, 1998).These include both single and the multiple rates.

The single rates comprises the conference estimate, and is based on a collective view of a group of individuals, and may at this stage not be quantified in any particular way .The group concerned must have the relevant experience of estimating the cost of similar projects. It is applicable where historical cost data is not appropriate and offers a qualitative view point to reinforce or otherwise a measured estimate (McNeil, 1981).

The Superficial Floor Area Method is measured from the internal dimensions of the building with no deductions made for internal walls, stairs and lift zones and compared to previous similar building cost per square area (Berthouex, 1972). Brook (1998**),** states that adjustment can be made for location and inflation, but specification adjustment is much more difficult. He further stated that subjective judgments are made for size, shape, number of storeys, services ground conditions and standard of finishes, with separate assessment made for external works.

Ashworth (1994) concluded that the huge range in the superficial area rates give surveyors some problems and can only be used as guide's prices, and only be adjusted to suit local conditions on the basis of the surveyor's personal experience and skills. This method is the most widely used method in Ghana and other countries.[should not be at this stage]

Southwell (1971) produced a formula that combined the floor area with the length of the building perimeter known as the superficial

perimeter method however, this method has not been used in practice due to surveyors' reluctance to adopt to change.

In some European countries like Germany, architects and engineers are familiar with building costs expressed as cubic meter prices. Once the contract was signed, its cost would be divided by the cubic content and entered into the office price book. The cost of new project could then be determined by calculating its volume and selecting an appropriate rate from the book. The rules of measurements for the cubic content of a building were defined by the R.I.B.A (1954). Ashworth, 1994 however concluded that building cost correlates better with superficial floor area than with volumes.

The unit method consists of choosing a standard unit of accommodation and multiplying by an appropriate cost per unit, say school, cost per pupil place, hospital, cost per bed place (McNeil and Hendrickson, 1982).

To overcome the many disadvantages ofthe other single-price methods of initial cost prediction, James (1954) devised a new method called the storey-enclosure which attempted to take accounts of plan shape, total floor area, vertical positions of floors, storey heights, overall building heights and extra cost of providing usable floor areas below ground.It was claimed to perform better in terms of accuracy than the other single-price methods, however lack of use meant that it was not possible to verify this.

The elemental cost method attempt to make use of the cost analyses from other similar projects by sharing the total cost amongst the various elements to get the per unit element cost. It provides cost advice during the design process and gives the client better value for money. Adjustment will however need to be made for inflation and significant specification changes. A spread sheet template stores the information and effect of changes reflected immediately they are made (Ashworth and Skit more, 1982). Two forms of this method exist; the first being the elemental cost planning also known as "designing to cost', where the project is designed within a framework of a cost limit; the other known as the "comparative cost planning" or "costing a design" where

alternative designs can be examined within an economic context (Brook, 1998).

The analytical method happens to be the traditional method of construction price prediction. It is used for determining unit rates by examining individual resources and the amount needed for each unit of work. This method takes a lot of time and data required is more. If the design technology for a facility has been specified, the project can be decomposed into elements at various levels of detail for the purpose of cost estimation. The unit cost for each element in the bill of quantities must be assessed in order to compute the total construction cost. This concept is applicable to both design estimates and bid estimates, although different elements may be selected in the decomposition.

2   METHODOLOGY

The researcher wanted to identify the existing methods in use for initial cost predictions in Ghana. There are various methods of initial cost prediction in use, the choice of which depends on one's familiarity and ease of use. Respondents were asked to state the level of familiarity and ease of use with these existing methods, using a scale 1 to 3, where 1=Very familiar, 2=Familiar and 3=Not Familiar.

The questionnaires were distributed in such a way that the total respondents would be a fair representative of the total population. In order to achieve this, a sample size formula propounded by Kish, was used to select 18 firms out of a total of 68 practicing quantity surveying firms.

Well structured closed-ended questionnaires were designed, vetted and tested. These questionnaires were set in line with the specific objectives and the aim. A total of forty (40) questionnaires in all were set and administered. The researcher covered five (5) out of the total of ten (10) regions in Ghana which were: Ashanti, Brong Ahafo, Greater Accra, Upper West, and Northern regions, and in each region the Architectural and Engineering Service Limited (A.E.S L),Government Consults, was considered together with some private firms. This was because most of the practicing firms are concentrated in these regions due to the high level of activities there. Thus it was assumed that as far as initial cost estimating practices were concerned, what happened in these five regions would be a fair reflection what is happening in the construction industry in Ghana. The experts to whom the questionnaires were administered included; quantity surveyors and architects in the various consultancy firms.

3 RESULTS
Accuracy of Initial Price Estimates
The survey indicated that initial price estimates are not very accurate and results in errors as high as ±20 to 40 percent of the final project cost as stated by (Marr, 1977). Nicco-Annan (2006) reported that for a limited survey of office buildings in Accra, Ghana, by a non-banking financial institution, cost overruns between 60 to 180% and Laryea observed that on the average cost overruns by 40% in Ghana.

Table 1: Accuracy of Initial Price Estimates

Options	Frequency	Valid Percent	Cumulative Percent
Very Accurate	1	2.5	2.5
Fairly Accurate	32	80.0	82.5
Near Accurate	7	17.5	100.0
Total	40	100.0	

Table 2: Accuracy dependent on Time

Options	Frequency	Valid Percent	Cumulative Percent
Yes	30	75.0	75.0
No	4	10.0	85.0
Somehow	6	15.0	100.0
Total	40	100.0	

Table 3: Influence of Sketch Designs on Initial Price Estimates

Options	Frequency	Valid Percent	Cumulative Percent
Very much	33	82.5	82.5
Very little	6	15.0	97.5
Not at all	1	2.5	100.0
Total	40	100.0	

Table 1 shows that only 2.5 of the respondents confirmed that their initial estimates are fairly accurate. 80% of them said that the initial

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estimates are fairly accurate with only 17.5% indicating that the figures are near accurate.

From Table 2, 75.0% responded that the accuracy of initial estimate usually depended on time, with 10% denying. The remaining 15% were undecided.

It was realised that these initial estimates are also based on sketch designs which are sometimes complex and lack a lot of relevant information. The estimates are also produced within a restricted time limit and above all, a shortage of relevant historical cost data. No further cost checks are done at the detail design stage as a cost control mechanism. Table 3 shows that 82.5% of the respondents agreed that sketch designs has influence on initial price estimates, with 15% indicating that it has very little influence. 2.5% denied it.

Cost Planning for Initial Cost Predicting Purposes
Ashworth (1994) indicated that cost planning ensures cost-effective and value-for-money designs and provides a greater involvement of the quantity surveyor at the design stage.

Table 4: Doing Cost Planning for Cost Prediction Purposes

Options	Frequency	Valid Percent	Cumulative Percent
Yes	16	40.0	40.0
No	5	12.5	52.5
Sometimes	19	47.5	100.0
Total	40	100.0	

From table 4, it was realized that as high as 47% of quantity surveyors agreed that they do not do cost planning often with 12% not practicing

it at all. This is due to the fact that most of the times quantity surveyors are only brought in when designs are completed by the architect and are ready for tender documentation; hence cost checking at this stage becomes a problem.

Site Visit before Preparing an Initial Estimate

Table 5: Visit to Site before Preparing Estimates

Options	Frequency	Valid Percent	Cumulative Percent
Not Often	24	60.0	60.0
Not at all	3	7.5	67.5
Based on Given Design	13	32.5	100.0
Total	40	100.0	

Table 5 indicates that quantity surveyors base the initial estimates on the sketch designs given without any visit to the site to actually ascertain the nature and the state of the site, since even the project location has a lot of influence on the initial estimate. It was also observed that because these estimates are normally produced within a restricted time limit, quantity surveyors rather tend to use percentage adjustments to cater for the unforeseen circumstances hence the significant differences between the initial and the final costs.

Factors Causing Variability in Initial and Final Costs.
The following factors were identified as being the cause of significant differences between the initial and final costs of construction and the extent to which each factor affects the initial cost. The respondents were asked to identify these factors and to rank them in order of importance.

Table 6: Factors affecting initial predicted cost and ranking

Options	Frequency	Valid Percent	Cumulative Percent	Ranking
Nature/Condition of Site	21	28.77	28.77	1st
Change in Design	19	26.03	100.00	2nd
Inflationary Trend	16	21.92	50.69	3rd
Change in Specification	10	13.70	64.39	4th
Time Overrun	7	9.59	73.98	5th

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Total	73	100.00

Nature/Condition of Site

This factor was ranked as number one on the list as the one with the most significant effects on the initial predicted cost representing 29% of the respondents.

The nature or condition of site has a lot of influence on the total cost of a project. This is because a sloppy site for example, will have different characteristics in terms of constructional methods, the designs and the general layout of the project as well as marshy and rocky areas for which if consideration is not given initially can have adverse effects on this predicted cost eventually.

It was realized during the survey that both architects and quantity surveyors do not often visit the sites to ascertain the nature and condition before the designs and cost predictions. Quantity surveyors also based their initial estimates on sketch designs given without having any in-depth prior knowledge about the site. This attitude of quantity surveyors and architects lead to a lot of variations and additional works which ultimately affect the initial cost.

In the construction of a dormitory block for one of the Senior High Schools in Brong Ahafo Region, the nature of the site lead to a variation of 41% on the initial cost. This was also confirmed during the research that the location of the site itself has a greater influence on the initial cost which is in agreement with Ashworth (1994) who stated that the cost of a project is affected by its location and that the ground conditions of the chosen site substantially influence constructional cost.

Change in Design

The client in collaboration with the architect can change the design based on which the initial cost prediction was done, and Ashworth (1986) agreed that these changes in the proposed plan shape will affect many of the major cost-important elements in the design.

This happens because the client may have seen a similar design somewhere which he prefers and will want certain modifications done to the original designs. Change in designs also occurs

where both the architect and the quantity surveyor did not visit the site before the designs and the initial cost were done. The nature of the site might be that it is a restricted, sloppy, marshy, made up ground, etc the effects of which could have been catered for initially if a visit was done.

There was a situation where the architect had to change the original designs to include a basement, construction of a dormitory block at a Senior High School, because the site was sloppy. There was another instance where retaining walls had to be introduced to support the filling material because it was also a sloppy site, construction of a dormitory block at another Senior High School, all in the Brong Ahafo region. For the construction of a Hostel Block in Kumasi, Ashanti Region, the redesign had to include a whole basement floor. In all these instances initial costs were affected.

Inflationary Trend

Inflation means higher costs and higher selling prices. The effect of higher prices on demand is not necessarily easy to predict. We live in an economy where the effects of inflation on construction projects cannot be neglected. It was realized that quantity surveyors find it difficult to predict the effects of inflation on the initial cost.

Change in Specification

Specifications are written descriptions of the type and standards of the materials and workmanship. Materials constitute greater part of the total cost of the work. Quoting from Manteau's work, materials cost may constitute 60% of the total cost of the work. Hence, any change in the type and quality of initial material specified will have either a negative or positive effects on initial cost.

In the Extension of an Office Block,in Sunyani, Brong Ahafo Region, the client ensured that, the original floor finish of terrazzo was changed to porcelain floor tiles, louver blades were all changed to aluminium sliding doors and windows, plywood ceiling was changed to plastic T&G, aluminium roofing sheets changed to long span coloured roofing sheets and ultimately the initial cost was increased by

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25%.In the construction of a 3-Storey Hostel Block in one of the Nurses Training Colleges, in Brong Ahafo Region, the original floor finish of terrazzo was to be changed to porcelain floor tiles which was to be an increment of 12%, likewise the regional library which was still under construction. In all these instances, the initial costs were affected.

Time Overrun
The concept of project duration is important in assessing the success and viability of a project and is also seen as one of the benchmarks in assessing the importance of a project.
Construction time has always been seen as one of the benchmarks in assessing the performance and efficiency of the project organization. Timely completion of a construction project is one goal of the client and the contractor because each party tends to incur additional costs and lose potential revenues when completion is delayed, as confirmed by Thomas et al, (1995).

Referring to Chan and Kumaraswany (1999), a project is usually regarded as successful if it is completed on time, within budget and to the level of quality standards specified by the client at the beginning of the project, and this was confirmed by Ashworth (1994) that one method of measuring the success of a project is whether it is available for commissioning by the date promised in the contract document. As concluded by Skitmore and Ng (2003), this completion time may be affected by the client, project and contractual characteristics.

The problem of project time overrun is of international concern. In Australia, it was found that seven-eighths of building contracts surveyed in the 1960s were completed after the scheduled completion time, while in Hong Kong, 70% of building projects were delayed.
In Saudi Arabia, Al-Khalil and Al-Ghafly (1999), confirmed in a study carried out in 1995, that contractors agreed that 37% of all their projects were delayed while consultants admitted that delayed projects accounted for

84% of projects under supervision, and that 70% of public projects in the same country experienced time overrun.

In Ghana, public projects experienced time overrun unduly, and this often leaves contractors in a state of uncertainty about their cash-flows. A limited survey of construction of few office buildings in Accra, Ghana, which were commissioned by a well-known non-bank financial institution, indicated that the time overrun was between 12 to 24 months.

The construction of various socio-economic developmental projects in towns in Brong Ahafo and Eastern Regions, by the Social Investment Fund (SIF), in collaboration with the District Assemblies were to take a maximum completion period of eight (8) months. This period doubled, yet the projects could not be completed, the construction of Dormitory Block in one of the Girls' Senior High Schools in Brong Ahafo Region, which was to be completed in one year, took five years to complete with fluctuation component of 28% and a general cost increment of 87% on the initial cost, which is a major deviation from the initial figure.

One of the main causes of time overrun in Ghana is the client's inability to honour payments in time as stipulated in the contract documents. It takes an average of one or more years to honour a twenty-eight days payment certificate. For the construction of proposed Assembly Block for a Senior High School, an interim payment certificate that was submitted in November, 2008 was not honoured through to March, 2010 the results of which was that the contractor had abandoned the site and the project was hanging. The consequences of time overrun on the initial project cost are re-evaluation of the rest of the works, calculation of fluctuations, and if none of these happens, it can lead to abandonment of the project by the contractor.

Table 7: Ranking of Initial Cost Predicting Methods in Use

No.	Initial Cost Predicting Methods	Very Familiar %	Familiar %	Not Familiar %	Ranking
C	Superficial Floor Area Method	95	2.5	2.5	1st
F	Unit Method	60	25	15	2nd
H	Element Cost Method	50	45	5	3rd

I	Analytical Method	40	32.5	27.5	4th
D	Superficial Perimeter Method	32.5	42.5	25	5th
E	Cube Method	32.5	42.5	25	5th
J	Cost Models	20	30	50	5th
B	Financial Method	23	40	38	6th
G	Storey Enclosure Method	20	42.5	37.5	7th
A	Conference Estimate	5	27.5	67.5	8th

Methods in use for Initial Cost Prediction in Ghana

A number of methods exist for initial cost prediction purposes the application of which depends on the ease of use and familiarity with the method.

The commonest method in use for that purpose by quantity surveyors is the superficial floor area or cost per square meter of floor area. Probably it is because it is simple and easy to remember, and a rapid method of calculating the costs and this might have overshadowed the fact that the method does not directly take account of change in plan shape, overall or storey height and construction methods. Jaggar et al. (2002), in their quest to access this method argued that, cost is influenced by factors other than floor area alone.

The research indicated that this is followed by the Unit cost and the elemental cost methods respectively, although the later provides better cost advice during the design process and gives the client better value for money.

4 DISCUSSION

Variability in Initial and Final Construction Costs

All things being equal one would have thought that the initial estimated cost would be equal to the final cost. Unfortunately this is not so because the effects of certain factors cannot be overlooked.

- **Nature/Condition of Site**

This has a lot of influence on the total cost of a project and it affects the constructional methods, the designs and the general layout of the site and the project. Unfortunately, architects and quantity surveyors do not often visit the sites before the designs and cost predictions are made resulting in lot of variations and additional works which ultimately affect the initial cost.

Change in Design

Changes in the original plan shape will affect many of the major cost elements in the design and this ultimately affects the overall cost of the project.

Change in designs often occurs where both the architect and the quantity surveyor did not visit the site to acquaint themselves with the nature and conditions of the site before the designs and the initial cost.

- **Inflationary Trend**.

Inflation means higher costs and higher selling prices. We live in an economy where the effects of inflation on construction projects can not be neglected and needs consideration at the initial cost prediction stage.

- **Change in Specification**

Specifications are written descriptions of the type and standards of the materials and workmanship. Materials cost constitutes greater part of the total cost of the work. Any change in the type and quality of initial material specified will have either a negative or positive effects on initial cost.

- **Time Overrun.**

Construction time has always been seen as one of the benchmarks in assessing the performance and efficiency of the project organization. A successful project is the one that has been completed within the time specified in the contract document and within budget.

Most of the project time overrun in Ghana is as a result of the client's inability to honour payments in time as stipulated in the contract documents, because no contractor would want to pay Liquidated and Ascertained Damages by intentionally delaying the execution of a project. The consequences of time overrun on the initial project cost are re-evaluation of the rest of the works, calculation of fluctuations, and abandonment of the project by the contractor.

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Recommendations
Methods of initial Cost Estimates

The various methods of initial cost estimation which are in common use in Ghana by quantity surveyors must be critically examined by Ghana Institution of Surveyors, other allied bodies and both researchers and prospective researchers and the necessary amendments made.

- **Superficial Floor Area Method**

The method does not take account of change in plan shape, overall building height and constructional methods of the new building in question. It is therefore recommended that further more research be done to establish a formular that can effectively include these variables in the method or to identify certain adjustment factors that can be used to adjust for these variables in the method so as to improve upon its usefulness and effectiveness. This should be done by researchers and prospective researchers in the building industry. Lecturers in the Departments of Building Technology at Kwame Nkrumah University of Science and Technology, Kumasi, together with their counterparts in the various Polytechnics should team up with students to do a thorough research in the area.

- **Elemental Cost Method**

The need to adopt this method by quantity surveyors is very paramount because it is an accurate method of preparing realistic estimates than the superficial floor area method. It allows for necessary cost checking at the design stage of individual elements and serves as an excellent base system for making useful comparisons with the costs of other buildings.

Cost Planning

Cost planning, a method of cost distribution, monitoring and control during the design stage is more appropriate for cost estimating purposes than the other methods. It allows for cost checking at the design stage against the cost target and provides cost information on the proposed total project expenditure which assists the design team members in design decision making.

It is therefore recommended that quantity surveyors in their various respective offices should have elemental cost analysis and cost plans for all the various past projects including residential, commercial, offices, schools, etc and completion times, with all types of finishes for easy comparisons with proposed projects.

By so doing it will assist the designer in the choice of the correct economic framework, provide cost information and check the designer's design solutions against the predetermined project budget.

Design Evaluation

As stated by Kwakye (1997), the design of the building influences its eventual overall building cost. The design team must therefore examine all viable design options at the various stages in the design sequence and maintain cost control by undertaking a series of cost checks.

The cost checks should be a series of on-going exercises which should be carried out during the design and must be in conjunction with the design process so that the cost effects of design decisions can be reported and examined and corrective measures taken when necessary to be within the project cost.

Computer-Aided Estimating

All the estimating methods identified so far can be made easy by the use of the computer. Quantity surveyors should explore the use of the computer in their fields of estimating and probably develop appropriate estimating software that can link an AutoCAD program to the estimating method so that reliable estimates can be obtained direct from the designs at any point in time.

Cost Data Publication

Publications of project cost data either quarterly or yearly by the appropriate professional body such as Ghana Institution of Surveyors (Gh.I.S), just as it is done for construction materials, in their quarterly magazine will go a long way to facilitate the process of estimating the cost of proposed projects. The basis of this cost data should be the actual cost of completed projects in the different regions in Ghana, with their locations, design features, building type, specifications and date of completion. This can be used as basis for cost estimations for proposed projects.

Site Visit

Architects, and for that matter quantity surveyors and other allied construction professionals should always endeavour to visit proposed sites to ascertain the conditions and nature before designs and estimating so as to avoid the issue of redesigning which could lead to a lot of variations and additional works.

5 CONCLUSION

The study has identifies the main pre-design construction project cost predictors in Ghana. It reveals that the initial cost estimate is always influenced by two main factors: (a) time and (b) sketch design. In addition, it identified the several factors which contribute to the variability of initial cost estimates and final one. Some of these are external while others are internal. The paper submits, thus, that Ghanaian professionals in the construction industry will do well to use the best three known cost predicting methods

In practice in order to ensure accuracy in the pre-design cost estimate and to reduce the chronic problem of cost- overruns. These are the superficial floor area method, unit method and the elemental cost method.

In addition, the paper strongly suggest that professional increase their use of computer-aided estimating to save time and cost and to enjoy the flexibility and accuracy it provides.

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Design, Development and Evaluation of a Continuous-Flow Mixing Grain Dryer

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Abstract
The drying performance of a designed and developed low-cost, 250kg to 1-tonne capacity continuous-flow mixing grain dryer(LSU type) was evaluated in the workshop of Agricultural Engineering Department of KNUST Kumasi. The dryer consists of three main parts: 1) the drying chamber made of inverted v-shaped ducts, to which the plenum inlet is connected; 2) the blower, with a 750 W (1 hp) electric motor and centrifugal fan which provides the drying air; 3) the heater, 1 kW electric, which raises the temperature of the drying air; 4) discharge rollers powered by a 3kW electric gear-motor and a 37.5:1 reduction gearbox. Trials conducted showed that paddy rice, at initial moisture content (MC) of 19.7%, 20.9%, 21.7%, 26.6% and22.7% for sundrying were dried to 12.7%, 12.4%, 12.6%, 13.1% , and 11.8%.The times for drying were 5.3, 5.7, 4.8, 5.6 and 5 for sundryinghours each with MC reduction rate, $\Delta mc\%/hour$ of 1.16%, 1.33%, 1.94%, 2.41%; and 2.18% for sundrying. The mechanically dried samples were better than the sun-dried sample in terms of milling and headrice recoveries. At the commercial milling centre, Asawase, Kumasi, buyers and observers noted with envy the excellent quality of the milled rice from the dryer and said that the dryer was better than sundrying in terms of quality of milled rice, and was immediately bought. The heat efficiencies of drying the four consignments were 39.80%, 36.40%, 57.80% and 62.70%. Data from the field (questionnaire) showed that the dryer has an almost universal acceptance and urgent need. The plus factors enumerated were: it was portable; it had an affordable investment cost; it saved time; it required less labour, work and time for transport; and it was easy to operate. The results of the study as indicated by analysis of variance **(ANOVA)** show that there is significant difference ($P< 0.05$) between the headrice yields between sun drying and mechanical drying using the dryer. Taking the headrice yield from consignments used for drying, it is seen that there is significant ($P> 0.05$) difference among the headrice yields, but there is high significant difference($P< 0.01$) in headrice yields between that of the second consignment and the sun dried. Thus the conditions that prevailed during 2nd consignment drying should be maintained in the dryer so that after further improvement of the dryer, a more competitive headrice yield will be obtained.

Keywords: Continuous-Flow Mixing, Discharge Rollers, Milling, Sundrying, Mechanical Drying, Ducts.

1 INTRODUCTION

Rice is one of the major staple crops in Ghana. The demand for rice in the West African sub-region is growing faster than any other major source of calorie for especially urban dwellers. Local production and processing usually yields rice of poor quality for storage and consumption. This is due to inadequate knowledge of processing, especially with the control of moisture content. According to Ahmed et al. (2006),cited by Ibrahim, (2009), moisture content is one of the most important factors affecting the quality of rough rice during storage and that, it is high at time of harvest and must be reduced to nearly 14%wb or less with an appropriate drying process. (Ibrahim, 2009).

Grains deteriorate due to heavy rains at the time of harvesting. If there is a facility like dryers in every village during this season, this heavy loss may be eliminated.

After drying farmers can store the grains for a long period and it will sell in market at the highest rate. Rice should be quickly dried down to a moisture level of about 12 percent for storage, especially if it is going to be stored for several months.

Most farmers in Ghana sun-dry their paddy rice either as their first option, or in the absence

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of another option such as a mechanical dryer, or in avoidance of cash expense for drying. One of the factors affecting the energy required for drying grain include the moisture content at harvest and moisture content for storage. (Hellevang, 1994). When rice grains in the field reach harvest moisture (22%), the field sample may contain grains with moisture contents (MC) between 15 and 45%. (Kunze, 2008)

When wet rice is exposed to air with low RH, the rice grain will release water to the air (drying). The equilibrium moisture content (EMC) is the final moisture content (FMC) of the grain or seed after being stored for some time with surrounding air of a certain temperature and RH (IRRI, 2009). Improper and over-drying may reduce head rice yield and aroma. Rice varieties differ in their critical moisture content (11-16%)below which they fissure readily and in equilibrium moisture (Juliano, 1995). Final MC, tempering duration, tempering temperature, and drying air temperature had significant effects on HRY (Siebenmorgen et al, 2006).

Thus when the standard FMC is not maintained for a particular grain, overdrying will create fissuring in the grain leading to low HRY. On the other hand, higher FMC will cause deterioration of the grain during storage.

The main types of continuous- flow dryers used in the grain industry are cross-flow, concurrent-flow, counter-flow and mixed-flow (Srzednicki, 2005)

Continuous flow dryers can handle moisture levels as high as 25 and 30%. (Werhspann, 1998).

From technical point of view, drying and milling are the major constraints in the rice processing industry in the southern sector of the country. Widespread introduction of grain dryers cannot be avoided in the near future in the country. Although numerous experimental results have been reported on sun-drying of rice in Ghana, no studies on heated-air drying are available in the literature, especially of the new varieties developed. For this purpose, a study of milling properties of heated-air dried rice varieties was undertaken.Headrice recovery or HRY is the percent headrice ratio of the weight of grains that do not break in the process of milling and with the size of ¾ or more of the whole grain, to the total weight of milled rice, expressed in percent.(Ulepet al, 2005).

The specific objectives were: (i) to design and develop a low-capacity continuous flow dryer, (ii) to evaluate the performance of the dryer.

2. MATERIALS AND METHODS

The drying chamber with a holding a capacity of 250 kg freshly threshed paddy rice was fabricated using locally available materials such as angle iron, mild steel sheets, bolts and nuts. The drier consisted of plenum chamber, drying cabinet, electric heater, blower and discharge roller assembly, as shown in **Fig.1.**
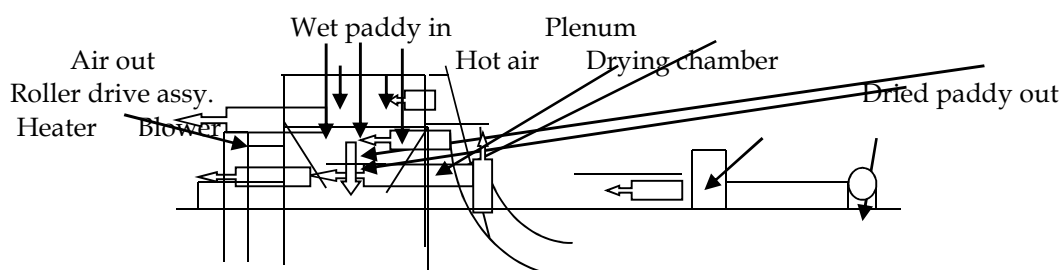
Fig. 1 Hot drying air and paddy movement of dryer.

The temperatures of heated and exhaust air were measured and a hygrometer was used to measure temperature of exhaust air also. Four consignments of wet paddy rice, 250 kg each were used for the evaluation of the dryer.

The following formulae were used for the calculations.

Humidity Ratio $X = \dfrac{0.622 \times Rh \times PS}{P_{atm} - Rh \times PS}$, in

[kg H_2O/kg dry air](Cengel& Boles, 2002)

$$PS = \frac{6 \times 10^{25}}{(T+273.15)^5} \exp\left[\frac{-6,800}{T+273.15}\right], \text{ in [Pa] (Hunter, 1987).}$$

Enthalpy, h = 1.005 x T + X x (2501.3 + 1.82 x T) , in [kJ/kg]. (Cengel&Boles , 2002),

whereT = Dry bulb temperature of air[   ]
PS = Saturation Pressure at T [Pa]
Rh= Relative humidity of air [%]

3.RESULTS AND DISCUSSIONS

Per batch, the amount of paddy rice dried was 250kg. Tests showed that paddy rice drying took from 4.8 to 5.6 hours for an MC reduction from 26.6% to a minimum value of 12%.

3.1 Inlet, and Outlet air Temperature, and Moisture content variations with Time

3.2 Relative Humidity of Ambient and Outlet air, and Moisture Content variations

Relative humidity graphs Fig. 3 shows that at the beginning of attaining steady thermometer readings, the relative humidity of the air in the drying chamber was very low, but rises sharply as soon as the rice is poured into the drying chamber.

3.3Humidity Ratio variation of Ambient and Outlet air

As indicated on Fig. 4 the humidity ratio of the outlet air for the first few minutes of drying increase and steadily decreased afterwards. The sharp increase was due to faster removal of surface moisture of the paddy. Towards the end of drying, the outlet moisture tended to be in equilibrium with the ambient, confirming completion of drying.

3.4 Enthalpy variations of Ambient and Outlet air

The enthalpy condition of the dryer was similar to that of humidity ratio, fig. 4. The sharp increase in enthalpy was due to faster removal

While the inlet temperature remains almost constant, the outlet dropped sharply from the steady state at the beginning when there was no rice in the drying chamber. As soon as the rice was poured the outlet air temperature dropped to attain that of the rice. The temperatures increase as the day wears on to midday. The moisture content MC is seen to decrease steadily to the required valueof12.4% for the paddy batches dried. The target MC was 12%.

Also the outlet air temperature is lower than the inlet, which confirmed the existence of temperature driving force for heat flow.

of surface moisture of the paddy. Towards the end of drying, the outlet moisture tended to be in equilibrium with the ambient, confirming completion of drying. Thus the enthalpy tends to remain constant.

3.5 Analysis of Milling Data

Milling and headrice recovery or the Head Rice Yield (HRY) are important criteria in assessing the quality of the paddy rice, which is greatly influenced by drying. Headrice recovery or HRY is the percent headrice ratio of the weight of grains that do not break in the process of milling and with the size of ¾ or more of the whole grain, to the total weight of milled rice, expressed in percent. This was determined from equation (a).

Head   Rice   Yield   = $\dfrac{weight\ of\ headrice}{toal\ grain\ weight}$
……………………………..(a)

The average milling and headrice recovery rates are shown in Fig.6. The mechanically dried samples had higher milling and headrice recovery rates than the sun-dried samples.
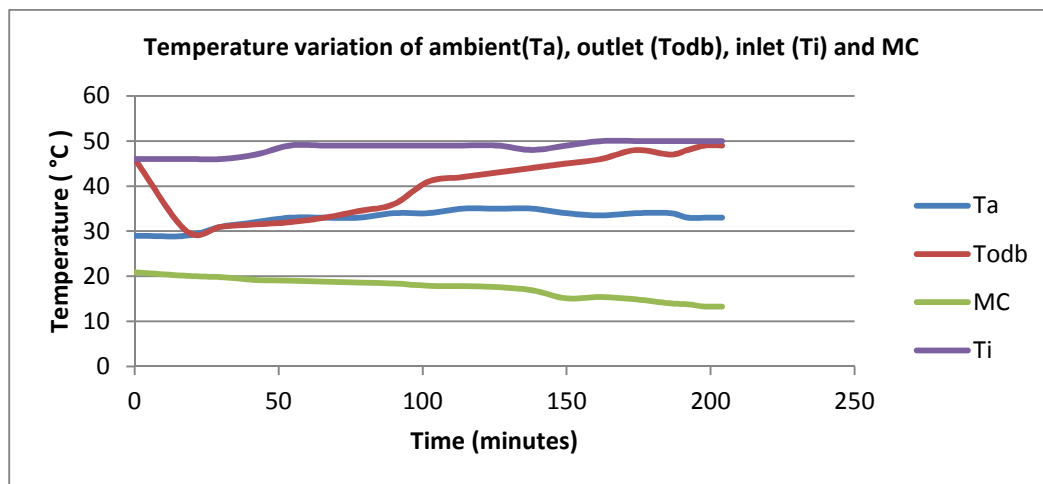
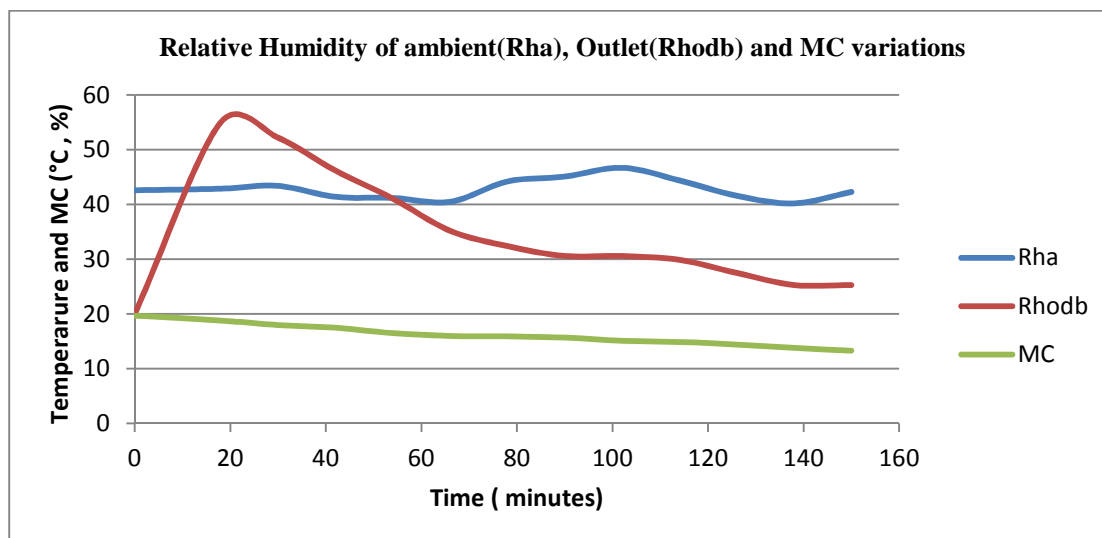**Fig. 2   Inlet, and Outlet air Temperature, and Moisture content variations with Time**

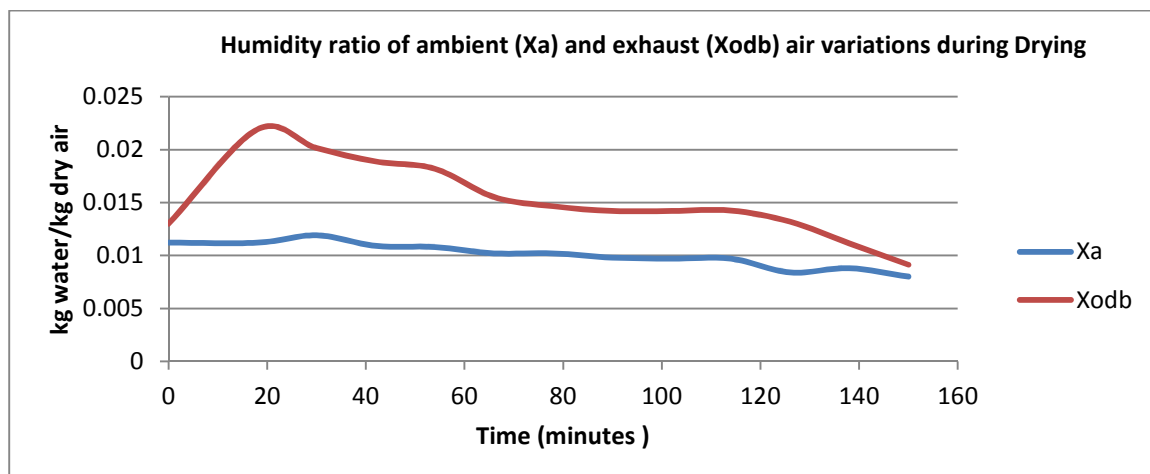**Fig. 3 Relative Humidity of Ambient and Outlet air, and Moisture Content variations**

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Fig. 4 Humidity Ratio variation of Ambient and Outlet air
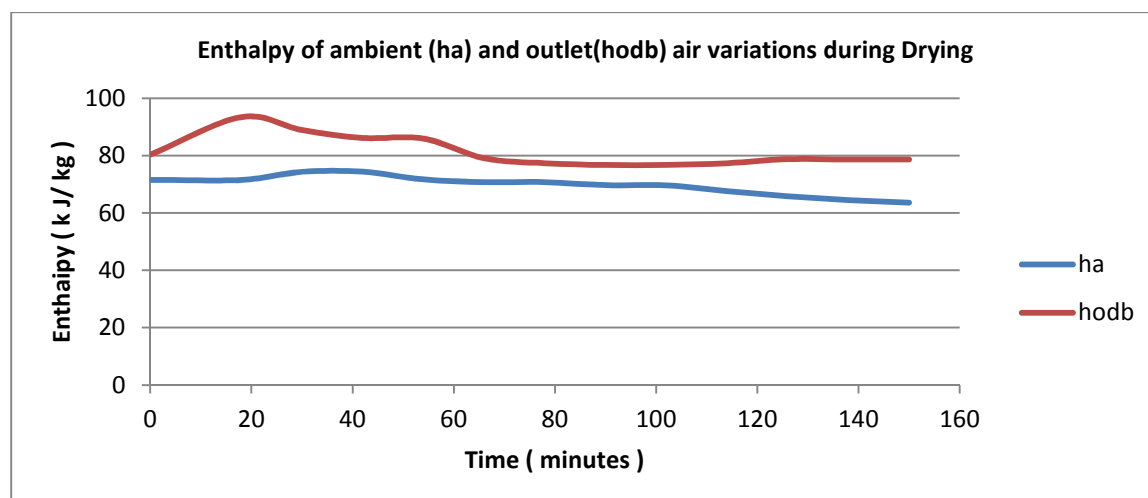
Fig.5 Enthalpy variations of Ambient and Outlet air
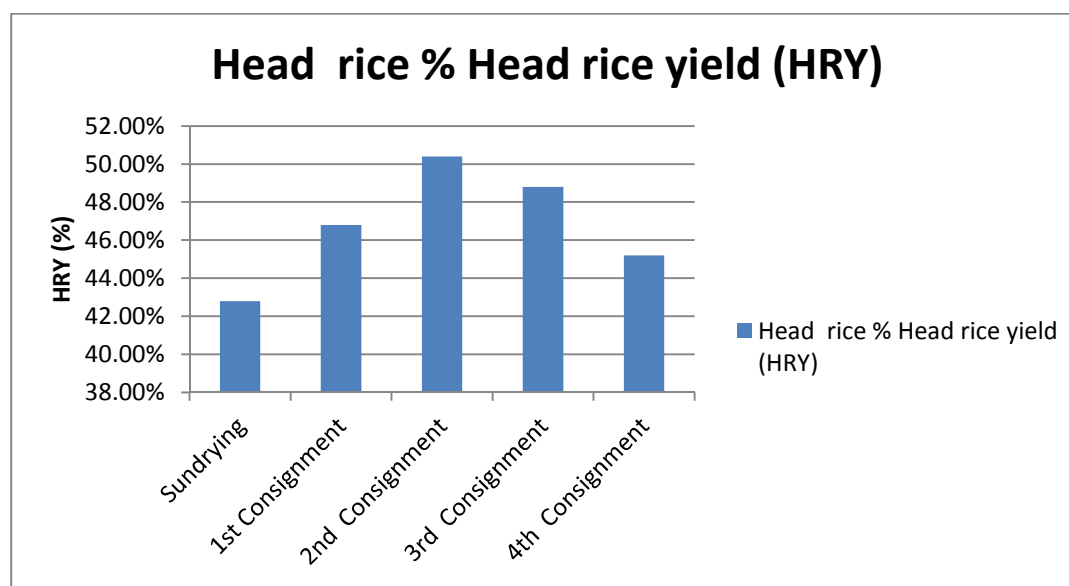
Fig. 6.Headrice versus % Headrice yield

3.5.1The superior headrice yield and quality of the Mechanically dried rice.

When the   rest of the rice was sent for commercial milling and sale, after taking the samples for analysis, the milling yield was much superior to the commercial sundried quality practiced by the local millers. The mechanically dried rice was the envy of the market women and within an hour, it was sold out, while that of the traditional sundried took three to four days to sell.

Commercial rice mills turn out 55% head riceyield on average, whereas head rice yield of village type rice mills is in the order of 30%.(IRRI, 2007).This design turned out an

average of 49%   head rice yield.Further refinement of the dryer can yield a target of 55% or more.

4 CONCLUSION

Although there are many available dryers, the continuous-flow mixing grain dryer was successfully built locally, using the available materials.The dryer was also evaluated, with moisture reduction during drying from an initial average of 22.2% to a final average of 12.7%. The drying rate ranged from 1.16% to 2.41% reduction of MC/hour, at a maximum heated air temperature of 49 .Thus this proved to be low temperature drying.

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The statistical analysis to compare the final moisture content withheadrice yield is shown below.

Table 1: Analysis of Variance (ANOVA)

Source of Var.	Rows	Columns	Error	Total
ss	28.3	2968.73	20.706	
df	4	1	4	
MS	7.2075	2968.73	5.1765	
F	1.39235	573.50121		
P-Value	0.3781	1.8E-05		
F_{CRIT}	6.3882	7.7086		

From Table 1, it is seen that the P-Value of 0.3781, (P>0.05) means there is no significant difference in the headrice yields for the corresponding final moisture contents.

Recommendations

There is, however, the need to improve the efficiency of the dryer by carrying out the following:

-   Further developing the technology itself, unwanted leakages of heated air and rice around the dryer should be sealed off, and roller design be improved.
-   , it is also important to reduce further the cost by using wood in the construction of the dryer instead mild steel.
-   Use vegetable waste as fuel for the dryer instead of electricity.
-   Design and develop bucket or pneumatic conveyor to accompany the dryer for easy loading and offloading.
-   The dryer should be used to test dry soya beans and other grains like maize, sorghum and millet in order to maximize its use in the field.

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APPENDIX I

Data on Paddy Rice

s/n	Paddy Consig	Initial Moisture	Final Moisture	Headrice recovery %
Source of Var.	**Rows**	**Columns**	**Error**	**Total**
ss	28.3	2968.73	20.706	
df	4	1	4	
MS	7.2075	2968.73	5.1765	
F	1.39235	573.50121		
P-Value	0.3781	1.8E-05		
F_{CRIT}	6.3882	7.7086		

- nments	content (IMC) %	Content (FMC) %	
1 C1	19.7	12.7	47.0
2 C2	20.9	12.4	51.2
3 C3	21.7	12.6	49.5
4 C4	26.6	13.1	45.4
5 Sun	22.7	11.8	42.3

APPENDIX II
Statistical Analysis

Anova: Two-Factor Without Replication

SUMMARY	Count	Sum	Average	Variance
Row 1	2	59.7	29.85	588.245
Row 2	2	63.6	31.8	752.72
Row 3	2	57.7	28.85	528.125
Row 4	2	62.4	31.2	655.22
Row 5	2	54.1	27.05	465.125
Column 1	5	62.6	12.52	0.227
Column 2	5	234.9	46.98	12.157

Monitoring the Motives of Student-Teachers Pursuing Further Studies in Sandwich Programmes in Basic Education

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Abstract
The purpose of this research was to apply factor analysis to reduce a set of twenty one motives of student-teachers who pursued the sandwich programme in Basic Education, to twelve most significant ones to enable policy makers to effectively and efficiently address them. A questionnaire of twenty one motives were constructed and distributed to about five hundred 2012/2013 sandwich-year students in the University of Education, Winneba, Ghana. The questions ranged from their personal information to issues of professional and job satisfaction. The data obtained was coded and explored with the Statistical Package for Social Sciences software. Descriptive statistics, correlation determinant, Kaiser-Meyer-Olkin value, Bartlett's statistic and scree plot were initially explored to assess the appropriateness of the method. The results of the correlation matrix, the communalities and the total variance were further validated with Varimax rotation with Kaiser Normalization and Cronbach Alpha oralpha factoring matrix atminimum threshold of 0.500. At the end of the iterations, the results showed that the six highly significant motives actually explained more than the targeted 70%. Therefore, for research, technology and innovation in education to serve as the bedrock for sustainable development in Ghana, policy makers must pay much attention to these twelve most significant motives bordering teachers who pursue further studies in the sandwich programme. The researchers also recommended this factor analysis method to academia, industry and other research institutions to replicate it in their areas of work.

Keywords: Monitoring; Motives; Sandwich; Student-Teachers

1.INTRODUCTION

The researchers originally set twenty-one questions on the student' gender, programme of study, class of teaching, number of years served, initial professional qualification and initial rank in teaching. The others were their present professional qualification, rank of teaching, rank aspired to, years served before first promotion, method used for first promotion, expected method of promotion after study and number of promotions obtained. The rest were present salary scale/level, returning/not returning to their education districts, reason for further studies, most challenging course, reason for the challenge and the main tool of success. The researchers drew inspirations from Tryfos (2001), Knafl (2005), Holand (2008), Ainsworth (2009), Ofori and Dampson (2011), Beaumont (2012) and Dinno (2012) procedures to explore the motives with the Statistical Package for Social Sciences (SPSS) software.

1.1 Statement of the Problem

Akyeampong, Djangmah, Oduro, Seidu and Hunt (2007) agree that much value have been placed on issues of gender, qualification and job satisfaction of the teacher and his/her conditions of service. Our experiences as former teachers of the Ghana Education Service (GES) also perceive the number of years of service, professional ranks and school positions or headships to be the most privileged concerns of every teacher. These promotions guarantee the teacher many privileges. Therefore, teachers look for all means possible to get promoted within the shortest possible period of service. We therefore need to explore many more of these motives and extract the highly significant ones.

1.2 Purpose and Objectives of the Study

The purpose of this research was to apply factor analysis to reduce a set of twenty one motives of student-teachers who pursued the sandwich programme in Basic Education, to twelve most significant ones to enable policy makers to effectively and efficiently address them. The specific objectives were to:
(1). pretest the data with descriptive statistics, correlation determinant, Kaiser-Meyer-Olkin

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value, Bartlett's statistic and scree plot to assess the suitability of the analysis.

(2). extract the significant motives with correlation matrix, the communalities (Eigen values) and total variance and explain the outcomes.

(3). validate the reduced significant motives with Varimax rotation with Kaiser Normalization and Alpha Factoring or Cronbach Alpha.

1.3 Hypothesis

H_0: the significant motives are independent (zero motive model).

H_a: they are not independent (i.e. there is at least 1 motive in the model).

Level of significance: 5%

Rejection criteria: p-value greater than 5% for all cases.

1.4 The Meaning of Factor Analysis

Tryfos (2001), Knafl (2005), Holand (2008), Albright and Park (2009) and Ofori and Dampson (2011) explain factor analysis as a statistical method used to find a small set of unobserved variables (also called latent variables or motives) which can account for the covariance among a larger set of observed variables (also called manifest variables). Factor analysis is a general name denoting a class of procedures primarily used for multiple data reduction and summarization in which the reduced variables are not either dependent or independent but rather interrelate. Tryfos (2001), Knafl (2005), Albright and Park (2009) agree that factor analysis usually proceeds in two stages. The first stage is called algebraic and it is the calculations of Eigen values and communalities which represent the theoretical variances and covariances according to a certain predetermined criterion. The second stage is called the geometric and it rotates the first with Varimax methods that fit equally well as the observed variances and covariances.

Algebraically, given the factors $F_1, F_2, ..., F_k$ that are linearly related to the unobservable motives $M_1, M_2, ..., M_k$, then

$$M_i = b_0 + b_{1i}F_1 + b_{2i}F_2 + ... + b_{1j}F_i + v_i$$
(1)

.

In (1) above, the b_{ij} are the factor loadings (communalities) explained by the common factors (motives) of F_{ij} and F_{ji} and v_i are the

error terms which seek to indicate that the hypothesized relationships are not usually exact.Geometrically too, Tryfos (2001) and Ainsworth (2009) explain that the factor extraction is equivalent to coordinate planes and the factors are the axes. This rotation is used to improve interpretability and utility of the algebraic communalities. Both definitions must satisfy some basic assumptions.

1.5 Assumptions of the Factor Analysis Method

The researchers agree with Knafl (2005) and Ainsworth (2009) assumptions that:

1). there should be reliable correlations, since this method is highly affected by missing data, outlying responses and truncated data.

2). sample size must be over 50. A sample size below 50 is described as very poor and over 1000 is excellent. A minimum sample size of 300 is always encouraged.

3). the sample distribution must be normal. We normally apply the multivariate method in assessing the number of factors.

4). there should be no multicollinearity or matrix singularity to enable us obtain the correlation matrix, the communalities and Eigen values. .

1.6 Pretest Methods of Factor Analysis

Knafl (2005) and Ainsworth (2009) hint that the common convention is to extract all factors with eigenvalues greater than 1 when using the Principal Component extraction. The other criteria are to extract all factors with nonnegative eigenvalues, using Kaiser-Meier-Olkin (KMO) measure ofsampling adequacy (MSA) greater than 0.05, the Bartlett's test of sphericity, correlation determinant and the asymptotcity of the scree plot. The researchers agree with Knafl (2005), Ainsworth (2009) and Ofori and Dampson (2011) assertion that researchers must carry out multiple test methods to assess the consistency of the factors extracted.

1.7 Correlation Matrix Determination (Residuals)

Knafl (2005), Holand (2008) and Ainsworth (2009) explain the correlation residuals as the measure of how well the model fits the correlations between factors. Ainsworth (2009), Ofori and Dampson (2011), Beaumont (2012) and Dinno (2012) at least, 50% of the correlation

matrix should be greater than 0.3. These residuals do not directly address data normality or outlier(s). We therefore need other pretest methods to support it.

1.8 Communalities Determination
Tryfos (2001), Knafl (2005) and Ainsworth (2009) define the communality as the amount of variance explained by the common factors. The communality is the sum of the squares of the loadings for the items over all the factors. The communality values always range between 0 and 1. Knafl (2005) and Ainsworth (2009) agree that all communalities start out as 1 and then recomputed from the initial extracted factors. When initial extracted factors are the same as the number of items, we use all the factors but when initial extracted factors are less, we determine the communalities themselves at our specified criterion.

1.9 Eigenvalues and Total Variance Determination
Knafl (2005) and Ainsworth (2009) explain the eigenvalue as the measures of how much of the total variance is being accounted for by its associated factors. They explain that eigenvalues are normally generated in decreasing order. So, factors with larger eigenvalues contribute more towards the explaining the total variance than those with smaller Eigen values. The sum of the eigenvalues over all factors equals thetotal variance. Eigenvalues greater than one (called the dominants) contribute more to the total variance and must be retained and those less than one should be discarded.

1.10 Varimax Rotation Validation Approaches
Knafl (2005), Holand (2008) and Ainsworth (2009) explain that when the first factor solution does not reveal the hypothesized structure ofthe loadings well, we rotate in an effort to find anotherset of loadings that fit the observations well. Tryfos (2001), Knafl (2005) and Ainsworth (2009) agree that the most widely used orthogonal rotation method is the Varimax. This is because the rotated loadings are easy to interpret, maximizes the variance, detects outlier factors, enlarges the significance factors and minimizes the absolute values in the component matrix.

1.10.1 Component Matrix Rotation
Knafl (2005) and Ainsworth (2009) explain the component matrix as the marker item (or a salient) whose absolute loading is high on one factor and low on all the other factors. They agree that an absolute loading of 50% and above is usually better. This means marker items that have either high absolute loadings on more than one factor or low absolute loadings on all factors should be discarded because they do not represent distinct aspects of the factor. Alternatively, Knafl (2005) and Ainsworth (2009) caution that if some factors have small numbers of marker items, the number of factors may have been set too high and need to be reduced.

1.10.2 Cronbach Alpha and Alpha Factor Determination
Knafl (2005), Ainsworth (2009), Fraenkel and Wallen (2009) explain the Cronbach Alpha as a method to assess the construct validity of the new scales derived after the factor analysis method. They purge the acceptable value at least 0.7 used to predict the related quantities extracted from the alpha factoring method. That is why Knafl (2005) and Ainsworth (2009) contend that the alpha factoring matrix can be used in place of the Cronbach alpha if it is found to be unreliable. This may be because its optimal properties may be lost after the Varimax rotation method.

2. METHODOLOGY
The researchers applied the PC method in exploratory factor analysis to determine the number of factors to be modeled as motives.Deshpande (2004), Onita and Schiopu (2010), Dogbegah, et al. (2011), Beaumont (2012) and Dinno (2012) have adopted many multinomial factor analyses with the SPSS software with varied sample sizes and coding schemes. The researchers adopted the 500 sample size to model this data. The researchers then developed a questionnaire on twenty-one items consisting of statements followed by six weighted options, except gender. The contents of the questionnaire distributed to about five hundred 2012/2013 sandwich-year students in the University of Education, Winneba, Ghana ranged from their personal information to issues of professional and job satisfaction.About 83% recovering rate was achieved. The researchers undertook some

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pretest measures to ascertain the suitability of the method and further validated the reduced set of significant motives with Varimax rotation and alpha factoring matrix.

3. RESULTS
3.1 Pretest Results
The descriptive statistics revealed that the means ranged from 1.44 to 4.39, the standard deviations from 0.50 to 1.76 and the coefficient of variations from 29% to 62%. It was therefore, observed that the responses were quite close and can be applied with the factor analysis method. The default output of the component matrix showed that there were 42 (53.0%) non-redundant residuals with absolute values greater than 0.5. These gave the researchers the impetus to apply the factor analysis.

Table 1: Pretest Results of KMO and Bartlett's Tests

Kaiser-Meyer-Olkin Measure (KMO) of Sampling Adequacy.		0.633
Bartlett's Test of Sphericity	Chi-Square	1673.925
	Degree of Freedom	210
	Level of Significance	0.000

The results in Table 1 show the pretest results of KMO and Bartlett's tests of all the twenty one motives. We have observed thatthe initial KMO value was 0.63 and with the Bartlett's test of sphericity of Chi-square value of 1673.925 at 210 degrees of freedom. The null hypothesis was rejected at the 5% level of significance for the alternative hypothesis. These results allowed us to undertake the data reduction process.
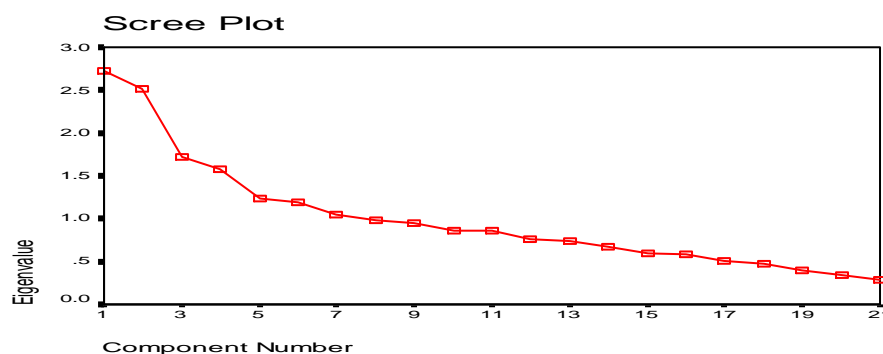
Figure 1: The Initial Scree Plot of the Twenty One Factors

The curve displayed in Figure 1 shows the initial scree plot of the twenty one motives to determine the existence of factors with higher eigenvalues or factor loadings. We have observed that there exists a tremendous change in slope between the 6th and 7th factors. This suggests that six factors might be a reasonable number to represent our highly significant motives. However, the slope is not totally asymptotic to the component axis and cannot be used as the best test for the actual number of motives to be retained.

3.2 Final Results of Loadings
Table 2: Final Factor Loadings/Communalities

Q. Motives	Extractions		
	Diagonal	Initial	Final
Q1. Gender	1.000	0.306	***
Q2.Programme offered in UEW	1.000	0.515	***
Q3. Level Teaching B4 coming to UEW	1.000	0.577	***
Q4. Years served in District	1.000	0.659	0.744
Q5. Initial Professional Qualification	1.000	0.561	0.660

Q6. Initial Rank of Teaching	1.000	0.672	0.775
Q7. Present Professional Qualification	1.000	0.556	***
Q8. Present Rank of Teaching	1.000	0.675	0.762
Q9. Promotion Rank After Course	1.000	0.668	0.820
Q10. Years before 1st Promotion	1.000	0.592	***
Q11. Mode for 1st Promotion	1.000	0.695	0.661
Q12. Mode of Promo after Course	1.000	0.534	0.670
Q13. No of Promos B4 Course	1.000	0.583	***
Q14. Salary Scale	1.000	0.728	0.701
Q15. Salary Level	1.000	0.662	0.736
Q16. Reason for Returning District	1.000	0.413	***
Q17. Reason for Leaving District	1.000	0.466	***
Q18. Reason for Further Studies	1.000	0.523	0.813
Q19. Most challenging course	1.000	0.473	0.726
Q20. Reason for challenging course	1.000	0.537	0.641
Q21. Tool to measure success of course	1.000	0.617	***

The results on Table 2 show the final communalities of both the twenty one (21) and the twelve (12) motives. We have observed that after the initial extraction, most communality loadings in column 2 were less than the minimum threshold of 0.500. We therefore, iterated it further to obtain the final loadings between 0.64 and 0.820 as in column 3. The asterisks indicated that those motives were eliminated because they had lower loadings. Even though we know those motives that were retained, we could not quantify how much they contribute individually and collectively to the over all data.

Table 3: Final Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulativ e %	Total	% of Variance	Cumulativ e %	Total	% of Variance	Cumulativ e %
1	2.206	18.387	18.387	2.206	18.387	18.387	1.927	16.062	16.062
2	1.807	15.061	33.449	1.807	15.061	33.449	1.481	12.344	28.405
3	1.336	11.136	44.585	1.336	11.136	44.585	1.396	11.630	40.035
4	1.280	10.668	55.253	1.280	10.668	55.253	1.382	11.520	51.555
5	1.051	8.757	64.010	1.051	8.757	64.010	1.274	10.613	62.168
6	1.030	8.582	72.592	1.030	8.582	72.592	1.251	10.424	72.592
7	.774	6.447	79.039						
8	.655	5.456	84.495						
9	.618	5.154	89.650						
10	.524	4.368	94.018						
11	.393	3.274	97.292						
12	.325	2.708	100.000						

The results on Table 3 show the final total variance explained by the first twelve most significant motives. We have observed that the dominant eigenvalues in decreasing order are 2.2, 1.8, 1.3, 1.3 and 1.1. Also, these first six motives that initially explained only 13%, 12%, 5.7%, 7.5%, 5.9% and 5.7% respectively, have each increased markedly to about 18%, 15%, 11%, 11%, 9% and 9% and 6% individually to the total variance. The six motives have also increased the total variance from about 57% to 79% altogether while all the first twelve jumped from over 80% to exactly 100%. This shows that the other discarded nine factors would have contributed barely anything to the total variance. However, this table falls short of showing the particular motives that really contributed more to the total variance. We used the Varimax rotation to detect these highly significant motives.

Table 4: Final Rotated Component Matrix

	Final Components					
Questions	**1**	**2**	**3**	**4**	**5**	**6**
Salary Level	**0.846**	0.082	0.108	-0.043	-0.008	-0.039
Salary Scale	**0.812**	0.095	0.020	0.149	0.097	0.030
Years served in District	-0.069	**0.840**	0.059	0.075	0.104	0.117
Mode for 1st Promotion	-0.320	**-0.705**	0.017	0.195	0.007	0.152
Promotion Rank After Course	-0.008	-0.064	**0.900**	-0.022	-0.002	0.079
Present Rank of Teaching	0.256	0.204	**0.679**	0.429	0.045	-0.089
Initial Rank of Teaching	0.207	-0.159	0.104	**0.834**	0.008	0.032
Initial Professional Qualification	-0.491	0.125	0.032	**0.626**	0.073	0.075
Most challenging course	-0.134	0.018	0.159	-0.078	**0.820**	0.056
Reason for challenging course	0.266	0.077	-0.165	0.161	**0.715**	0.011
Reason for Further Studies	0.027	0.172	-0.074	0.092	-0.063	**0.874**
Mode of Promo after Course	-0.079	-0.374	0.199	-0.056	0.241	**0.651**

The results on Table 4 show the final rotated component matrix of the twelve most significant motives. We have observed that salary level and scale (0.812 and 0.846) loads highly on first motive, years served and first promotion (0.840 and -0.705) on the second, rank of promotion after course and present rank (0.900 and 0.679) on third, initial rank and professional qualification on the fourth (0.834 and 0.626), most challenging course and the reason (0.820 and 0.715) on the fifth and reasons for further studies and mode of promotion after the course (0.874 and 0.651) on the sixth factor. It must be noted that mode for first promotion was the only motive with negative maximum absolute loading. That notwithstanding, one can now clearly see the six most significant motives pushing teachers to pursue further studies. It had been confirmed that many of them actually came in order to get promoted to the higher ranks to obtain higher salary scales and levels. The alpha factoring was used to assess the appropriateness or otherwise of these results.

Table 5: Alpha Factoring of Twenty-One Motives

Factors	**Motives**					
	1	**2**	**3**	**4**	**5**	**6**
Gender	-0.184	0-.250	0.162	0.067	0.047	0.102
Programme offered in UEW	-0.042	0.331	0.203	0.112	0.273	-0.043
Level Teaching B4 coming to UEW	0.346	0.104	-0.110	0.054	**0.430**	-0.075
Years served in District	0.104	0.308	**-0.491**	-0.200	0.267	0.184
Initial Professional Qualification	**0.400**	-0.080	-0.150	0.028	-0.038	-0.166
Initial Rank of Teaching	**0.354**	0.299	0.037	0.130	-0.193	-0.269
Present Professional Qualification	0.259	0.338	0.096	**0.447**	-0.103	0.040
Present Rank of Teaching	0.383	**0.501**	-0.098	0.380	-0.138	0.038
Promotion Rank After Course	**0.397**	0.183	0.162	0.338	0.007	0.186
Years before 1st Promotion	**0.437**	-0.361	0.234	0.079	0.008	0.217
Mode for 1st Promotion	0.293	**-0.457**	0.324	0.090	-0.162	-0.050

Mode of Promo after Course	**0.412**	-0.109	0.324	-0.098	0.049	0.202
No of Promos B4 Course	**-0.355**	0.149	-0.046	-0.052	-0.027	0.111
Salary Scale	-0.247	**0.631**	0.178	0.076	-0.057	0.171
Salary Level	-0.359	**0.601**	0.268	0.129	-0.019	0.138
Reason for Returning District	-0.290	-0.012	**0.328**	0.061	0.022	-0.048
Reason for Leaving District	0.215	0.199	0.195	**-0.335**	-0.080	-0.008
Reason for Further Studies	0.214	0.073	0.217	-0.224	0.234	-0.068
Most challenging course	0.250	0.088	0.064	-0.280	-0.054	0.191
Reason for challenging course	0.115	**0.337**	-0.005	-0.360	-0.245	0.037
Tool to measure success of course	-0.172	0.149	0.299	-0.164	0.003	-0.361

The results on Table 5 show the alpha factoring of the twenty-one original motives on the six highly significant motives. This method was used in place of the Cronbach alpha to confirm whether these dominant motives can stand the test of time. We have observed that salary level, salary scale and present rank have reached the minimum threshold of the 0.50 and no dominant motive had a value below the worst value of below 0.30. This meant the method was fairly accurate.

4. DISCUSSION

We have pre-tested the suitability of the methods with descriptive statistics, correlation determinant, KMO value and scree. The closed mean range of 1.44 to 4.39, the standard deviations of 0.50 to 1.76 and the coefficient of variations of 29% to 62% were very suitable. Also, the Bartlett's test of sphericity of Chi-square test of significance at the 5% was rejection to mean that the analysis would produce significant factors to fit a model that adequately explain why the teachers pursued the programme.

Particularly, the results of six factors explained about 79% and twelve factors explained all the main motives for pursuing the further studies. This means even though twelve motives were significant, six of them were very crucial in explaining the massive exodus of teachers for further studies. Policy makers must not only pay more attention to these six motives but also put eagle eyes on the other six. The results of the component rotated matrix confirmed that the teachers actually came to the University of Education, Winneba to get promoted to higher ranks to obtain the privileges that go with higher ranks.

5. CONCLUSIONS

The results showed that twelve motives explained 100% and six highly significant motives alone explained more than 79%. Therefore, for research, technology and innovation in education to serve as the bedrock for sustainable development in Ghana, policy makers must pay much attention to these six most significant motives bordering teachers in the classroom. In particular, the most volatile issues were staying more than two years in the classroom, getting quick promotions and being paid higher salaries. The researchers have therefore, recommended that factor analysis method implored by academia, industry and other research institutions in their areas of work.

- All 2012/ 2013 final-year sandwich student-teachers

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Structural Time Series Analysis of Inflation and Interest Rate Volatility in Ghana.

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Abstract
The relationship between inflation and interest rate is of interest to many economy planners. The objective of this paper is to establish the relationship between interest rate and inflation in Ghana. Using monthly data for the period January 2003 to December 2013, this paper employ time series techniques, namely unit root tests, cointegration test and Granger causality to the data. The unit root test showed that both interest rate and inflation are non-stationary at the levels of the process but stationary at first difference. Again, the cointegration analysis revealed that there is exist cointegration among inflation and interest rate for the period under study and that interest ratecauses inflation but the converse is not true. The paper recommends that managers of the Ghanaian economy should focus more on regulating the conduct of commercial banks in terms of managing theinterest rates commercial banks set since it has be found that the interest rate drives inflation more than inflation driving interest rate.

Keywords: Cointegration, granger causality, levels, stationary and unit root.

1 INTRODUCTION

Inflation and interest rates have been at the center of discussion on the Ghanaian economy in recent times. This is partly be due to the significant contribution of these variables in any economy. Again, the accurate prediction and study of these variables is critical to all stakeholders in the economy due to their relative closeness in practice and theory. Indeed Fisher (1930) maintained that interest rate is the main determinant of inflation. Known as the Fisher's hypothesis, this hypothesis has been tested in many economies around the world with interesting results. Sheefeni (2013) tested the relationship between interest rate and inflation in the Namibian economy from 1992 to 2011. He concluded that the Fisher's hypothesis do not hold in the Namibian contest for the period under study.

In the Ghanaian context, recent development and commentaries about the economy suggest that interest rate and inflation are different trends and this makes it very difficult for economic planners, business leaders and the general citizenry. It is in light of this that the researcher seeks to establish the structural nature of these two important variables and establish the stochastic phenomenon in the two variables. Indeed, data from the past two decades from 1993 – 2013 suggests a very interesting phenomenon.

In light of the revelation from the data from 1993 – 2013, this paper attempts to examine whether the Fisher hypothesis is valid in the Ghanaian context by empirical evidence. This motivation for this work is from the fact that many published work in the field has failed to examine the two variables co-currently. Again, Ghana is a developing country and the findings of the study would help policy makers to give suitable policy directions as far as inflation and interest rates are concerned.

Related works
According to Fisher (1930) expected inflation is the main determinant ofinterest rates. He maintained that the nominal interest rate consists of an expected 'real' rate and anotherexpected inflation rate component. The implication is there is a one-to-one relationship between inflation and interest rates.Again, the hypothesis also suggests that real interest rates were unrelated to theexpected rate of inflation and were determined entirely by the real factors in an economy, such asthe productivity of capital and investor time preference. According to Mundell (1963) there is noone-to-one adjustable relationship between nominal interest rate with expected inflation rate.
However, Mundell (1963) supports the Mundell-Tobin effect, that nominal interest rates would rise less thanone-for-one with inflation as suggested by Fisher (1930). This is due to the fact that according to inflation changes and movements, the public wouldhold

less in money balances and more in other assets, which in effect will cause interest rates to fall.

Again, Fama (1970) is of the view that there is a negative relationshipbetween inflation and stock prices and this does not affirm Fisher hypothesis. This gave birth to the theory of "Efficient Capital Market", thedefinitional statement of this theory is that in an efficient market, prices "fully reflect" availableinformation. The argument put forward is that because all information about the market isimmediately reflected in the prices, an increase in the level of inflation will lead to an increase inthe nominal value of securities such as stocks relative to the real value. Mishkin (2004) clarifiedFama's hypothesis by arguing that securities such as stocks represent ownership of real assets.When the nominal value of these securities surpasses their real value as a result of the inflationeffect, investors would sell their financial assets (i.e. stocks) in exchange for real assets. Theselling of these financial assets leads to decline in the financial assets price due to an increase inthe market supply. This implies a negative relationship between inflation and these financialinstruments.

According to Sheefeni (2013), empirical literature has verified a positive relationship between inflation rate and interest rate.Among them are Mundel (1963), Tobin (1965), Feldstein (1976) and Mishkin (1981). However,there are other studies who found no strong relationship between the two variables. Among themare, Mishkin (1992) and Ghazali (2003). Brazoza and Brzezina (2001) and Fave and Auray(2002) are among the studies that found long-run relationship between interest rate and inflation.Booth and Ciner (2001) have studied the relationship between interest rate and inflation rateusing cointegration in nine (9) European countries and U.S. The findings confirm a long-runrelationship between the two variables, except for one case.

Lardic and Mignon (2003) examined the relationship between interest rate and inflation rate inG-7 countries using Engel-Granger cointegration method. The findings from their study confirmthat there is a long-run

relationship between interest rate and inflation rate.

Berument, Seylan and Olgun (2007) investigated the validity of the Fisher hypothesis for theG7 countries. The study estimated a version of the GARCH specification. Furthermore, the studyalso tested the augmented Fisher relation by including the inflation uncertainty. The findingsreveal that there is a positive relation between interest rates and expected inflation, for the G7countries and 45 developing economies. The simple Fisher relation holds in all G7 countries butin only 23 developing countries. There is a positive and statistically significant relationshipbetween interest rates and inflation uncertainty for six of the G7 and 18 of the developingcountries and this relationship is negative for seven developing countries.

Sathye et al (2008) studied a relationship between short-term nominal interest rate andinflation in the context of the Indian financial market. They employed Augmented Dickey-Fuller,co-integration and Granger-causality test on monthly data of inflation and nominal short terminterest rates during the period of April 1996 to August 2004. The findings are that expectedinflation and nominal short-term interest rates are co-integrated in the Indian context. Hence, the present study does not reject the Fisher effect in the Indian financial market. Furthermore, the test shows that expected inflation is Granger caused by nominal short term interest rates.

Mahdi and Masood (2011) analyzed the relationship between interest rates and inflation in Iran, in the context of Fisher's hypothesis by using the Johansen's co-integration approach and then vector error correction model (VECM) approach. The result shows that there is one cointegration relation, so there is one co-integration equation too. Consequently, the results show that there is a long run relationship between these variables in Iran. Also, the results show that the long run relationship between the weighted average of interest rate is weak, while the long run relationship between rental rates of housing and inflation is strong.

Awomuse and Alimi (2012) investigated the relationship between inflation and interest rate in Nigeria using annual data for the period 1970 – 2009 in order to test whether the Fisher hypothesis holds. The study utilized Johansen cointegration and error correction mechanism. The results reveal that interest rates and inflation move together in the long-run but not on one-to-one basis. This implies that the whole Fisher hypothesis does not hold fully but there is a very strong Fisher effect. The results further shows that causality run strictly from expected inflation to nominal interest rates as suggested by the Fisher hypothesis and there is no "reverse causation".

Teker et al (2012) examined the relationship between deposit rates and consumer price index to test the Fisher hypothesis. The study employed the threshold vector error correction (T-VEC) analysis on the monthly data for the period 2002:01 – 2011:03. The findings show that interest rate and inflation are positively affected by their pass two and one periods respectively.

In light of the above mentioned literature, one may conclude onthe opinion that there are mixed findings with regard to the Fisher hypothesis ranging from those refuting, agreeing and no relationship at all. There are also different methodological approaches whether it is cross-country or individual country's studies. There is variation in terms of data frequency used ranging from monthly, quarterly and annually.

There seem to be no study on Ghana that has tested the Fisher hypothesis in examining the structural time series effect of these two important econometric variables. It is against this background that this study intends to fill the gap and add to empirical literature for Ghana.

2. METHODOLOGY
The methodology followed in this study is that of the Mahdi and Masood (2011) in testing the validity of Fisher hypothesis. In particular, the following three – step procedure is adopted.

(i)   Testing for unit root and determine the order of integration for the two variables

(ii)   Testing for cointegration

(iii)   Conducting Granger – causality if it is established that there is cointegration among the variables.

Unit Roots Tests
If any time series data shows that the mean, variance and covariance are not constant over time, then there is what we called non-stationarity which may lead to spurious regression. To avoid spurious regression and have valid results that can be depended upon, it is important to first and foremost conduct unit root test in order to establish whether or not the data under review is stationary and again to determine the order of integration. It is therefore imperative to assess the time series component and identify whether there exist pure random walk, that is no intercept and time trend, random walk with drift, that is intercept and no time trend or even random walk with drift and time trend meaning the presence of intercept and times components.

These are presented by:

(i)   Pure Random walk

$$\Delta y_t = u y_{t-1} + \sum r_t \Delta y_{t-1} + v_t$$

...   . **(1)**

(ii)   Random walk

$$\Delta y_t = r + u y_{t-1} + \sum_{t=1}^{p} r_t \Delta y_{t-1} + v_t$$

...   . **(2)**

(iii)   Random walk with drift and time trend

$$\Delta y_t = r + x t + u y_{t-1} + \sum_{t=1}^{p} r_t \Delta y_{t-1} + v_t$$

...   . **(3)**

Cointegration Tests
Cointegration seeks to establish the existence of long run equilibrium relationship among variables. That it find out whether the variables will converge in the long run. This study make use of the Johansen cointegration test in order to determine the existence of cointegration equations. The first step is the difference equation by the vector autoregressive (VAR) framework

$$Y_t = s_1 Y_{t-1} + s_2 Y_{t-2} + s_3 Y_{t-3} + ... + s_n Y_{t-n} + v_t$$

...   . **(4)**

Where Y_t is the lag length $n(p \times 1)$ vector endogenous variable, then difference changes as

$$\Delta Y_t = \sum_{k=1}^{n-1} f_k \Delta Y_{t-k} + f Y_{t-n} + v_t \qquad \ldots (5)$$

Whereby f_k is a short term adjusting coefficient to explain short - -term relationship, f is long term shock vector that includes long term information. The rank of f decides the number of cointegreted vector and has three forms or presentation. These are

(i)   When all the variables are stationary in the regression (Y_t) then

$$rank(f) = n$$

(ii)   When all the variables are stationary series in the regression (Y_t) then

$$rank(f) = 0$$

(iii)   When some of the variables exist for some number of cointegreted vector, r, then

$$0 < rank(f) = r < n$$

The Johansen cointegration approach uses the rank of f to distinguish the number of cointegreted vector and examine rank of vector in testing the number of non-zero characteristic roots exist in the vector under consideration. The two statistic processes for cointegration included the Trace and the Maximum eigenvalue tests.

The Trace Test
The trace hypothesis is given below. The null hypothesis is valid for at most r integrated vector and for the alternate hypothesis, there must be at least $r+1$ integrated vector.

$$H_0 : rank(f) \le r$$
$$H_1 : rank(f) > r \qquad \ldots \qquad \ldots \qquad \ldots (6)$$

$$\}_{trace}(r) : -T \sum_{i=r+1}^{n} \ln(1 - \hat{\}}_i) \qquad \ldots \qquad \ldots (7)$$

T is the sample size, $\hat{\}}_i$ is estimate of characteristic root. If we reject the null hypothesis it implies variables exist at $r+1$ long term cointegreted relationship.

Maximum Eigenvalue Tests
In a similar manner to trace test, the maximum eigenvalue hypothesizes as follows.

$$H_0 : rank(f) \le r$$
$$H_1 : rank(f) > r \qquad \ldots \qquad \ldots \qquad \ldots (8)$$

$$\}_{max}(r, r+1) : -T \ln(1 - \hat{\}}_{r+1})$$

The process starts with testing from variables that do not have any cointegration relationship for $r = 0$. The number of cointegretive item to a point of not rejecting the null hypothesis which implies there are $\ln(1 - \hat{\}}_{r+1})$ cointegreted vector.

Causality Tests
There are different hypotheses to study the cause and effect relationship of variables. Granger (1969) developed a model based on lead and lag relations in forecasting. Granger causality test is considered to be very useful technique for determining whether a time series process is good for forecasting another variable. Granger causality test can be applied under various conditions. A simple bivariate Granger can be conducted where there are two variables and their respective lags. When there are more than two variables to be considered, then a multiple Granger causality can be applied. Again, Granger causality can be used to test a Vector Autoregressive (VAR) process in a multivariate model when we need to test for simultaneity of all variables included.
Granger use two factors of VAR to establish the casual relationship between variables. The VAR can be seen as a means of conducting Granger causality Tests in a more specific term. For inflation denoted by gross domestic product (GDP) and nominal interest rate denoted by INT, we can develop two basic equation for the testing of causality among the two variables.

$$(GDP)_t = \Gamma + \sum_{i=1}^{m} s_i (GDP)_{t-i} + \sum_{j=1}^{n} \ddagger_j (INT)_{t-1} + \sim_t$$
$$\ldots \qquad .. \qquad \ldots \qquad \ldots (9)$$

$$(INT)_t = {}_n + \sum_{i=1}^{p} w_i (INT)_{t-i} + \sum_{j=1}^{q} \{_j (INT)_{t-j} + y_t$$
$$\ldots \qquad \ldots \qquad .. \qquad \ldots (10)$$

Based on the estimated OLS coefficients for equations (9) and (10), four different hypotheses about the relationship between GDP and SP can be formulated. These are

(i) Unidirectional Granger – Causality from INT to GDP. In this case, interest rate increase the rate of inflation in the economy but not vice versa. Thus $\sum_{j=1}^{n} \ddagger_j \neq 0$ and

$$\sum_{j=1}^{q} \{_j = 0$$

(ii) Unidirectional Granger – Causality from GDP to INT. In this case, rate of inflation increase the interest rate in the economy but not vice versa. Thus $\sum_{j=1}^{n} \ddagger_j = 0$ and

$$\sum_{j=1}^{q} \{_j \neq 0$$

(iii) Bidirectional (or feedback) causality is when is a case

$$\sum_{j=1}^{n} \ddagger_j \neq 0 \text{ and } \sum_{j=1}^{q} \{_j \neq 0 .$$

That is to say change in inflation causes change in interest rate and vice versa.

(iv) Finally when $\sum_{j=1}^{n} \ddagger_j = 0$ and

$$\sum_{j=1}^{q} \{_j = 0 ,$$ then we say there is independence between interest rate and inflation and that there is no Granger-causality in any direction.

Hence by obtaining one of these results, then there would be the possibility to detect the causality relationship between interest rate and inflation in Ghana.

In effect two – step procedure in testing for the situations to be concluded on either equation (9) or (10). Considering (9) for example we proceed as follows.

1. Restricted regression is conducted by regressing GDP on its past values excluding interest rate, INT, in the regressors to obtain the restricted sum of squared residuals.
2. Again, a second regression, called unrestricted regression by including the lagged INT from which we derive the unrestricted sum of squared residuals is obtained. Then the F – test statistics is computed as follows.

$$F = \left. \left\{ \frac{SSR_r - SSR_u}{n} \right\} \middle/ \left\{ \frac{SSR_u}{T - (m + n + 1)} \right\} \right.$$
...   . (**11**)

Where SSR_r and SSR_u are the two sums of squared residuals related to the restricted and unrestricted form of the equation; the elements that form the degree of freedom are T, while **n** and **m** are the number of lags. The optimal values are $m = 2$ and $n = 7$ for m defined as lag of the GDP series and **n**, the lag for the INT series (Foresti, 2006).

3 RESULTS AND DISCUSSION

Monthly inflation and interest rate data from January 1993 to December 2013 in Ghana were obtained from the Ghana Statistical Service. Using SPSS version 16 and Microsoft Excel spreadsheet packages, the results and discussion on the study are presented.

Unit Root Tests

The Augmented Dickey – Fuller (ADF) and Phillip - Perron (PP) tests are non – stationary tests which have the limitation of lower power and persistent unit roots respectively. This implies the ADF and PP test tend to under – reject the null hypothesis of unit roots; for this reason the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, which is a stationary test in also conducted as a confirmatory test to the non-stationary tests (Akuffo et. al., 2013).The results of the unit root test are presented in Table 1.

Table 1: Unit root tests using ADF and PP in levels and first difference

Variable	Model	Levels		First difference		Order of integration
		ADF	PP	ADF	PP	
$\ln(GDP)_t$	intercept	-3.23	-2.54	-8.46**	-15.35**	1
	intercept and trend	-3.43	-2.94	-8.44**	-15.24**	1
$\ln(INT)_t$	intercept	-2.07	-1.75	-11.07**	-12.43**	1
	intercept and trend	-1.76	-3.87	-11.01**	-12.34**	1

Notes :(a) 5% Critical value for the intercept is -2.95, and -3.61 for the intercept and trend model. (b)**rejection of null hypothesis at 5%.

From Table 1, since all the absolute test statistics are less than the critical values, at levels for both models, we fail to reject the null hypothesis and conclude that, both inflation and interest rate are non-stationary at levels. However, after, transformation,it can be seen from Table 1 that the absolute test statistics are all greater than the absolute critical values, hence we reject the null hypothesis and conclude that inflation and interest rate for the period is stationary at first difference. This results is consistent with the results of Akuffo and Ampaw (2013) on modelling of inflation using ARIMA model in Ghana.

As a confirmatory test, a stationarity test is also conducted using Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test of stationarity on the series. The results of the KPSS test is as presented in Table 2.

Table 2: Unit root test using KPSS in levels and first difference

Variable	Model	Levels	First difference	Order of integration
		test statistic	test statistic	
$\ln(GDP)_t$	intercept	0.56	0.05**	1
	intercept and trend	0.19	0.05**	1
$\ln(INT)_t$	intercept	2.54	0.03**	1
	intercept and trend	0.23	0.01**	1

Notes :(a) 5% Critical value for intercept model is 0.458, and 0.146 for intercept and trend model (b)**rejection of null hypothesis at 5%.

From Table 2, it can be seen that, at levels, all the test statistics are more than the critical values at 5%, hence we reject the null hypothesis that the process is stationary and conclude that inflation and interest rate in Ghana for the period 2003 to 2013 is non – stationary. However, after first difference, the KPSS test shows test statistics of less than the critical values at 5%, hence, the process becomes stationary after first difference just as in the case of the Augmented Dicker Fuller and Philip Perron tests.

We can now confidently conclude that the process, inflation and interest rate for the period are stationary at first difference notwithstanding the limitation of the **ADF** and **PP** non – stationarity tests. Once stationarity has been achieved, the next step is to conduct the cointegration test.

Testing for Cointegration
Haven achieved stationarity, the Johansen cointegration test based on the trace test and maximum eigen tests are conducted to establish whether or not there are cointegration among inflation and interest rate during the period under review. The results of the test are presented in Table 3.

Table 3: Johansen Cointegration test based on Trace and Maximum- Eigen values.

Hypothesis	Rank	Johansen Statistic		95% Critical Value	
		$\}_{trace}$	$\}_{max}$	Trace	Maximum eigen value
Null hypothesis	$r = 0$	18.33	15.57	15.50	14.25
	$r \leq 1$	3.04	3.04	2.82	2.82

From Table 3, since the test statistics for both the trace and maximum eigen value tests, are more than the stated critical values, we reject the null hypothesis. We conclude based on both the trace test and maximum eigen values, that there exist cointegration between interest rate and inflation for the period under study.

In effect it is expected that there exist a long run relationship between inflation and interest rate in Ghana. This suggests that the variables may

Granger causality test

Following the discussion under section 3.3, the results of the Granger causality test is as presented in Table 4 and Table 5for equation (9) and (10) respectively. The tables report various output corresponding to different regressions for comparison.

The Granger causality test for equation [9] is as presented in Table 4. The values of F statistic suggest that interest rate causes inflation, and

be causally related at least in one direction. That is to say change in inflation may lead to a change in interest rate or vice versa.

The theoretical task now is to establish which of these variables will influence the other the more. As indicated in the literature, we appeal to the Granger test of causality to determine which of these variables influence the other the more.

inflation does not Granger – cause interest rate. That is past values of interest rate contribute to the prediction of the present values of inflation even with past values of inflation for different combination of lags. However, the relatively low levels of R^2 in the estimated models suggest the limited ability in using interest rate for the prediction of inflation in Ghana.

Table 4: Results of Granger-Causality Test for "interest rate cause inflation" model

N	m	F - Stat	F – Ratio	DW - Stat	$\overline{R}^2$
1	2	5.472*	6.784***	2.21	0.239
		(1, 120)***	(3, 120)		
2	2	10.004**	9.231***	2.05	0.242
		(2, 120)	(4, 120)		
3	2	6.872**	7.456***	1.88	0.253
		(3, 120)	(5, 120)		
4	2	5.437**	6.234***	1.94	0.206
		(4, 120)	(6, 120)		
5	2	3.921***	5.612***	1.05	0.119
		(5, 120)	(7, 120)		
6	2	3.654***	4.832***	1.92	0.193
		(6, 120)	(8, 120)		
7	2	3.0285***	4.321***	2.07	0.281
		(7, 120)	(9, 120)		

Note:* indicates statistical significance at 5%, ** indicate statistical significance at 1%.

That is to say other important variables are needed for successful prediction of inflation. However, theR2for (n, m) pair of 0.281 gives

theoptimal combination of the lags for prediction of inflation using interest rate.

Table 5: Results of Granger-Causality Test for "inflation cause interest rate" model

Q	P	F - Stat	F – Ratio	DW - Stat	$\overline{R}^2$
1	2	0.042	0.143	1.712	0.008
		(1, 120)	(3, 120)		
2	2	0.627	0.464	1.728	0.0275
		(2, 120)	(4, 120)		
3	2	0.341	0.451	0.937	0.023

		(3, 120)	(5, 120)		
4	2	0.310	0.291	0.989	0.021
		(4, 120)	(6, 120)		
5	2	0.482	0.424	1.984	0.044
		(5, 120)	(7, 120)		
6	2	0.492	0.464	2.113	0.196
		(6, 120)	(8, 120)		
7	2	0.411	0.3869	2.332	0.249
		(7, 120)	(9, 120)		

From Table 5, clearly, it can be seen that there exist statistical non-significance. The associated F test give opposite results as presented in Table 4. That is there is no Granger-Causality from past values of GDP for future values of interest rate. The low levels of R^2 also give credence to the fact that inflation may not have enough predictive power to predict interest rate in Ghana.

For confirmatory analysis, we conduct a Granger causality for lags VAR. The results is as shown in Table 6.

Table 6: Granger causality results for lags VAR

Model with GDP as dependent variable		
Variable	FW – statistics	Probability
GDP	**63.1869**	**0.0000**
INT	**1.0234**	**0.3654**

Model with INT as dependent variable		
Variable	FW – statistics	Probability
GDP	**4.0330**	**0.0124**
INT	**9.4235**	**0.0001**

Source: Author's own calculations

From the Granger causality test as presented in Table 6 for the models specified in equation (9) and (10) it can be seen that interest rate (INT) shows statistical insignificance for inflation rate (GDP) rate with a probability measure of 0.3845. That is to say the lagged variable of inflation rate does not cause movement in interest rate per the results in Table 6. However, the Granger causality test for inflation rate shows statistical significance for interest rate with a probability measure of 0.0124. That is, if the statistical Granger causality test with respect to estimated model for lagged VAR is used, then there exist a unilateral causality between inflation and interest rate. The implication is that inflation is caused by the lagged interest rate in Ghana but the one – on – one causation cannot be establish. Thus the results can be considered as a confirming the results obtained by Table 4.

4 CONCLUSION

Using monthly data, the study has presented the relationship between interest rate and inflation from 2003 to 2013 in Ghana. The motivation for the study was from the fact that these two economic variables are crucial in any developing economy and its mixed interpretation given nowadays in the Ghanaian economy. From the study it was revealed that there is a causation effect between inflation and interest rate exists in the Ghanaian context. The Granger causation test revealed thatchanges in interest rateslead to changes in inflation as stipulated by Fisher (1930) but the one-on-one relationship could not be establish with R^2 of 28%. The implication is that, the notion that interest is the main determinant of inflation do hold good in Ghana and that, if authorities want to hold inflation in check, then interest rate management is key but the converse is not true per the findings. This raises questions about the suitability of inflation targeting that is being practiced by the Bank of Ghana.

That is to say since interest is found to influence inflation and not vice versa, it will be economically prudent and statistical imperative to target interest rate and manage it in the economy. The study therefore recommends that the Bank of Ghana should reconsider its inflation targeting policy

implementation in the face of the current findings.

Further work

Again, a multivariate model such as classical regression should be conducted involving variables as inflation, interest rate, exchange rate, money supply, demand, etc. to determine the significance of these variable also on inflation.

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Assessing Quality of Domestic Water Sources in Central Gonja District

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Abstract
The quality of water sources in the Central Gonja District in the Northern Region of Ghana has been questioned due to activities that pollute water in the area. This research analysed the quality of drinking water sources in the Central Gonja District. One hundred and eight (108) water samples were collected from boreholes, rivers, rainwater and dam in the wet and dry seasons within six months. The samples were analysed in the laboratory according to the procedures and protocols outlined in the Standard Methods for the Examination of Water and Wastewater for pH, turbidity, total hardness, nitrate and faecal coliforms (FC). Analysis of the water sources showed that the parameters of boreholes measured were seasonally affected except for conductivity which was high in the dry season. All the parameters for river and dam water varied with the seasons. In relation to faecal contamination, the borehole, river water and dam were seasonally affected, and unsuitable for drinking without treatment. Based on the WHO guidelines, rainwater in the area can be regarded as potable owing to its higher quality over the other water sources in the study area. Generally, rainwater can be recommended for drinking, cooking, bathing and washing for the people of Central Gonja District.

Keywords: Dam; River; Borehole; Rainwater; Season.

1. INTRODUCTION

Water supply which is easily available, potable and affordable is a prerequisite for good hygiene, sanitation and is central to the general welfare of all living things. The World Health Organisation (WHO) estimated 1.8 million deaths each year due to lack of access to safe water, sanitation and hygiene. However, about 784 million people worldwide still need to gain access to safe drinking water (UN, 2008). The United Nations Environmental Programme (UNEP) estimates show that 250 million people in Africa will be at risk of water stress, less than 1700 m³ of water available per person per year by 2020 and up to 500 million by 2050 (Falkenmark et al., 1989). Sub-Saharan Africa is making the slowest progress in meeting the MDGs target with one-third of the population still need safe drinking water (UN, 2008).

Ghanaians still suffer from water shortages, 50 % of the population uses unimproved sources of drinking water. This figure is 10 % higher than the average for the African continent, where 40 % lack access to improved drinking water supply (Murcott et al., 2008). In the Northern Region of Ghana, 56 % of the population uses unimproved water supplies for drinking. This problem is exacerbated by lack of improved sanitation in the region where 92 % lack access to good sanitation (vanCalcar, 2006).

The water supply situation in the Central Gonja District is grim and water scarcity is regarded as one of the root causes of water related diseases and poverty in the area. Residents of the district rely on boreholes, rainwater, dams, rivers, and dug-outs for their domestic water needs. Some of these water sources serve as drinking places for animals as well, and the health risks posed by this situation are endless and far reaching. This paper assessed the quality of domestic water sources in the Central Gonja District.

2. METHODOLOGY
2.1 Water sampling and preservation
First, 52 plastic bottles were soaked in nitric acid (NHO₃) overnight, washed with distilled water, rinsed with deionised water and dried in a drying cabinet. Some of the dry containers were selected, filled with distilled water and the pH tested, when it is 7.0 then it is ready for use, otherwise the container was washed and the pH tested again. This was done to minimise or eliminate potential contamination of the samples. Water samples were collected from each sampling site between the months of August 2010 and April 2011 that is from August

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2010 to November 2010 (wet season) and from January 2011 to April 2011 (dry season). This was done to account for any seasonal variation in the quality of the water sources. In the wet season, fresh rainwater samples were collected directly from the sky using the plastic bottles at Buipe, Yapei and Mpaha towns (12 samples) which served as control. The plastic bottles were raised from the ground by placing them on top of 1 m blocks in order to avoid sand and rainsplash and other ground based pollution. Three (3) boreholes were also sampled at Buipe, Yapei and Mpaha towns (36 samples). In addition, the Black and White Volta Rivers were sampled in Buipe and Yapei towns respectively, whilst the Mpaha dam was sampled in Mpaha town (16 samples). The boreholes, rivers and the dam (8 samples) were sampled every month for the wet season. Boreholes were pumped for five minutes prior to sampling to ensure collection of a representative sample. In the dry season, sampling was similarly repeated. The sample containers were clearly labelled with the site, date and time of sampling on the bottles.

2.2 Analysis of Water Samples
The key physico-chemical and biological parameters were determined according to procedures and protocols outlined in the Standard Methods for the Examination of Water and Wastewater (APHA, 1992).

2.2.1 Water pH
The pH of water samples was determined immediately after sampling using Fisher brand Hydrus 100 pH Meter. Before the measurement was taken, a manual three buffer solutions of pH 4.01, 7.0, and 9.2 were used to calibrate the pH meter. The CALCULATE key was pressed to calibrate and the automatic calibration procedure was followed. The pHs of the samples were measured by reading the values displayed on the screen after the READY signal had disappeared.

2.2.2 Total hardness
25 ml of the well-mixed water sample was measured into a conical flask. 2.0 ml of buffer solution and a pinch of Eriochrome black were added. If the sample turned into wine red in colour, magnesium and calcium was present. The solution was titrated against 0.01 M EDTA until the wine red colour turned to blue. A blank titration was also carried out using distilled water.

Calculation:

$$TH = \frac{(A-B)}{C} \times 1000 \qquad [1]$$

Where; TH: Total Hardness (mg/l), A: Volume of EDTA for sample (ml), B: Volume of EDTA for blank (ml) and C: Volume of water sample (ml).

2.2.3 Nitrate
An aliquot of 2 ml of 0.1 M NaOH solution and 1.0 ml of naphthyl-1, 1-amide was added to the sample. The mixture was allowed to stand for 20 minutes. The nitrate concentration was determined at wavelength 543 nm wavelength of absorbance using a 5500 photometer. A blank analysis was performed with all the reagents without sample for all the analysis.

2.2.4 Faecal Coliform
The Coliscan medium was poured into a sterilized petri-dish, which was labelled with the code of sampling site and the quantity of sample water used from each site. 250 ml of the sample was measured into the petri-dish using a sterilized pipette. The water sample was swirled around the petri-dish to ensure even distribution. The petri-dish was covered with a lid and set aside at room temperature until the solution solidified. The procedure was repeated for all the samples and the petri-dishes were incubated at 44 °C for 24 hours. The petri-dishes were then taken out from the incubator, and all developed dark-blue and pink colonies were counted separately.

Calculation:

$$FC = \frac{C_C}{V_f} \times 100$$

[2]

Where; FC: Faecal coliform units (cfu/100 ml), CFU: Coliform Faecal Unit per 100 ml, C_C: Colonies counted and V_f: Volume of sample filtered (litres).

2.3 Data Analysis
The mean values of parameters were computed using Microsoft Excel software. Two replicates (Should have been a minimum of three?) were made and statistical test (t-test at 5 %) was used to separate the mean values of the parameters measured. Descriptive statistics were also presented using charts and comparing the

mean values with WHO Drinking Water Guidelines.

3. RESULTS
3.1 Water pH
The mean pH of borehole water from Buipe town were 8.65 and 7.65 for the wet and dry seasons respectively with significant difference (5.41, P<0.05) between the seasons. At Yapei town, the mean pH of borehole water in the wet season was 9.95 whilst the dry season had a value of 8.9 with significant difference (4.51, P<0.05) between the seasons. Borehole water from Mpaha town had mean pH of 9.74 for the wet season and 8.85 for the dry season with significant difference (4.51, P<0.05) between the seasons.

River water from Buipe had mean pH of 8.9 and 7.70 in the wet and dry seasons respectively. There was significant difference (3.70, P<0.05) of pH between the seasons. At Yapei town, the wet season had a mean pH of 9.25 and that for the dry season was 7.85 with significant difference (5.33, P<0.05) between the seasons.

The mean pH of the dam at Mpaha town was 8.25 in the wet seson and 7.11 was recorded in the dry season. Th ere was significant difference (5.29, P<0.05) of pH between the seasons. The mean pH of rainwater from Buipe, Yapei and Mpaha towns were 6.26, 6.37 and 6.82 respectively. There was no significant difference between rainwater from Buipe and Yapei towns (0.34, P<0.05). However, significant difference of pH was recorded between rainwater from Buipe and Mpaha (1.84): Yapei and Mpaha towns (1.92) at 0.05 significant levels.
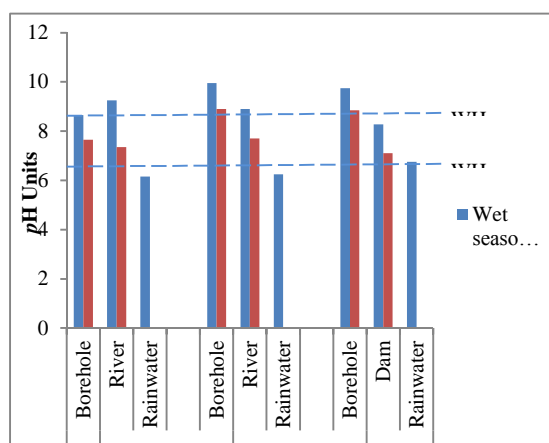
Fig. 1.0: Comparison of water sources in terns of pH

3.3 Nitrate
The borehole samples from Buipe town had mean nitrate concentration of 4.5 mg/l and 3.30 mg/l in the wet and dry seasons respectively. There was significant difference (2.52, P<0.05) of nitrate concentration between the seasons borehole samples from Buipe. In Yapei, the mean nitrate concentration was 4.33 in the wet season and 3.30 in the dry season. There was significant variation (2.41, P<0.05) of nitrate concentration between the season for borehole samples from Yapei. The mean nitrate concentration of the borehole samples from Mpaha town in the wet season was 4.25 mg/l and 3.20 mg/l in the wet season. At Buipe, the river samples had mean nitrate concentration of 9.93 mg/l in the wet season whilst the dry season had a value of 5.2 mg/l with significant difference (5.09, P<0.05) between the seasons. The river samples from Yapei town had mean nitrate concentration of 9.59 mg/l and 4.75 mg/l for the wet and dry seasons respectively. Mean concentration of nitrate for the dam in Mpaha was 24.10 mg/l and 20.87 mg/l in the wet and dry seasons respectively. There was significant difference (1.36, P<0.05) between the seasons in terms of nitrite concentration. Rainwater samples from Buipe, Yapei and Mpaha towns had mean nitrate concentration of 2.19 mg/l, 2.15 mg/l and 2.17 mg/l in the wet season.
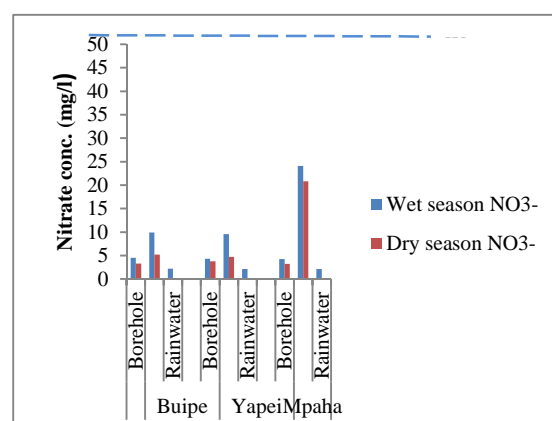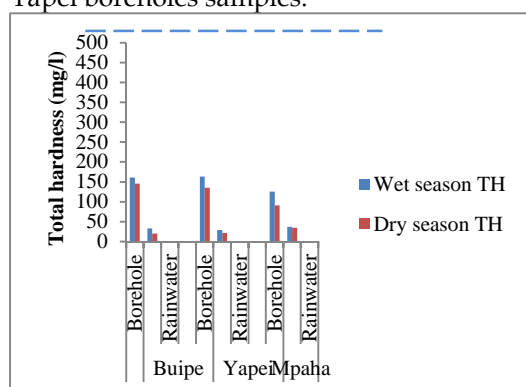

Fig. 2: Comparison of water sources in terns of Nitrate

3.4 Total hardness
The borehole samples from Buipe had mean total hardness of 226.67 mg/l in the wet season

whilst the dry season had 170.83 mg/l with significant difference (3.83, P<0.05) between the season.

The boreholes samples from Yapei had mean total hardness of 163.50 mg/l and 135.41 mg/l for the wet and dry seasons. The borehole samples from Yapei were also significantly affected (1.45, P<0.05) by seasonal variation. In Mpaha, the borehole samples had mean total hardness of 125.41 mg/l and 90.83 mg/l fro the wet and dry seasons respectively. There was significant variation (1.48, P<0.05) of total hardness between the season for the borehole samples from Mpaha. Mean total hardness measured for the river samples from Buipe was 32.67 mg/l in the wet season and 20.35 mg/l for the dry season. The river samples from Buipe were significantly affected (3.32, P<0.05) by seasonal variation in terms of total hardness. In Yapei, the borehole samples had mean total hardness of 29.05 mg/l and 21.55 mg/l for the wet and dry seasons respectively. Also, significant difference (1.07, P<0.05) of total hardness occurred between the seasons of the Yapei boreholes samples.
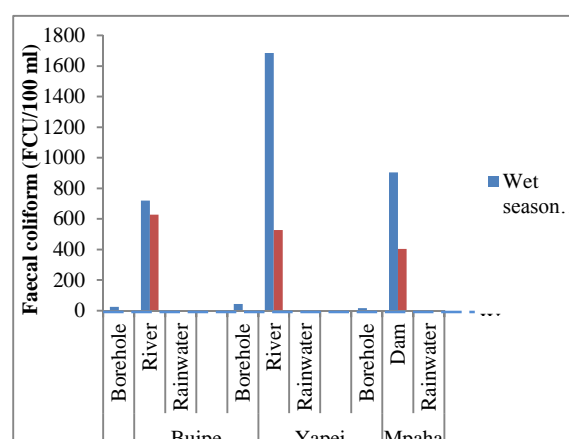

Fig. 3: Comparison of water sources in terns of TH

3.5 Faecal coliform
The mean faecal coliform of borehole samples from Buipe was 25.16 CFU/100 ml in the wet season and 3.33 CFU/100 ml in the dry season. There was significant difference (3.422, P<0.05) of faecal coliform between the seasons for the borehole samples from Buipe. In Yapei, the mean faecal coliform recorded for the borehole samples was 43.91 CFU/100 ml and 2.41 CFU/100 ml for the wet and dry seasons respectively. Significant difference (5.37, P<0.05) of faecal coliform was found between the seasons for the borehole samples from Yapei. The borehole samples from Mpaha had

mean faecal coliform of 16.84 CFU/100 ml in the wet season whilst the dry season had a value of 2.16 CFU/100 ml. The borehole samples were also significantly affected (2.84, P<0.05) by seasonal variation in terms of faecal coliform.

The river samples from Buipe had mean faecal coliform of 1720.25 CFU/100 ml in he wet season and 627.5 CFU/100 ml in the dry season. There was significant difference (5.75, P<0.05) of faecal coliform between the seasons for the borehole samples from Buipe. In Yapei, the mean faecal coliform for the river samples was 1685 CFU/100 ml and 526.50 CFU/100 ml for the wet and dry seasons respectively. Significant difference (6.23, P<0.05) of faecal coliform occurred between the seasons for the river samples from Yapei.
The mean faecal coliform for the dam in the wet season was 904.25 CFU/100 ml and 403.75 CFU/100 ml in the dry season. There was significant difference (6.23, P<0.05) of
faecal coliform between the wet and dry seasons. Faecal coliform was not detected in the rainwater samples from Buipe, Yapei and Mpaha suggesting that it is devoid of pathogens from intestines of mammals.

Fig. 3 Comparison of water sources in terns of FC

4. DISCUSSIONS
4.1 Borehole Water
The results indicated that borehole water from Yapei and Mpaha towns were alkaline throughout the year. However, the high mean pH in the wet season may be due to the presence of limestone in the aquifer formation that dissolved to release $CaCO_3$ into the water (Freeze and Cherry, 1979). The low mean pH in the dry season may have been caused by high

temperatures that increased the concentration of H^+ ions, hence decreasing the pH of the borehole water. There was no significant difference of pH between the borehole water from Buipe and Yapei (1.33): Buipe and Mpaha (1.4): Yapei and Mpaha (0.82) at 0.05 significant level in the wet season. In the dry season, no significant difference of pH was recorded between borehole water from Buipe and Yapei (1.24): Buipe and Mpaha (1.45): Yapei and Mpaha (0.82) at 0.05 significance level. This may be attributed to the almost homogeneous geological materials, mainly sedimentary rocks that underlie the study area (Dickson and Benneh, 2004). The sedimentary rocks are sources of Calcium ions which might have increased the pH of borehole water from the studied towns. The presence of nitrates in the boreholes suggests the leaching of dissolved nitrogen from fertiliser application from nearby farms facilitated by rainwater percolation into the groundwater.

The low mean nitrate concentration in the borehole samples may be due to the reduction of nitrate to nitrogen gas and ammonia by microbes (e.g. nitrobacteria). A study on the modelling of groundwater flow and quality by Konikow and Glynn (2005) found that the presence of organic carbon (present in the soil) may cause the reduction of NO_3^- to NO_2 and sometimes to NH_4^+ ions in the phase of denitrifying microbes

The high mean total hardness of the borehole samples in the wet season may be due to dissolution of metallic ions such as Mg^{+2}, Ca^{+2} ions from limestone and sedimentary rocks by rainwater percolation in the soil. The ions may have originated from run-offs that infiltrated into the soil, causing leaching and weathering of limestone and feldspars in the soil. The result is the precipitation of Ca^{+2} and Mg^{+2} ions and other mineral constituents in the soil that can also increase the total hardness of groundwater. A study by Freeze and Cherry (1979) of groundwater established that Ca^{+2} and Mg^{+2} ions are usually released into groundwater by the dissolution of limestone, feldspars and micas which increases its hardness. The low total hardness in the dry season may be the result of low aquifer recharge, hence less dissolution of the mineral composition of the aquifer.

The high faecal coliform in the wet season can be associated with the insanitary habits of residents in the studied communities. For instance, the practice of compound burial by the inhabitants can be reflected in the presence of faecal coliform in the borehole samples from all the communities. In Buipe and Yapei, the boreholes are located within households and may have been the reason for the higher faecal loads in the borehole samples. However, the boreholes from Mpaha are located 2 km away from the households, and the possibility of faecal contamination may be low. The ingress of coliform bacteria into the groundwater might have been facilitated by rainwater which percolated into the borehole.

4.2 River Water

The high mean pH of river water in the wet season could be due to the release from farmlands of alkaline fertilizers such as ammonia and phosphates carried by run-offs into the rivers. These substances might have altered the acid-base equilibrium and resulted in a lower acid-neutralizing capacity, hence raising the pH of the rivers (Wetzel, 2001). However, the mean pH of the river samples decreased in the dry season. During the dry season, CO_2 is released when phytoplankton and other organic materials in the river decay (Wetzel, 2001). The CO_2 can combine with the water to form HCO_3^- that may have lowered the pH of the rivers in Buipe and Yapei. Significant difference (1.82, $P<0.05$) of pH was recorded between river water from Buipe and Yapei in the wet season. The relatively low pH of Black Volta at Buipe may be due to high concentration of dissolved organic loads (Rickey et al., 1990). The low pH of Black Volta at Buipe might have been caused by high amounts of dissolved sediments.

The high mean nitrate concentration in the wet season can be attributed to run-offs from nearby farms which carried nitrogen fertilizers into the rivers. A study of trading on water by Greenhalgh and Faeth (2001) indicates that in the wet season, run-offs carry nutrients from farmlands and deposit it in the river body. In the presence of denitrifying bacteria, the nitrates may have been converted to NH_4^+ ions which lowered the nitrate concentration of the rivers as confirmed by Konikow and Glynn

(2005). The high total hardness of the river samples in the wet season means   run-off carried sediments containing Ca^{+2} and Mg^{+2} ions into the rivers.

The high faecal coliform in the wet season may be caused by the massive floods that hit the Central Gonja District between August and December yearly. The floods affected 112 communities with 15 boreholes and 3 public toilets submerged in the district (CGDHD, 2010). Also, the high microbial load in the rivers might be due to contamination caused by human activities and livestock in the area. It is a common practice for people living along the river catchment to discharge domestic and agricultural wastes as well as human excreta into rivers.

4.4 Rainwater
Buipe and Yapei are situated along the Kumasi-Tamale trunk road, hence the lower mean pH values can be attributed to wet atmospheric deposition of CO_2, SO_2 and NO_2 produced by vehicular emissions including the slash and burn method of land preparation for farming in the study communities. Kohler et al. (1997) in their study of the contribution of aircraft emission to atmospheric nitrogen content indicates that rainwater acquires slight acidity as it dissolves CO_2 and NO_2 gases in the atmosphere. Rainwater from Buipe and Yapei may acquire slight acidity from vehicular emissions along the Kumasi-Tamale trunk road as confirmed by Kholer et al. (1997). Mpaha is located about 60 km away from the main road which might have accounted for relatively high pH values. Generally, the mean pH of the boreholes, rivers, dam and rainwater sources in Buipe, Yapei and Mpaha areas were within the "safe range" of drinking water. Therefore, no skin diseases are expected in the study area. This may be the reason for no major reported cases of skin diseases in the study area as indicated by 2009/2010 annual report of Central Gonja District Health Directorate.

The presence of nitrates in the rainwater samples may be due to direct dissolution and oxidation of NO_2 to NO_3^- particles caused by the use of nitrogen fertilizers for crop cultivation in the study area. This observation is buttressed by Thomas (1993) in his study of rainwater quality from different roof catchments that in agricultural areas, rainwater could have higher concentration of nitrate due to fertilizer residue in the atmosphere. Rainwater samples from Buipe, Yapei and Mpaha areas recorded 0.00 mg/l mean total hardness. The above is confirmed by Krishna (2003) that the zero hardness of rainwater helps prevent scale formation on appliances. However, there is some indication that very soft water may have adverse effect on mineral balance (Appiah, 2008).

Faecal coliform was not detected in the rainwater samples from Buipe, Yapei and Mpaha, suggesting that it is devoid of pathogens. The absence of coliforms can partly be explained by its mode of collection. Rainwater samples were collected directly into containers as it fell from the sky. However, contamination of rainwater may result from the environment, roof materials and containers which are used for rainwater storage (Polkowska et al., 2001). The unacceptable coliform counts in the boreholes, rivers and dam may be linked to the high rate of gastro-enteritis because many inhabitants rely on these water sources for domestic use. Currently, medical records from the District Health Directorate in the study area indicate that diarrhoeal diseases increased by 168 % in 2009 against 2010 318 %, and 321 % for Buipe, Yapei and Mpaha.

5. CONCLUSION
The results of the study showed that the parameters of boreholes measured were seasonally affected except for conductivity which was high in the dry season. All the parameters for the river and dam water varied with season. In relation to faecal contamination, the borehole, river water and dam were seasonally affected, and unsuitable for drinking without treatment. Based on the WHO guidelines, rainwater can be regarded as potable owing to its higher quality over the other water sources in the study area.

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Impact of Vat Rate Changes on Vat Revenue in Ghana

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Abstract
One of the critical activities of any government is the raising of revenue to achieve fiscal policy objectives. Most of these revenues are raised through taxes. The main purpose of this research was to investigate the effects of the changes in the VAT rates on VAT revenue. The researchers used ARDL cointegration procedure to analyse the effect of changes in the VAT rate on VAT revenue in Ghana. Data for 2003-2012 was used. The study revealed that changes in the VAT rates have not had any significant effect on the VAT revenue. Rather, government expenditure and improvement in GDP had a more significant impact on the VAT revenue, even though the tax buoyancy was generally low and this is attributed to lapses in the tax system in Ghana. Based on the findings of this studyhave been made and it is expected to serve as a guide to management of the VAT Service, policy makers and other stakeholders in tax revenue mobilisation.

Keywords:VAT Rate; ARDL Cointegration; VAT Revenue; Inflation; Ghana

1 INTRODUCTION

Taxes are of paramount importance to every government. This is because the success or failure of every government depends on its ability to undertake development projects and improve on the life of its people. Governments therefore need to raise enough revenue to meet their commitments. The primary purpose of tax is to collect revenue to finance government expenditure. Ebril, Keen and Bodin (2002) stated that Value Added Tax (VAT) is defined as a tax applied on the value which is added to goods and services at each stage in the production and distribution chain. According to the authors, the defining feature of VAT is that it sets off taxes paid by enterprises on their material inputs against the taxes they must levy on their own sales. Notwithstanding the widespread use of VAT for revenue mobilization, there is no uniformity in the administration of VAT system across countries. Some countries have used a uniform rate for VAT across all sectors while others have used different rates for different sectors and products. Some governments have also resorted to increasing the tax rates over time to raise more revenue while others too have maintain static rates.

In Ghana, the VAT was first introduced on the 1st March 1995 by the VAT Act, 1994(Act 486) as part of the Tax Reform Programmes which began in 1993. It was however suspended three months later after implementation by the Government in response to a general public outcry against high inflation. In 1998 the VAT was reintroduced under the Value Added Tax Regulation, 1998(LI 1646) to replace sales and service taxes previously administered by Customs Excise and Preventive Service (CEPS) and Internal Revenue Service (IRS) respectively. Accordingly, a new Act (Act 546 of 1998) was enacted to make the tax operational in Ghana, beginning from December 1998 with a rate of 10% instead of the initial 17.5% that was proposed in 1994 and implemented in March 1995. The VAT system in Ghana is administered by the VAT Service and the CEPS which is responsible for collecting the VAT on imports. Now the domestic tax division which is made up of VAT and IRS are responsible for the collection of Domestic VAT after the integration. Over the past thirteen (13) years that VAT has been operational, there have been a couple of upward reviews in the uniform rates charged. It started from 10% and is currently at 15%. The theory is that a decrease in VAT rate will lead to a higher VAT yield as consumers will have more confidence and consequently spend more – albeit that it is the consumer currently suffering with less cash to spend!

Good tax policy has a number of interesting side effects. For instance, history tells us that tax revenues grow and "rich" taxpayers pay more tax when marginal tax rates are slashed.

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There is also a link between government spending and tax revenue. Government spending increases and the inflation rate leads to adjustments in the VAT rates necessary to obtain the expected VAT revenue required to balance the budget, while at the same time sustaining low inflation and economic growth. Thus, the rate of inflation is both a result of taxation policies and an indicator of future fiscal policy needs.

Value Added Tax is a primary source of tax revenue in many European and other developed countries. With the exception of the United States, all countries of the Organization for Economic Cooperation and Development (OECD) use VAT or similar tax on consumer expenditures. Many African countries have also introduced VAT in the last two decades.

Value-Added Tax was first suggested in Germany by a businessman during the post–World War I period as a replacement to the country's turnover tax. The turnover tax was similar to the VAT system but did not provide rebates for the taxes paid at each stage. France was the first country to begin using VAT to partially replace its own turnover tax system.

However, it was not until 1953 that the VAT system was put in place in Europe. In 1967 the Council of European Economic Community (EEC) issued directives for widespread adoption of VAT to replace existing turnover taxes and link EEC members with a common tax system. After the directive, countries outside the EEC such as Austria, Sweden, Brazil, Greece, and Peru also adopted some variation of the VAT, either in addition to or as a replacement for their own national tax structures. From 1987 to 1997, VAT was introduced in many Eastern European countries, the former Soviet republics, and Asia. China, Thailand, the Philippines and Bangladesh implemented the policy during the mid-1990s. Ebrill(2002) claimed that "the rapid rise of the value-added tax was the most dramatic-and probably most important-development in taxation in the latter part of the twentieth century, and it still continues." Most of the countries that adopted the VAT did so not only to enhance trade but to also help control the persistent budget deficits they were experiencing. The wind of change in the tax system did not leave Africa behind. African countries like South Africa, Nigeria, Kenya,

Lesotho and Ghana were all hooked to the VAT system as a result of their affiliation to the IMF. Analysis of government tax with respect to VAT in France by Michel (2003) concluded that the introduction of VAT in the country has led to a continuous increase in government total domestic revenue mobilisation over the years. He said this has made France's gross domestic product (GDP) to rise to $1.76 trillion from $1.42 trillion, while per capita income increased to $29,410 in 2003 from $29,089 in the previous year. He further observed that government revenue target has always been achieved,with VAT in particular registering substantial growth over the period.

Teffera (2004), in analysing the implementation of VAT in Ethiopia, stated that VAT has become a major tax instrument worldwide and the global trend to introduce VAT in more countries is continuing. VAT revenue performance and its neutrality and efficiency are also the reasons for superiority of this tax in contrast to other common tax instruments such as the turnover tax (Zeljko&Fareed, 1993). The emerging conventional wisdom, based largely on practice and numerous country case studies, suggests that a single rate of VAT (with the rate between 10 and 20%), with very few exemptions and, therefore, broad based is superior to a VAT with multiple rates and many exemptions which reduce its base and complicate administration (Teffera, 2004).

After evaluating tax reforms in Ethiopia with particular reference to VAT performance, Alemayehu and Abebe (2004) also indicated that VAT revenue collection in Ethiopia has shown a 50% significant growth as compared with the replaced sales tax. They contended that domestic VAT collection contributed 14.9% while that of import VAT collection contributed 27.1% to total revenue collections in the country. To this end, Alemayehu and Abebe (2004) attributed the high contribution of import VAT to total VAT collection in the country to seemingly its well checked entry point. VAT is the major part of tax system raising about one-fourth of the world's tax revenue (Ebrill, Keen, Bochin and Summers, 2002). This has been reiterated by Bahl and Bird (2008) as they indicated there is no question that the VAT is now properly considered central to a good tax system in raising revenue in most countries. However, Emran and Stiglitz

(2005) cautioned that the welfare gains from a switch to the VAT are questionable in the presence of large informal sector. But this view has been counteracted by Aizenman and Jinjarak (2005) as they indicated that a frequently cited advantage of VAT is the fact that it is collected throughout the production chain and associated with easier enforcement giving it a practical advantage.

Guptal et al(2008) also explained that rising domestic revenue not only creates additional fiscal space for supporting high-priority spending and healthy fiscal conditions; it also allows a country to maintain spending consistent with its policy priorities when aid is phased out. It is worth mentioning that tax administration has come a long way in many developing countries over the last three decades (Bird and Zolt 2007). However, there are still much more left to be done to improve tax productivity (Bird 2008). The fact therefore remains that it is not by accident that most developing countries have also adopted a modern tax system of VAT.

Increasing the VAT rate alone cannot be seen as a panacea to improving VAT revenue especially in the developing world economies associated with low incomes; welfare of the populace will greatly be affected given the fact that VAT is regressive in nature and majority of Ghanaians are poor. To mitigate the impact, most necessities like food, clothing and shelter are exempted from the VAT. Addressing the challenges of VAT collection could improve revenue better than increasing the tax rate. This is what this research seeks to find out. AizenmanandJinjarak (2008) also indicated that the tax efficiency is determined by the probability of audit and by the penalty on underpaying.

1.1 Empirical Literature

The inflation rate might reduce real VAT revenues if there is a lag in collection, and this, in turn, might increase the inflation rate needed to finance a given level of government spending (Tanzi, 1977; Mourmouras and Tijerina, 1994). Alternatively, if the projected inflation rate underestimates the realized inflation rate, then real government spending may decline if programmed government spending is fixed in nominal terms, thus

reducing the need to collect tax revenues (Cardoso, 1998). In this sense, the effect of inflation rate on fiscal balance depends on whether the effect on revenues is greater or lower than the effect on government spending. Given that the VAR model explicitly accounts for feedback effects, the authors' interest mainly centres on the potential short-run and long-run impact of changes in the VAT rate and the inflation rate on VAT revenue, in the light of recent debate on the direction of the VAT tax rate and monetary policy in Mexico. The model accounts for the direct and induced economic effects of tax rate changes without imposing restrictions on how the policy variables and economic outcomes are interrelated.In all, the endogeneity of government spending, inflation, VAT revenue and the VAT rate may be a more important issue in developing economies, given the significant integration between political and economic structures in these countries. The Mexican case is unique in that it allowed one to analyze the connection between these variables during a period of increasing economic opening and fiscal reforms (Maloney and Azevedo, 1995).

Tatiana Slobodnitsky and Lev Drucker (2008) of Ministry of Finance, State Revenue Administration of Israel, did a research on the VAT rates and their impact on the Israeli economy. Their findings revealed that VAT revenues are highly correlated with the development of tax base and have high elasticity with regards to VAT rate. They also found that the VAT revenues are "well behaved", especially in comparison with the corporate tax proceeds. For example, they estimated VAT revenues/VAT rate cross elasticity to be high.

In periods of VAT rate increase, the response is estimated by 91% from the potential, while the response in periods of decreasing VAT rates is 49%. Thus an increase in the VAT rate is likely to generate an increase in the VAT revenue than the rate at which revenue will reduce due to decrease in the VAT rate.

Bogeti and Hassan (1993) also gave a different dimension to the analysis. They studied the use of multiple VAT rates and came out with the following conclusions:Single verses multiple rates: An empirical study on 34 countries shows

that single VAT rates (between 10-20%) with minimal exemptions and hence a broad base is better (in terms of generating revenues) than a system with multiple rates and exemptions which reduces the base and increases compliance costs and administrative work load. Typically, multiple rates help include various social and political objectives into the VAT system which however, are detrimental to revenue generation. The World Bank study recommends that for superior revenue collections, VAT should be levied at one rate on as broad a base as possible. From the findings of Bogetic and co, it can be deduced that multiple rates might have other motives rather than revenue improvement. If for social, political or other reasons than economic, then the multiple rates could be recommended. If it is for revenue mobilisation, then a single standard rate is preferable. VAT rates and exemptions: The IMF study on VAT in Russia and other countries of the former Soviet Union indicates that these countries did not see any wide proliferation of tax rates after three years of introduction of VAT. Charlet and Owens (2011) also studied the VAT in the EU countries and made the following conclusions. They sought to study how EU countries tried to overturn their persistent budget deficits. Two approaches are used to achieve this. First, countries have increased their VAT rates over the past two years across the EU, 12 countries have increased their standard VAT rates. However, the U.K. first lowered its standard VAT rate from 17.5 percent to 15 percent from December 2008 until January 2010. As of January 4, 2011, the standard VAT rate in the U.K. was increased to 20 percent. Those VAT rate increases are usually combined with a reduction of income tax rates.

Over the last two years, seven EU member states cut their corporate income tax rates (Czech Republic, Greece, Hungary, Luxembourg, Slovenia, Sweden, and the U.K.). The increased VAT revenue has also been used by some governments to reduce social security contributions payable by employers or employees (Bulgaria, Hungary, Germany, and Sweden). These countries indicated that increase in VAT rates lead to increase in government revenue.

Cashin et al,(Year?) studied the temporary effect of change in VAT rate in Japan and came out with these findings. They performed several different tests to find out whether there was a significant reduction in household spending (independent of the inter-temporal substitution effects) following implementation of the VAT rate increase. In general, their results suggest that the rate increase did not have a significant impact on real household expenditures, a finding which stands in contrast to the conventional wisdom that the consumption tax rate increase was largely responsible for Japan's recession in the late 1990s, but is consistent with the revenue-neutral nature of the tax reform. Kumar Narayan used a computable general equilibrium model to examine the Fijian economy wide effects of VAT policy. They found out that while the VAT improves government revenue and brings about a small 0.6% increase in real GDP, it fails to address investment levels.

2 METHODOLOGY
2.1 Data Collection
The Researchers collected quantitative secondary data for this research work. Information was gathered from the Bank of Ghana, the VAT Service, the Ministry of Finance and Economic Planning and Ghana Statistical Service. The secondary data collected included: VAT revenue collections and the targets set by the government for the period under review, GDP figures, Inflation rates, Government expenditure for the period under study and total tax revenue. A quarterly data time series from 2003 to 2010 was used.

2.2 Quantitative Design
The researcher used quantitative methodology. The quantitative data obtained from the various institutions were used to assess the revenue growth of VAT over the period due to changes in the VAT rates. The dependent variable is the tax revenue (VATF), the independent variables are the VAT rate (RATE), inflation (INF), government spending (GOVT) and Gross Domestic Product (GDP). The researcher used ARDL Cointegration Procedure to analysing the data. The equation is as follows:

$$\Delta LVATF_t = \alpha + \sum_{i=1}^{p} \lambda_{1i} \Delta LVAT_{t-i} + \sum_{i=0}^{q} \lambda_{2i} \Delta LINF_{t-i} + \sum_{i=0}^{r} \lambda_{3i} \Delta LGOVT_{t-i} + \sum_{i=0}^{s} \lambda_{4i} \Delta LRATE_{t-i} +$$

$$\sum_{i=0}^{r} \lambda_{3i}\Delta LGDP_t ++\delta_1 LVAT_{t-1}+\delta_2 LINF_{t-1} + \delta_3 LGOVT_{t-1} + \delta_4 LRATE_{t-1} + \delta_5 LNGDP_{t-1} + \beta_6 TREND+\varepsilon_t$$

Where   is a difference operator, *p,q,r,s,t* represent the lag length on the regression variables and ε_t is an error term which is assumed to be white noise. The parameters λ_{mi} for m=1, 2,3,4,5 represent the short run dynamics of the model whereas the long run relationship are given by the δ_s.

The researchers first used the Augmented Dickey Fuller (ADF) unit root test regression to set the maximum lag order based on the Schwartz Criterion before the ARDL. This was also based on the Akaike Information Criterion (AIC) which determined the optimal lag of each variable.

The Unrestricted Error Correction Model (UECM) of econometrics was used to examine the long run relationships between variables in the main model. The relationship was tested using the F-test for the null hypothesis.
Time series diagnostic tests were carried out to ensure that the model satisfies the classical linear regression model assumptions. The diagnostic tests conducted include tests for serial correlation, heteroscedasticity, normality of the disturbance term and functional form misspecification.

4.0 Data Interpretation and Analysis

Provided below is the detailed analysis and interpretation of the model used and the findings. To provide a clear understanding, the findings have been presented in tables and graphs by using ARDL Cointegration Procedure.

Table 1:STATIONARITY TEST

VARIABLE	AUGMENTTED DICKEY FULLER
LGDP	-0.7413[0]
	-0.8214
D(LGDP)	-5.6443[0]***
	-0.0001
LVAT	-0.808[0]
	-0.8027
D(LVAT)	-5.314[0]***
	0.0002
LGOV	-0.886[0]
	-0.7792
D(LGOV)	-5.175[0]***
	-0.0002
LINF	-2.915[2]*
	-0.0558
LRATE	-1.920[3]
	0.319
D(LRATE)	-5.477[2]***
	-0.0001

*, ** and *** represent significant levels of 10%, 5%, and 1% respectively

Table 1 aboveindicates the statistical significance of the test statistic at 10%, 5% and 1 % respectively. Figures in parenthesis are p-values; whiles figures in square brackets are the lags of the ADF unit root test regression. A maximum lag order of 9 was set for the ADF test according to the Schwartz formula for determining the maximum lag order. The number of lags selected for the ADF test was selected automatically based on the Schwartz Criterion. The results of the ADF unit root test shows that all the variables except inflations are not stationary in levels. They however achieve stationarity after the first difference. Thus whereas inflation (LINF) is integration of order zero [I (0)], government expenditure (LGOV), tax revenue (LTAX), tax rate (LRATE) and gross domestic product (LGDP) are all integrated of order one [I (1)].

The results of the stationarity tests therefore imply the traditional cointegration tests of Engle Granger and Johansson cannot be applied and that ARDL cointegration approach is the most appropriate.

4.1 ARDL CointegrationProcedure

The ARDL or Bounds Testing cointegration procedure is useful in testing the existence of long run relationships between level variables within a multivariate frame work. It involves the following procedure: Testing the long run relationship between the level variables; estimation of the long run coefficients of the variables; and estimation of the short run coefficients of the variables.

4.1.1   Testing the Long Run Relationship between the Level Variables

The long run relationship among the variables can be expressed as:

$$\Delta LVATF_t =$$

$$r+\sum_{i=1}^{p}\}_{1i}\Delta LVAT_{t-1}+\sum_{i=0}^{q}\}_{2i}\Delta LINF_{t-1}+\sum_{i=0}^{r}\}_{3i}\Delta LGOVT_{t-1}+\sum_{i=0}^{s}\}_{4i}\Delta LRATE_{t-1}+\sum_{i=0}^{s}\}_{5i}\Delta LGDP_{t-1}+u_1 LVAT_{t-1}$$

$$+u_2 LINF_{t-1}+u_3 LGOVT_{t-1}$$

$$+u_4 LRATE_{t-1}+u_1 LNGDP_{t-1}+S_6 TREND+v_t$$

Where Δ is a difference operator, p,q,r,s,t represent the lag length on the regression variables and V_t is an error term which is assumed to be white noise. The parameters, $\}_{mi}$ for $m=1,2,3,4,5$ represent the short run dynamics of the model whereas the long run relationships are given by the δ_s. The ARDL Bounds Test requires the determination of the maximum lag order of the regression variables. Given the study sample size and the number of regressors used in the model, the maximum lag order of the regression variables is set to two. After setting the maximum lag order to two, determination of the optimal number of lags to be introduced in the ARDL model is based on the minimum Akaike Information Criterion (AIC). In determining the optimal lag of each variable in using the Akaike Information Criterion (AIC), the ARDL Bounds Test estimates $(p+1)^k$ regressions, where p is the maximum lag order of the variables and k is the number of variables in the model. The rationale for the Unrestricted Error Correction Model (UECM) of the econometric model is to examine the long run relationships between the variables in the model. In testing for the existence of any long run relationship between the variables, the F test is used to test the joint significance of the coefficients of the lagged level variables. The F–test tests the null hypothesis of no cointegration against the alternative of cointegration. The null hypothesis of no cointegration is given by:

$$H_0 : u_1 = u_2 = u_3 = u_4 = u_5 = 0 \qquad \text{(No Cointegration)}$$

The null hypothesis of no co-integration is tested against the alternative of co integration given by

$$H_1 : u_1 \neq u_2 \neq u_3 \neq u_4 \neq u_5 \neq 0$$

The F-test used for testing the null hypothesis assumes an asymptotic non-standard distribution (Pesaran et al., 2001). The F statistic for the cointegration test which is normalized on LVAT is denoted by:

$$F_{LVAT}(LVAT, LINF, LRATE, LGDP, LGOVT)$$

The decision rule of the F test depends on the critical values to which it is compared. The critical values however depend on the number of explanatory variables in the model, whether the explanatory variables in the regression model are integrated of order zero or one and also on whether the model contains an intercept, and or trend, or neither (Pesaran et al, 2001). Based on the order of integration of the explanatory variables, two asymptotic critical values are derived: an upper critical value and a lower critical value. The lower critical values are based on the assumption that all the explanatory variables are integrated of order zero, whiles the upper critical values assume that the explanatory variables are integrated of order one (Pesaran et al, 2001). The decision rule for the F test is as follows:

- ❖ Reject the Null hypothesis of no co integration if the F statistic is greater than the upper critical value.
- ❖ Fail to reject the Null hypothesis of no co integration if the F statistic is lesser than the lower critical value.
- ❖ If the F statistic lies between the two critical values, then the decision can only be made if the orders of integration of the underlying explanatory variables are known (Pesaran et al., 2001).

The relevant critical values for the F test was taken from Pesaran et al., (2001) based on Table CI (v), Case V with unrestricted trend and unrestricted intercept, and number of regressors, K=5. The results are depicted in the table 2 below.

Table 2: F- STATISTICS TEST

K=5	
Computed ARDL F-Statistic	6.5013
Bounds Tests Critical Values at 1%	Lower Bound 3.189
	Upper Bound 4.329

From the results shown in Table 2, the computed F statistic (6.5) exceeds the upper bound (4.329), implying that the null hypothesis is rejected and thus there is cointegration between tax revenue and the independent variables. Since cointegration is established, the next stage in the ARDL cointegration procedure is to estimate the long and short run coefficients of the model.

4.2 Diagnostic tests

Time series diagnostic tests are carried out to ensure that the model satisfies the classicallinear regression model assumptions. The diagnostic tests conducted include tests for serial correlation, heteroscedasticity, normality of the disturbance term and functional form misspecification.

Table 4.3 Diagnostic Tests

****

*Test Statistics LM Version   F Version

****

A:Serial Correlation CHSQ(4)= 16.2823[.003]
   F(4, 7)= 2.6586[.123]

B:Functional Form CHSQ(1)= 16.7585[.000]
   F(1, 10)= 16.3634[.002]

C:Normality CHSQ(2)= .20337[.903]Not
   applicable

D:Heteroscedasticity CHSQ(1)= .40197[.526]
   F(1, 25)= .37782[.544]

****

A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

The null hypothesis of the tests above has no serial correlation, correct functional form, normal distribution and homoskedasticity. Using the F test we reject only the null hypothesis for the functional form. Thus the model does not suffer from serial correlation (autocorrelation) and heteroscedasticity.

4.3 Stability Test

Analyzing the long run model for policy analysis demands a stability test of the coefficients of the model. To assess the stability of the VAT model, the CUSUM (Cumulative Sum) and the CUSUMQ (Cumulative sum of squares) of recursive residuals tests are used. The CUSUM (Cumulative Sum) and the CUSUMQ (Cumulative sum of squares) of recursive residuals tests show that a stable relationship among the variables owing to the fact that neither CUMSUM nor CUMSUM SQ exceeds the 5% significant level depicted by the boundary lines.

4.4 Discussion of Long Run Results

After establishing model stability and long run relationship among the variables in the tax model, the long run coefficients of the model are derived from the dynamic ARDL(0,0,0,0,0) model. The estimated long run coefficients generated using Microfit 4.1 are displayed in table 4.4.The long run estimates indicate that only government expenditure (LGOVT) and income (LGDP) have significant long run impact on the VAT revenue in Ghana. Since the variables are expressed in the logs the parameter estimates can be interpreted as elasticities. The coefficient of GDP is referred to as tax buoyancy which shows how a percentage change in income affects tax revenue. In other words it measures automatic response of tax revenue to GDP changes less the discretionary tax changes. In this study the coefficient of

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LGDP (0.234) is less than one showing that it is inelastic. In other words a percentage change in income results in a less than proportionate change in VAT revenue. This contradicts the works of Twerefou et al (2008) who found higher buoyancy for total tax in Ghana. The coefficient of government expenditure (LGOVT) is positive and significant, implying that government expenditure significantly determines VAT revenue in the long run. The coefficient (0.77) is less than one (inelastic) implying that a percentage increase in government expenditure will result in less than percentage increase in VAT revenue in the long run. The positive sign indicates that increasing government expenditure triggers increase in VAT revenue but at smaller rate. Even though the long run coefficient of the VAT tax rate (LRATE) is positive it is insignificant, implying that in the VAT rate does not have any long run impact on the VAT revenues. Thus changes in the VAT rates do not have any significant impact on the volume of VAT revenues in the long run. Also the result also shows that inflationary dynamics (LINF) does not really have any significant impact on VAT revenues in the long run.

Table 4: Estimated Long Run Coefficients using the ARDL Approach

ARDL (0,0,0,0,0) selected based on Schwarz Bayesian Criterion

****

Dependent variable is LVAT

27 observations used for estimation from 2004Q2 to 2010Q4

****

Regressor Coefficient   Standard Error T-Ratio [Prob]

LRATE .81190 .64188   1.2649[.220]

LGOVT .77177 .10592   7.2865[.000]

LGDP   .23467   .11525   2.0361[.055]

LINF   .11100   .11026   1.0067[.326]

INPT -.52895   1.3026   -.40609[.689]

TREND -.0080960 .0080014   -1.0118[.323]

****

*, **, *** represents significant levels of 10%, 5%, and 1% respectively. INPT and TREND are parameter estimates for intercept and trend respectively.

4.5   Estimation and discussion of short run coefficients

After establishing the long run relationship between the variables and estimating the long run coefficients, the final stage in the ARDL Bounds testing procedure entails determination of the short run dynamics associated with the long run estimates of the variables in the model. This is achieved by estimating the Error Correction Model (ECM) representation of the ARDL (0,0,0,0,0).

From the short run dynamic of the model in Table 4.5 it can be observed that consistent with the long run results, all the short run coefficients of the regressors achieve the same signs as their long run coefficients. The short run dynamics indicate a 1% increase (decrease) in government expenditure (LGOV) will result in a 77% increase (decrease) in VAT revenue and is statistically significant at 1%. Likewise the short run dynamics indicate that a 1% increase (decrease) in income (LGDP) will result in a 23% increase (decrease) in VAT revenue and is significant at 10%. The short run estimates of the VAT rate though consistent with a positive sign is insignificant confirming the estimates in the long run and implying that the VAT rates does not have neither short nor long run impact on the VAT revenue. In other words, variations in the VAT revenue are exogenous of the changes in the VAT rates. This can be attributed to the fact that during the study period there has not been any significant change in the tax rates. Interestingly the coefficient of the lagged error correction term is equal to -1, implying that is that in each time period, approximately 100% of shocks can be justified as a long run trend (Afzal et al., 2010). It further implies that deviations in VAT

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revenue from equilibrium are corrected 100% within a given year.

TABLE 5: SCHWARZ BAYESIAN CRITERION

Error Correction Representation for the Selected ARDL Model

ARDL(0,0,0,0,0) selected based on Schwarz Bayesian Criterion

****
****

Dependent variable is dLVAT

****
****

Regressor	Coefficient	Standard Error	T-Ratio [Prob]
LRATE	.81190	.64188	1.2649[.220]
LGOVT	.77177	.10592	7.2865[.000]
LGDP	.23467	.11525	2.0361[.055]
LINF	.11100	.11026	1.0067[.326]
INPT	-.52895	1.3026	-.40609[.689]
TREND	-.0080960	.0080014	-1.0118[.323]

ecm(-1)   -1.0000 0.00

NONE

****
****

List of additional temporary variables created:

dLVAT = LVAT-LVAT(-1)

dLRATE = LRATE-LRATE(-1)

dLGOVT = LGOVT-LGOVT(-1)

dLGDP = LGDP-LGDP(-1)

dLINF = LINF-LINF(-1)

dINPT = INPT-INPT(-1)

dTREND = TREND-TREND(-1)

ecm = LVAT -.81190*LRATE -.77177*LGOVT -.23467*LGDP -.11100*LINF +

.52895*INPT + .0080960*TREND

****
****

R-Squared   .98477   R-Bar-Squared .98114

S.E. of Regression   .12372   F-stat. F(6, 20) 226.2847[.000]

Mean of Dependent Variable .23326   S.D. of Dependent Variable   .90093

Residual Sum of Squares   .32144   Equation Log-likelihood   21.5041

Akaike Info. Criterion   15.5041   Schwarz Bayesian Criterion   11.6166

DW-statistic   2.5120

****
****

R-Squared and R-Bar-Squared measures refer to the dependent variable dLVAT and in cases where the error correction model is highly restricted, these measures could become negative.

Table 5 shows the Schwarz Bayesian Criterion. R-Squared and R-Bar-Squared measures refer to the dependent variable dLVAT and in cases where the error correction model is highly restricted, these measures could become negative.

The research results and findings discussed above show that changes in VAT rates do not have any significant effect on VAT revenue; rather changes in government expenditure and GDP have significant effects on VAT revenue. The null hypothesis that changes in VAT rate have significant effect on VAT revenue is therefore rejected.

Conclusion
The long run estimates indicate that only government expenditure (LGOVT) and income (LGDP) have significant long run impact on the VAT revenue in Ghana. A percentage change in income results in a less than proportionate change in VAT revenue. This contradicts the works of Twerefou et al (2008) who found higher buoyancy for total tax in Ghana. The relationship between government expenditure and VAT revenue is also positive. The

coefficient of government expenditure (LGOVT) is positive and significant, implying that government expenditure significantly determines VAT revenue in the long run. A percentage increase in government expenditure will result in less than a percentage increase in VAT revenue in the long run. The positive sign indicates that increasing government expenditure triggers increase in VAT revenue but at smaller rate. Even though the long run coefficient of the VAT tax rate (LRATE) is positive, it is insignificant, implying that the VAT rate does not have any significant long run impact on the VAT revenues. The result also shows that inflationary dynamics (LINF) does not really have any significant impact on VAT revenues in the long run. The short run regression also gives the same result of significant positive relationship between GDP and Government Expenditure and VAT revenue whiles VAT rate and inflation have an insignificant relationship with VAT revenue. The insignificant effect of the changes in VAT rate on the VAT revenue could be attributed to a lot of loopholes in the tax system in Ghana. The tax base is narrow, leaving a lot of people outside the tax net. Many businesses are not registered. It also confirms the study in Japan which indicated that consumers reduced their demand for durable goods when there was an increase in the VAT rate from 3% to 5%. However this contradicts the study in Mexico, Israel and UK where VAT revenue goes up at an increase in the VAT rate. The Fiji experience also points to the fact that increase or decrease in the VAT rate must have other macroeconomic factors to facilitate its desired impact. The VAT Service must also try to rope in all qualified traders to register and collect and account for the tax. Enforcement of the Law must also be intensified to get a change in the VAT rate yield the desired result.Based on the result of this research, the suggestion is that government must have a critical look at the tax administration system to help the tax institutions perform their responsibilities well. The VAT Service must improve on its revenue mobilisation effort since there are a lot of people outside the tax net.

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An Analysis of Construction Cost Trends in Ghana

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Abstract
This study was conducted into the trend of construction costs in the Ghanaian construction industry. The main aim of the study was to examine the behaviour of the main construction cost items and building rates, concurrently with socio-economic behaviour, as a means of identifying trends and relationships between these key parameters. Primary data was collected by the use of questionnaires and secondary data and information were also collected from the appropriate government departments and agencies and from the journals and conference papers. Statistical Package for Social Sciences (SPSS) and Microsoft Excel were used to analyse the data collected. Descriptive statistics as well as trend analysis were done on the data. The following findings were made from the results of the analyses: Most professionals in the construction industry are worried about the trend of construction costs over the recent years, the prices of materials are not stable and fluctuate too frequently and are always on the increase. These changes in prices are driven by inflation, fuel price increases and increase in import duties. It was also found that most consultants increase their building rates with increase in material and labour costs. Based on these findings, some recommendations were made that some sort of regulation of material and labour prices will go a long way to stabilize prices in the industry. It was also recommended that some of the materials which are used frequently must be manufactured locally. Although cement is made in the country, it can be said that the greater portion of the manufacturing process is done elsewhere. These recommendations can be followed together with other actions to help lower construction costs in the country.

Keywords: Construction Costs; Construction Industry; Trends; Inflation; Professionals

1 INTRODUCTION

One major problem facing the construction industry in Ghana in the last few years is delay in project completion as well as complete abandonment of projects. One of the notable causes of this is sharp changes in the cost of construction during the construction stage of the projects, leading to large margins of fluctuation (Fugar and Agyakwah-Baah, 2010). Sometimes, this difference is so significant that it could not have been predicted during the project planning stage.

Although there are measures in place to take care of fluctuations when they occur during project execution, substantive fluctuation based on astronomical changes in price levels has often overstretched clients' budget and this has often meant that prompt payment of fluctuation is not guaranteed. The establishment of cost trends relative to the existing socio-economic conditions as a means of making relatively accurate predictions on the rate and extent of fluctuations during project execution stage is therefore absolutely vital.

In his article, "Keeping Project Costs in Line", Davis (1976) stated that managers who keep track of a project by analysing cost reports are behind what is actually occurring on the site. He suggests the use of projected completion costs to analyse the project's cost control. He states that this method will better serve the project managers and allow them to respond to problem areas before they escalate. This research therefore seeks to analyse such costs so as to give a fair basis on which projections can be made.

Background
The construction industry provides a very important contribution to the national/local economy through its job generating ability for skilled, semi-skilled and unskilled labour. The construction process needs inputs from other industries and production factors (labour, land and capital). This could generate considerable employment through multiplier effects.

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The state of the construction industry will affect most common measures of a national economy, such as GDP as mentioned earlier. It will affect the availability of capital, the decisions a government makes and even the social health of the country. The construction industry also has significance interaction with other economics sector as multiplier effects through its backward and forward linkages.

The construction industry is frequently used as a tool by government to manage the local/national economy. For example, when it is recession and the number of unemployment is high, government uses the construction sector to increase the public expenditure (Ball and Wood, 1994). Therefore the detailed way in which the construction sector interacts with the national/local economy and wealth of people involved should be well understood. It needs methods to investigate the detail interaction between the construction industry and the national/local economy.

Any developer, construction professional, or individual involved in a construction project will be concerned about what drives or effects construction costs. Africa and even the rest of the developing world is experiencing a far more competitive market driven by the current global recession and shortage of work, and much is often debated about construction cost drivers, or how changes in the market affect construction costs or tender prices.

A tender for any building contract is made of four constituent parts; the cost of labour, materials, plant and equipment and market forces, although the proportions will vary depending on the nature of the particular project or market. An increase in cost however, in any of these elements, will not automatically affect tenders and certainly not to the same degree. A 'normal' construction project might have a split of labour 30%, materials 65% and plant 5% of the overall costs. The most significant element of material prices will undoubtedly have an effect on construction costs, but this is not necessarily what one would expect.

Conversely, labour costs (which admittedly have been static recently) have a far greater potential to affect prices. A rise in labour costs

by 5% could increase the costs of the construction project by 1.5% and it is important to put this into perspective.

In the current economic climate work has become scarcer and therefore more contractors are chasing less work and margins are being eroded. Whilst labour, material and plant prices have risen and are forecast to continue to increase marginally over the next three years, tender prices have fallen since their peak in 2008 and this trend is likely to continue for a number of years. Contractors are effectively absorbing material price rises by reducing profit in order to remain competitive.

It is interesting to note the historic relationship between building costs and tender prices, or more accurately the lack of relationship. Accurate historic data is not readily available for this region but the principle is the same worldwide. Building costs whilst influencing construction costs are not the driving factor.

The trend of construction costs in the Ghanaian construction industry requires thorough studies from time to time in order to help proper planning for construction projects in the country. Many projects have stalled or even been abandoned due to significant changes in cost trends over the period of project delivery. Some of these changes could have been predicted and taken care of during the project planning stage. It is therefore very significant to have a basis for analysing the possible changes in cost trends over some period so as to assist project planners take care of the possible shocks that may arise as a result of these changes. It will also help make these seemingly unpredictable changes much more predictable in order to avoid huge cost over-runs due to changes in construction costs.

Aim and Objectives
The main aim of the study is to examine the behaviour of the main construction costs and building rates, concurrently with socio-economic behaviour, as a means of identifying trends and relationships between these key parameters.

The specific objectives of this study are:
- To identify the trend of main construction cost items and building rates over a five year period.

- To identify the trends in major socio-economic indicators over the period.
- To identify a relationship between the main construction cost items and the major socio-economic indicators.

2 METHODS AND DESIGN
This research was conducted by first conducting a comprehensive review of existing literature. Secondary data which comprised figures from five randomly selected from Bills of Quantities for buildings works from public consults, one each from each year, over a span of five years were analysed. A field survey was also conducted with the administration of questionnaires to members of the sample selected.

In the former case, percentages of the cost of the various work sections over the total cost of each building were estimated. These were compared for trend analysis. In the later case, questionnaires were distributed to ten (10) building material merchants and twenty (20) professionals. Out of these eighteen (18) were validly returned from the professionals and all the ten (10) from the building merchants.
The analysis of these set of data formed the basis on which findings were made, conclusions drawn and recommendations given.

3 RESULTS
Background of Respondents
The respondents' educational background was sought and it came out that out of the nine (18) professional respondents, six (6) were master's degree holders. This represents 33.3% of the respondents and ten (10) which represents 55.6% were bachelor's degree holders. The other two (2) representing 11.1% was an HND holder. From the analysis, it became clear that all of the respondents in the case of the consultants had attained at least a Higher

National Diploma (HND). This means that the respondents possessed enough educational qualifications to make their responses authentic. Most of the respondents were quantity surveyors and this auger well for the research since they are the professionals who are most suitable to give out the kind of information necessary for the research to come to a proper conclusion. The professions of the respondents' included six (12) quantity surveyors, two (4) architects and one (2) structural engineer. These represented 67%, 22% and 11% of quantity surveyors, architects and structural engineers respectively. In addition, ten (10) building material merchants were also issued with the questionnaires.

Professional Experience of Respondents
When the experience acquired by the respondents in the practice of these professions was sought, it was found that 22% of them had been in practice for periods between 1 – 5 years, whilst 67% had practiced for between 6 – 10 years and 11% had also been in practice for between 11 – 15 years. This means that most of these professionals have enough experience to make their opinions credible.

Table1 and Figure 1 represent the presentation of the data

| YEARS	2008		2009		2010		2011		2012	
Work Sections	COST	%TAGE	COST	%TAGE	COST	%TAGE	COST	%TAGE	COST	%TAGE
Substructure	58,992.42	21.54	28,230.28	11.30	29,143.50	3.72	29,586.40	22.43	84,977.30	31.51
Concrete Works	68,075.40	24.86	57,712.51	23.10	19,916.40	2.54	7,968.20	6.04	9,982.75	3.70
Blockwork	21,840.80	7.98	11,739.57	4.70	14,253.00	1.82	11,552.00	8.76	18,468.80	6.85
Roofing	12,120.71	4.43	10,937.99	4.38	10,206.00	1.30	11,079.00	8.40	44,154.00	16.37
Carpentry	49,698.77	18.15	16,056.76	6.43	40,491.35	5.17	10,016.15	7.59	6,490.80	2.41
Joinery	9,776.89	3.57	11,308.85	4.53	107,109.61	13.68	10,412.45	7.89	19,084.32	7.08
Metal Work	292.12	0.11	6,651.42	2.66	75,830.00	9.69	3,609.00	2.74	64,121.10	23.77
Plumbing	-	-	13,363.50	5.35	41,742.00	5.33	3,130.00	2.37	-	-
Electricals	-	-	44,725.00	17.90	131,000.00	16.73	11,832.00	8.97	-	-
Finishing	36,631.62	13.38	39,183.62	15.68	194,177.60	24.80	17,634.40	13.37	14,060.70	5.21
Glazing	12,460.50	4.55	5,579.96	2.23	30,594.00	3.91	1,218.00	0.92	952.00	0.35
Painting And Decorating	2,781.36	1.02	4,327.93	1.73	49,377.95	6.31	4,981.15	3.78	3,926.38	1.46
External Works	1,160.75	0.42	-	-	39,062.00	4.99	8,915.40	6.76	3,483.00	1.29
Total	**273,831.33**	**100.00**	**249,817.39**	**100.00**	**782,903.41**	**100.00**	**131,934.15**	**100.00**	**269,701.15**	**100.00**

Data from Bills of Quantities (2008-2012)
Cost
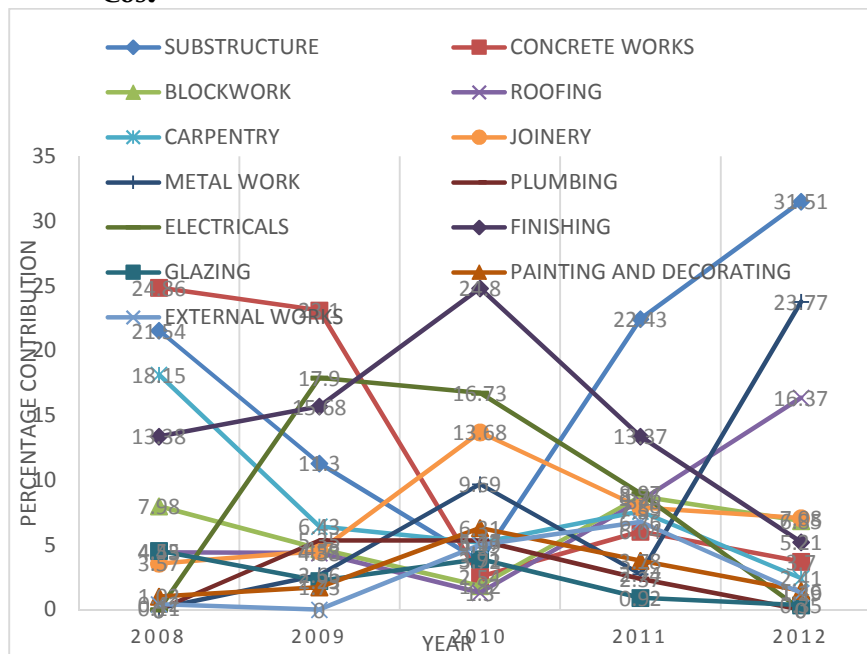
Figure 1: Annual Average Percentage Contribution of Various Work Sections to Contract Sum

4 DISCUSSION

The approach used was to follow the structure of the questionnaires used and the other secondary data analysed. The questionnaires were of two kinds: one for consultants and another for hardware dealers. In each case the results highlighted key construction materials and the relationship with some socio-economic factors that affect them and how they are affected. (what did each questionnaire sought to do?)

Perception about Construction Cost Behaviour

Among this class of respondents, all of them reported that they have been following the general behaviour of construction costs and all of them also reported that they were concerned about the general trend of cost behaviour. This was expected as this is a very important aspect of construction and any serious player in the industry is expected to take keen interest in the behaviour of construction costs.

All the respondents were of the view that construction costs were unstable and that it fluctuates too frequently. This they believed was as a result of the prices not being properly regulated. Prices have also continued to be on the rise all the time. It was also unanimous among the respondents that the prices of materials always increase with rise in fuel prices and increases in import duties. Most of the respondents (78%) think that labour costs are sensitive to inflation and rise in fuel prices but not increases in import duties. This could have been viewed as some form of regulation on prices since these figures are somewhat regulated by the government. With the exception of inflation, fuel prices as well as import duties are always managed by the government and could therefore be used as a means of regulating material prices. Labour prices are also adjusted to match changes in material prices and therefore keeping tabs on the material price increases could have a profound effect on the labour costs as well.

Construction Costs and the Socio-economic Environment

Most of the respondents (89%) were inclined to adjust their building rates whenever prices of materials rise, whilst 11% raise theirs sometimes, but they were unanimous that this induces a proportionate increase in construction costs. The occurrence of this phenomenon several times within a year poses difficulties for them in adjusting their rates, they all reported.

All the respondents again reported that they had established a general proportional relationship between labour and materials in the cost of construction. Whilst 33% were of the view that the relationship between labour and materials was 30:70 in percentage terms, 67% opined that the relationship was 40:60%.

Construction Materials Usage and Cost Issues
Key Cost Influencing Construction Materials

When they were asked to rank a selection of materials according to how important they were in terms of influencing construction costs, it was seen that Cement came up as the material that has the greatest influence on construction cost. With a mean of score of 3.97 most respondents were of the view that the influence of cement has a very high influence on construction costs. In fact, when people talk about construction costs, they always make reference to cement prices and this has fuelled the notion that cement is the material that influences construction costs the most. Apart from cement, Aggregates and Reinforcement Bars were also seen to have a "high" influence on construction costs, with both materials having a mean of 3.44. These materials were seen as such probably because they are relatively expensive as compared to the other materials. Because of their high prices, whenever they are used in a project they tend to influence the over-all cost of the project greatly.

The respondents ranked Water storage tanks as the least with a mean of 1.44 which means that it has a "very low" influence on construction costs. This is probably because the use of this material is optional and also it is not such an expensive item. Burglar Proofing Materials as well as Ironmongery were also seen to have a "low" influence on construction costs, both having a mean of 1.67. These materials are also less expensive and they are not used extensively on projects. The costs of these materials as compared to those of the other materials are far less and sometimes could be considered as negligible. This will account for

the low ranking of these materials as having a low influence on construction costs.

Extent to which Key Construction Materials are influenced by Inflation and other Socio-economic Factors

Inflation and other socio-economic factors have a great influence on material prices. The respondents were therefore asked to rank the materials according to how they are influenced by inflation and these other socio-economic factors.

In summary, the responses given by respondents regarding the extent to which the various materials are affected by inflation and other socio-economic factors showed that Cement is the material that is most influenced by inflation and other socio-economic factors with a mean of 3.98 indicating that the influence of these factors on cement is "very high". This trend can still be attributed to the fact that cement is seen as a base material for construction. In any scale of construction, cement is used to some extent as explained in the previous section. The Ghana Statistical Service (GSS) also uses the price of cement as an indicator of construction costs in the country. This creates the impression that cement is used as some sort of a regulator for construction costs in the country. And this probably accounts for the fact that cement was rated as the material that is most influenced by inflation and other socio-economic factors. Also high on the list were Reinforcement bars and Tiles (Wall and Floor). They were also seen to be under a "high" influence by these factors, with means of 3.44 and 3.33 respectively. Tiles were probably ranked as such because of the high rate of import but reinforcement bars are here as a result of their sheer cost.

Again, Water Storage Tanks was the least ranked item in this respect with a mean of 2.00 and standard deviation of 1.000, which means that there is a "low" influence on it by these socio-economic factors. Although respondents agree that there is some level of influence by these factors on water storage tanks, they also agree that this influence is low as compared to the other materials. This might have come about as a result of the fact that this material is locally produced and is not very expensive. This reason will also suffice for Burglar Proofing Materials also being seen to be under

a low influence by these factors having a mean of 2.11. But extent of use of these materials could be another factor. In the same vein, Timber and Timber Products, Paints (Emulsion, Oil, Vinyl etc.) as well as Ironmongery were all seen to be under a "low" influence by these factors, with mean and standard deviation combinations of 2.33 and 0.707, 2.33 and 0.707 and 2.33 and 0.500 respectively.

Extent to which Key Construction Materials are used in the Industry

The views of the respondents were sought regarding the extent of use of the various materials in the industry. Although, all the materials listed are in common use in the construction industry, the respondents thought that Cement is the most used material. It had a mean of 3.99, meaning that the extent to which Cement is used in the industry is "very high". As explained earlier, all forms of construction, from the very least scale such as domestic house construction to the very largest scale such as dam construction or the erection of roads or sky-scrappers, the dominant material that is used is concrete. With cement being a key component of concrete, it stands out as the material that is most widely used in the construction industry. This is also complemented by its use in other areas such as the moulding of blocks as well as mixing of mortar. Sand came in second in this respect with a mean of 3.87. This is also due to the fact that sand is also a constituent of concrete and other mortars which are widely used in construction at all levels. It was not surprising that most of the materials listed were found to be in the "very high" category. This is because; materials such as Aggregates, Timber and Timber Products, Electrical, Plumbing Materials all having a common mean of 3.78 are materials that are indispensable in the realization of any construction project. The order in which they were ranked is also appropriate because it is a true representation of what happens on the ground. Other materials also having "very high" ratings were Reinforcement Bars, with a mean of 3.67 and Roof Covering (Aluminium, Tiles, Shingles, etc.) with a mean of 3.56.

Even the least ranked item in this respect which was Water Storage Tanks had *a* mean of 2.11 which means that the extent to which this material is used in the industry is on the best part of "low". The extent to which Burglar Proofing Materials are used was also seen to be "low" having a mean of 2.44 and a standard deviation of 1.014.

Extent to which Key Construction Materials are imported
When the respondents were asked to rank the materials according to the extent to which they are imported into the country, Tiles (Wall and Floor) came up as the material which is most imported. It has a mean of 3.67 meaning that the extent to which Tiles (Wall and Floor) is imported into the country is "very high". This is because all the materials used for the laying of tiles are imported into the country. This sometimes includes even the tile cement. Some of the materials which were also found to be in the "high" category were Plumbing Materials, Ceiling Materials (Wood, Plastic, Plasterboard etc) and Electricals, having means of 3.33, 3.00and 2.78respectively. The advent and rise of the use of plastic tongued-and-grooved (T & G) materials as the preferred material for ceilings has accounted for the high ranking of ceiling materials in this respect. The wood variants are all locally produced, but they are gradually dying out of the system. Although electrical materials are imported to a large extent into the country, a good proportion is also locally produced, but plumbing materials are entirely imported.

It also came out that the least ranked items in this respect were Sand, Aggregates and Timber and Timber Products all having a common mean of 1.00, indicating that the extent to which these materials are imported into the country is "very low". This is a true reflection of events on the ground because these materials are never imported, but are obtained from naturally occurring products in the country.

Percentage Contribution of Various Work Sections to Contract Sum
The priced bills of quantities (BoQs) for some selected projects were analysed in order to ascertain the percentages contributed by the various work sections to the contract sum. The result of this analysis is presented in appendix 3. However, figure 4.4 presents a summary of the average percentage contribution of the work sections to the contract sum annually.

After carefully analysing the results of the survey, the following findings were made:

- Most professionals in the construction industry are worried about the trend of construction costs over the recent years.
- The prices of materials are not stable and fluctuate too frequently.
- Material Prices are always on the increase.

These changes in prices are driven by inflation, fuel price increases and increase in import duties.

- Prices are not regulated and are determined by market forces.
- Labour costs also increase with increasing material prices.
- Labour costs are also affected by the factors that affect material prices because they increase with increase in material prices.
- Among materials, labour and plant, the most sensitive to inflation is materials.
- Most consultants increase their building rates with increase in material and labour costs.
- The materials that have the greatest influence on construction costs are those ones that are used extensively in the industry. These are also the same materials that are affected much by inflation and fuel price increases.
- The materials that are imported into the country are expensive due to the imposition of high import duties.
- Most of the materials that are not imported into the country are naturally occurring. The prices of the imported ones could therefore be reduced greatly if they were manufactured in the country.

5 CONCLUSION

The study reveals that the trend of construction cost in Ghana is not well defined and that certain key factors

The following conclusions can therefore be drawn from the study:

- The material that is most affected by inflation and other socio-economic factors is cement. This is followed by tiles.
- Construction costs are not regulated and as such fluctuate too frequently. This leads to difficulty in cost planning on projects.

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Energy Conservation Knowledge and Practices in Tertiary Institutions: A Case Study at Koforidua Polytechnic

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Abstract
The inability to meet energy demand in Ghana has prompted the need to improve energy conservation practices. There is much challenge in implementing energy conservation measures especially in institutions. As much as policies on energy conservation are helpful, knowledge and practices of energy conservation measures by individuals in the institution are essential factors for realizing energy savings. Using structured questionnaires, participant observation and interviews, we aimed at assessing the human practices and knowledge towards energy conservation in the Koforidua Polytechnic institution. We also set out to identity the effectiveness of policies on energy management and translate it to how it affects their actions towards energy conservation. Our findings revealed that members of the Koforidua Polytechnic community are aware that energy conservation is a challenge but lack the knowledge about how to conserve it. The study also revealed that majority of the respondents' practices lead to energy wastage but they are not aware of it. A written policy should be implemented to ensure individuals are aware of what to do to conserve energy. Moreover, individuals should be educated both formally and informally to make them conscious of energy conservation.

Keywords: Practices; Knowledge; Energy conservation; Energy saving awareness; Energy conservation policies

1 INTRODUCTION

Energy demand in most countries including Ghana is influenced by parameters such as the rapid growth of economic activities, population growth and increasing urbanization (Masjuki, Mahlia, & Choudhury, 2001). Currently there is a high demand for energy as a result of rapid economic and social development in Ghana. Growth in demand for charcoal and fuel wood is about 3%, whiles that for both electricity and petroleum products are 6-7% and 5% respectively per annum (National Energy Policy, 2010). It is impossible for any country to progress economically and socially without a safe, reliable, sustainable and affordable supply of energy. The Government of Ghana's aim of reaching a middle income country and achieve a macro-economic stability by the year 2020 will not be achievable without a steady supply of energy in the country. Even with adequate and reliable supply of energy, inefficient use of the energy will result in wastage and high tariff within the system.

There are policies and plans established by the Government of Ghana to meet the rising energy demand which includes adopting renewable energy and implementing efficient energy management practices. The vision of the Ghanaian energy sector is to 'secure a reliable supply of high quality energy services for all sectors of the Ghanaian economy and also to become a major exporter of oil and power by 2012 and 2015 respectively' (National Energy Policy, 2010). The Renewable Energy Act was passed in 2011 to develop and inject renewable energy into our energy mix to reduce the over-reliance on crude oil. As a matter of fact, the overall national renewable energy policy target is to attain 10% Renewable Energy in the national energy mix by 2020(Ministry of Energy, 2010;Ahiataku-Togobo,2012). Alternatively, efficient energy management practices can be implemented in various sectors of the economy, so that the energy generated is used effectively.

Koforidua Polytechnic is a multi-cultural institution with the people having different perception on energy usage and management. Data from the estate department revealed that between April 2012 and April 2013, the cost of electricity consumed in the polytechnic amounted to 270,707 GHS. The school has contributed to renewable energy use by building a small scale biogas plant using waste generated at the campus as feedstock. However, other externalities such as

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behaviours and practices of the students and staff play important roles in ensuring that energy conservation is achieved. The behaviours and practices toward energy conservation will be positive only when there is proper knowledge in energy conservation practices. Without the knowledge, it will be impossible for the people to practice them. Again it can be observed that although most researches have concentrated on energy conservation practices and behavior on households (Yohanis, 2012; Dianshu et al, 2010; Ma et al, 2011), very few studies have been conducted on educational institutions (Kaplowitzet al, 2012).

This study is therefore aimed at identifying the knowledgeand practices towards energy conservation in the Koforidua Polytechnic. In addition, this paper will review if any, the energy management guideline or policy in the institution.

Energy Conservation behaviours, practices and knowledge

Energy conservation behaviours can be defined as actions carried out by individuals in relation to energy use reduction. There is a strong link between human behaviors and energy conservation. Promoting a change towards sustainable behaviour such as energy conservation is complex and it involves not only knowledge in efficient energy use but it also includes factors such as individual values, beliefs, social norms and attitudes(Kaplowitz, 2012).

According to Hitchcock (1993), there are three aspects to energy use behaviour;usage related behaviour which refers to the day- to- day frequency, duration and intensity of use of appliances; purchase -related behaviour which describes why for instance occupants change their characteristics of dwellings based on the energy attributes of the products they buy; and maintenance -related behaviour which refers to servicing and repairs appliances.

According to Owen and Wilhite(1988), 10-30% of domestic energy consumption can be reduced by changing occupants' behaviour.

Energy conservation practices and knowledge are also inter-linked. Knowledge into energy conservation measures goes a long way into determining the kind of practices that will be adopted by an individual. For instance, an individual will turn off an appliance instead of leaving it on standby if he/she knows that it will still draw energy. This scenario is true and was asserted in 2008 when Firth et al investigated electricity use in UK dwellings and showed that overall electricity consumption is attributed to a 10% increase in consumption of standby appliances. With the right knowledge in energy efficient equipment, efficient equipment will be bought by an individual to begin with. Governments, utilities companies and NGO's have taken a stride in providing information on energy conservation measures but its effectiveness is varied (Yohanis, 2012).According to the Ministry of Energy, it has in collaboration with other agencies, made efforts to promote energy efficiency and conservation in the country but these efforts have not resulted in sustained adoption of energy efficiency and conservation due to a number of financial and institutional obstacles (National Energy Policy, 2010). This shows that energy conservation is a big concern for the government of Ghana. Although policy formation is a good way to start energy conservation, the choice to improve energy
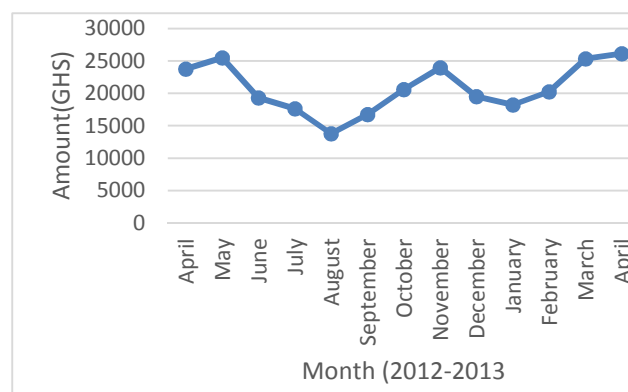

Figure 6(a):Electricity charges for Koforidua Polytechnic from April, 2012 to April, 2013

efficiency is highly dependent on the individuals involved.

Energy consumption at Koforidua Polytechnic

Electricity and heat energy are the two main forms of energy utilized on the premises. Electricity is provided for many applications such as lighting, air conditioning and miscellaneous equipment, that is, computers, printers and photocopier machine. There are three main sources of electric power which are:

the national grid connection, a standby generator and a photovoltaic panel installed at the Energy Systems Engineering Department. The heat energy sources include solar water heating, LPGs and biogas. The solar water heating system is used at the Energy Systems Department whiles LPG and biogas are used at the Hospitality Department for cooking.

Electricity is utilized throughout the day in both administration and classroom blocks. During the day, the administration block utilizes majority of the electricity. At night, when most offices have closed, the classroom blocks use electricity for evening lectures therefore making the electricity demand fairly constant. In Figure 1(a), electricity charges from April, 2012 to April, 2013 is depicted.
Source: Estate Department, Koforidua Polytechnic, 2013

2 METHODOLOGY
Research variables and parameter
Three main approaches were employed in this study namely; participant observation, administration of questionnaires and interview of personnel. Three groups were targeted for this research,that is, students, senior members and junior staff.

Data collection
In order to identify the general practices and behaviors to energy conservation, a walk through survey was conducted in the various general offices and lectures rooms. It was an unannounced visit so the occupants of the offices did not have any prior knowledge of our coming. We scheduled to visit the general offices during lunch hours when majority of the staff were out for their afternoon meal. With regards to the class room blocks, we visited the premises during early hours before lectures had begun and after class hours. During the observation, we also noted the design and architecture of the rooms to identify whether it has design capability of improving energy conservation.
In the second phase, structured questionnaires were administered to students and senior members using the random sampling approach. The questionnaires were distributed to students after their lectures while the senior members were approached in their offices and staff common rooms. There was provision for

the respondents to make comments on their choices; whiles the students had the chance to write their comments on the questionnaire, the senior members explained them vocally with the researchers taking notes.
The third phase of our research had to do with interviews. Firstly, security personnel and janitors were interviewed face to face since they have the responsibility of ensuring that electrical appliances in their watch posts are turned off. On the average, each interview lasted for 7 minutes. Then, we conducted a one-on-one semi-structuredinterview with the head of engineering, estate department. We adopted the methodology used by Kaplowitz, Thorp, Coleman, & Yeboah (2012) whereby the semi-structured interwiew had follow up questions based on the interviewee's previous answers and comments. The estate department has the responsibility of managing all structures and equipment on the premises and that includes all electrical appliances. The estate department works hand-in-hand with the procurement department to ensure that quality equipment arebought for the smooth operation of the institution. We ought to find out whether they put into consideration energy saving potentials of electrical equipment before requisitions are made. During the interview, we intended to establish if there is a policy on energy conservation within the polytechnic. With his permission, the interview was recorded which lasted for 18 minutes. The whole data collection exercise spanned from April 2012- June 2013. The respondents and participation rates is represented in Table 1 below. Statistical methods used to analyze the data included tables and bar charts.

Table 5: Overview of respondents' participation

Group	Target	Responded	Success rate (%)
Students	400	311	77.75
Senior members	200	112	56
Junior members	50	35	70

3 RESULTS
3.1 Participants' observation
Our observation revealed that the design of the buildings in the institution is primed for efficient use of energy. The windows are

designed to allow maximum air circulation in cooler days without the need for air conditioners. The position of the buildings allows enough illumination into the rooms on clear days.

We observed empty classrooms with the lights and fans on. This normally occurs when students vacate the room after a lecture. We noticed a particular trend during the observation concerningelectricity utilization in the classroom blocks. We observed that the classrooms are normally occupied by a small number of students for personal studies but have all the lights and fans on. A typical scenario is when we observed one student studying in a room with lights and fans on, then found two students in the next classroom also with the lights and fans on.

Majority of staff members do not turn off their desktop computers when leaving for lunch or going out for a meeting that will last more than an hour. In the general offices, we noticed that the lights remain on all day but this trend occurs because the office space is large so it is seldom empty.

3.2 Questionnaires

Table 6: Energy conservation practices (students)

Sample question	Yes	No
Do you turn a light/fan off when seen on in an empty classroom?	113	198
Do you turn off the lights when sunlight coming to the room is enough?	125	186
Do you turn the lights off when you are the last person to leave a room?	219	92
Have you ever thought of reducing the energy you use whiles on campus?	32	279
Have you ever thought of reducing the energy you use at home?	270	41

In Table 2, the survey examines energy conservation practices of students. The results in two of the questions show that majority of the respondents do not exhibit energy conservation practices. 60% of the respondents said they do not turn off the lights when there is enough illumination in the room. Further probe revealed that some of the respondents feel reluctant to walk to the switch to turn it off. Meanwhile, 70.4% of the respondents claim they turn off the lights when they are the last to leave a room. Noteworthy is the fact that this statistic is not consistent with our observation on the ground and interviews with security personnel. During our observation, we noticed lots of empty rooms with the lights still on especially during the day time. When the participants were asked whether they have ever thought of reducing the energy they use on campus, 89% responded NO. When further asked if they practiced the same thing at home, majority (87%) said YES with the reason that they pay their own electricity bills so have to be conscious of how they use it. This is in line with a survey conducted by Dianshuet al, 2010 in Liaoning Province, China, reporting that more than 90% of the respondents indicated their motivation behind energy conservation was as a result of reducing cost.

Table 3: Energy conservation knowledge (students)

Sample question	Yes	No
Do you know that energy is a challenge for Ghana?	267	44
Do you know that your actions can help reduce energy wastage?	102	209
Do you know of a policy on energy conservation in the polytechnic?	11	300
Do you have knowledge of energy conservation practices?	98	213

The survey revealed that even though the students are aware of energy challenges in the country, more than 67% are unsure that their actions do have a directly effect on energy conservation. A high percentage of students (70%) indicated that they turn off light when they are the last to leave a room but this is in contradiction with the percentage of students (67%) who know that their actions can help reduce energy wastage.

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Table 4: Energy conservation practices (staff)

Sample question	Yes	No
Do you turn off the lights when sunlight coming to the room is enough?	78	69
Do you turn the lights off when you are going out for a short while?	45	102
Do you still leave the windows opened when the air condition is on?	37	87
Have you changed your power settings on your computer to save power?	23	111
Do you put your computer to sleep when it is not in use?	31	81
Have you ever thought of reducing the energy you use whiles at work?	63	84
Have you ever thought of reducing the energy you use whiles at home?	127	20

This indicates that some students practice some energy conservation mechanisms without being conscious of their actions. 69% of the respondents stated that they have little knowledge of energy conservation practices. The results however, contradicts the result in Table 2 where majority of the respondents do not exhibit energy conservation practices.

We investigated energy conservation practices among the senior members and the results are shown in Table 4. We had two main areas of interest. We set out to identify their practices when going out of the office for a short while and also capture practices when working in the office. From the table, it is seen that majority of the respondents do not observe conservation practices when going out for a short period. 70% of the respondents close the windows when the air condition is on, whiles 72% do not put the computer to sleep when it is not in use. These results revealed that the respondents have energy conservation attitudes but are not totally aware of minor details that can help minimize energy wastage.

Table 5 belowrepresents knowledge of staff in energy conservation. From the results, 85% of the respondents indicated that they are aware of the energy challenges facing Ghana and know that their actions can help reduce energy wastage. However, they do not have much knowledge in the kind of actions that lead to energy conservation.

Table 5: Energy conservation knowledge (staff)

Sample question	Yes	No
Do you know that energy is a challenge for Ghana?	124	23
Do you know that your actions can help reduce energy wastage?	88	59
Do you know of a policy on energy conservation in the polytechnic?	27	120
Do you have knowledge of energy conservation practices?	68	79

The research findings revealed that as a result of lack of clear information and knowledge of the roles they can play in saving energy, energy is mismanaged in the polytechnic.

3.3 Interviews
The interview protocol solicited information on the roles security personnel and janitors play in ensuring energy conservation in the institution. The respondents unanimously stated that it is part of their duties to ensure that before and after their shifts, they check each room on their block to turn off lights and fans. According to them, lights and fans are always seen on during their rounds. One respondent said, 'the students make our jobs so difficult because, you turn the fans and lights off, only to be informed by your superiors that they are still on'.

The interview with the head of engineering of the Estate Department revealed that currently, there is no policy on energy conservation and management in place. However, he mentioned that the department had conducted a comprehensive study to identify approaches to employ to minimize energy usage in the institution. The report was submitted to management, pending approval. We asked him whether energy efficient electrical equipment are procured for use in the institution. He replied, 'we only advise the Procurement Department on types of energy efficient equipment and appliances available, beyond

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that, it is entirely out of our hands'. We asked him steps taken to ensure efficient use of energy when the school is connected to the generator plant. According to him, all non-essential equipment such as air conditioners do not come online when the generator is in operation.

4 DISCUSSION

One focus of the study was to identify whether the staff and students of Koforidua polytechnic have knowledge in energy conservation. The research findings indicate substantial knowledge gaps in energy conservation among personnel of the institution.This can be seen in Figure 4(a) where majority of the respondents indicated their awareness in energy challenges but less than 50% indicated they have little knowledge in energy conservation measures.Holistically, knowledge in energy conservation do not necessary translate to energy saving practices. However, elementary knowledge in why and how energy can be conserved serves as a springboard to implementing a sustainable energy conservation measures (Abrahamse et al, 2007; Bradford & Fraser, 2008). Ueno et. al. (2006)argued that it is preferable to provide information and knowledge on how to use household appliances efficiently than installing and using energy efficient appliances.The lack of knowledge in energy conservation can be tackled with educational efforts. This strategy will address specific measures they can adopt to reduce their energy consumption.
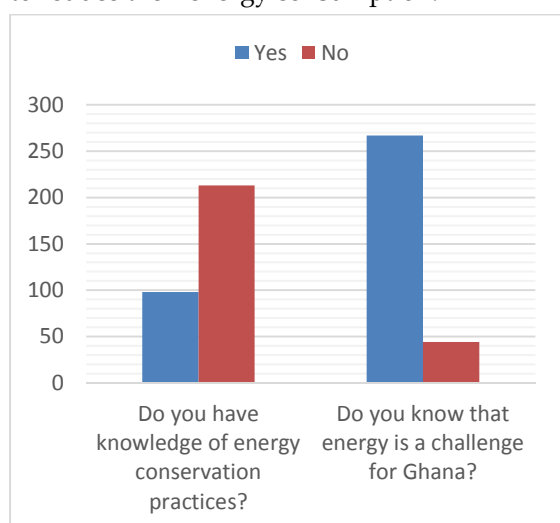
Figure 4(a): Comparison between awareness of energy challenges and knowledge in energy conservation practices (students)

In addition, our results showed that the energy conservation practices in the institution remain in the fringes. Apparently, this barrier is evident because there is no obligation to conserve energy in the institution. It can be seen in Figure 4(b) that nearly half of the respondents that stated they are aware of energy challenges in the country try to reduce energy use at home but not in the work place. This barrier can be overcome by promoting behavioral change with respect to energy conservation. Human beings tend to copy from people in authority, therefore, when senior members start practicing energy conservation measures, students and other subordinates will follow suit. This approach will likely produce long term results, however, implementing efficient lighting designs and efficient office equipment settings will reduce electricity use in the institution in the short term(Lam, Wan, Tsang, & Yang, 2008).
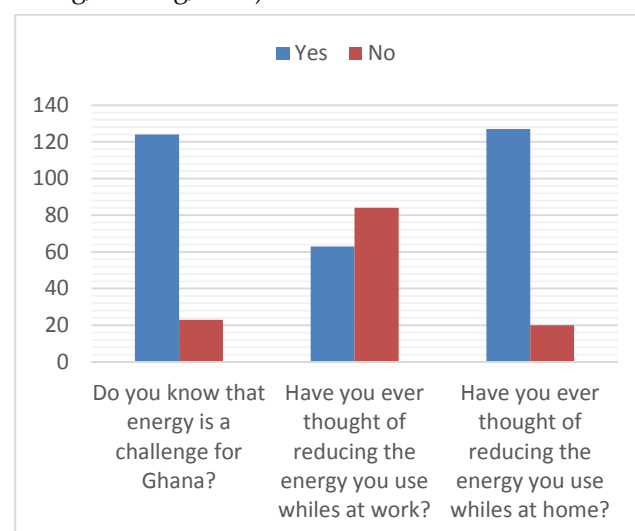
Figure 4(b): Comparison between energy conservation knowledge and practices of staff

The results of this study also revealed that there is not in existence any well-defined policy on energy conservation and management. The absence of such a policy inhibits strict enforcement of mechanisms for energy conservation. A global issue revealed in the study isthe reluctance of individuals to conserve electricity especially when they are not directly paying the electricity bills. In a study by Feng, Socacol & Vu (2010) showed that nearly half of respondents stated that they have never thought about conserving electricity. It is expedient that individuals identify that their actions wind up to affect

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them. For instance, if they are aware that lack of energy conservation can lead to increases in energy prices and destabilize the economy, they will be willing to contribute their quota in managing the energy efficiently.

5 CONCLUSIONS AND RECOMMENDATIONS

In conclusion the study revealed that there are potentially high number of avenues to realize energy savings in Koforidua Polytechnic however, there are three main limitations. Firstly, students and staff of the institution haveinsufficient knowledge in energy conservation measures. Secondly,practices towards energy conservation in the institution is spontaneous since there is no energy management policy in existence that will serve as a guideline for using energy efficiently.Lastly, students and staff of the institution show reluctant behaviours towards conserve energy because they have a belief that they are not responsible for paying the bills.

Based on the conclusions, the following recommendations are made:

- Information on energy conservation measures and practices should be passed to members of the institution through educational platforms.
- Control settings should be added to electrical equipment and appliances to allow for energy saving capabilities.
- Design and implement an energy conservation policy that will foster the smooth dissemination of efficient mechanisms for energy conservation.

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The Impact of Contraceptive Usage and Projection on Birth Rate in Northern Ghana: The Savelugu District

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Abstract
The effect of high birth rate on the population across the globe has serious ramifications. Some of these include high dependency ratio, poverty, high cost of living and low standard of living. In this light, birth control is the obvious solution to these problems. The purpose of this study was to; investigate the impact of contraceptive use on number of births and to project the number of births in the Savelugu District of Northern of Ghana. The study uses secondary data, obtained from the family planning unit of Savelugu Health Post. Data included annual contraceptive use and corresponding number of births from 2006 to 2012. The data was decomposed from annual averages to quarterly averages to increase the data points using Eview7 and run using Minitab 16. The analysis revealed no significant relation between contraceptive use and number of births (R-square = 13.2%, p-value = 0.057). Projection of the total number of contraception usage will rise from **3433** in the year 2012 to **4946** in the year 2017 representing a percentage rise of **44.1%**.

Keywords : Impact; Contraceptive; Projection; Birth Rate; Northern Ghana.

1. INTRODUCTION

In 1970 the population of Savelugu and its environs stood at 9,895 which rose to 16,965 in 1984.(http://en.wikipedia.org/wiki/Savelugu -Nanton_District). At the 2000 Population and Housing Census (PHC) the population of the district stood at 24,937 and projected to be 30,529 by 2007. The current district population is 139,283 according to the 2010 PHC results. About 39.7% of the district's population resides in the Savelugu Township according to 2010 PHC.

Without artificial (human) intervention population control, the population was reduced by catastrophes such as famine or war according to Thomas Malthus (1798). He urged for moral restraint: people must practice abstinence, sterilization, and have criminal punishments for those who have more children than they can support (Thomas Malthus…..). Also, high levels of maternal mortality and infant mortality in Africa especially in rural areas are reasons why people want to reduce births. Different forms of contraceptives are therefore introduced in the market to achieve this objective of population reduction.

According to Thomas Malthus when population growth exceeds resource, growth will lead to catastrophic checks on overpopulation like famine, disease, and wars (www.boundles.com/sociology/population). To check the menace of overpopulation birth control is the only way out which include contraception.

Family planning (FP) plays a pivotal role in population control, poverty reduction, and human development. Robust FP services have a range of benefits, including maternal and infant survival, better nutrition, increased educational attainment, a stronger position of girls and women at home and in society, prevention of sexually transmittable diseases (STDs), and environmental conservation (Bernstein & Hansen, 2006; Griffin, 2006; World Bank, 2004;).

FP is also a prerequisite for achieving the United Nations' Millennium Development Goals and for realizing the human right of reproductive choice (Allen, 2007). Much research has already been conducted on how FP affects health, but much less is known on the effects of FP on the economic situation of households and regions (e.g. Cleland et al., 2006; Singh et al., 2004; Smith et al., 2009). It seems obvious that smaller families, resulting from effective use of FP services, have lower expenses on children and therefore can more easily make ends meet and have higher potential for making savings and investments (Montgomery &Lloyd, 1999; Gillespie et al.,

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2007; Channon et al., 2010). However the available evidence on the link between FP outcomes and wealth accumulation is still restricted (Greene & Merrick, 2005).

There are a number of small-scale studies indicating that through the long-term commitment to

FP and maternal-child health, families have more assets and live in better houses (Eastwood & Lipton, 2001; Paes de Barros et al., 2001; Joshi & Schultz, 2007; Adeoti et al., 2009), but broad comparative research on the importance of the various aspects of FP for wealth accumulation and economic growth of regions is still largely lacking.

Contraceptive prevalence rate is the percentage of women who are practicing, or whose sexual partners are practicing, any form of contraception. The contraceptive prevalence (% of women ages 15-49) in Ghana was last measured at 34.30 in 2011, according to the World Bank the highest over the past 31 years while its lowest value was 9.50 in 1980 ((ICF Internation, 2012; UNICEF, 2012). With the current contraceptive prevalence rate, it can be assumed that current contraceptives will help decrease birth rates tremendously but this seems not to be the case in Savelugu. According to the Daily Graphic; fertility rate among Ghanaian women has dropped from 6.4 children per woman in 1998 to 4.0 in 2008, making the trend the lowest in sub-Sahara Africa (Daily Graphic, 1st Oct. 2009). However, the Total Fertility Rate (TFR) among womenin rural Ghana stands at 4.9 children per woman as against 3.1 in urban Ghana of which Savelugu is no exception (2008, Ghana Demographic and Health Survey) . According to the government's chief statistician Mr Baah Wadieh in a workshop in Accra to disseminate the 2008 Ghana Demographic and Health Survey (GDHS), said the fertility rate declined with increasing education of women. The survey indicated that women with secondary education or higher educational attainment had an average of 2.1 children, while those with no education had an average of 6 children (Press release, 4th Oct. 2009). He further noted that the proportion of women who used any method of contraception doubled from 13% to 24% over the past 20 years and those who used

modern methods of contraception increased from 5% in 1998 to 17% in 2008.

The population growth rate in Savelugu is 3% which is higher than the national rate of 2.6%. This is partly due to the low family planning acceptance rate (http://savelugunanton.ghanadistricts.gov.gh). The crude birth rate of the Savelugu District is 30.9 with a total fertility rate of 4.3 making it one of the highest in the Northern Region (2010 PHC). Due to this high fertility and birth rates, especially in the Savelugu District, the Family Planning subunit of the public Health Department was set up to educate couples on the need to space their births and also to limit their family size in order to enjoy a better quality life through contraceptive use.

Despite all these interventions, the District still records high birth rates each year which results in the following question questions being asked.Is the modern method of contraception really effective? and Does number of contraceptive use leads to a decline in number of births?

Technology has brought us to a stage where less human effort is required for more efficient, faster and economic alternatives for labour. With the substitution of labour with machines, unemployment, economic hardship, high levels of maternal mortality and infant mortality especially in the rural areas are some of the reasons why people want to reduce the number of births. To reduce births, different forms of contraceptives are therefore introduced into the markets to achieve the objectives of population reduction. The purpose of this study was to determine the effect of contraceptive use on birth rate and also to project contraceptive usage in the next five years in the Savelugu District in the Northern Region of Ghana

2. METHODOLOGY
Under this section, we describe the study area and source of data. Statistical data analysis is also explained.

2.1 Study area
Savelugu District has a population of 38,074 out of about 2,479,461 population of Northern Region of Ghana (2010 census).

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Savelugu/Nanton shares boundaries with Tolon Distirct and Kumbugu District to the west, Tamale Metropolis to the south and Mamprusi and Mamprugo/ Moaduri District to the North. The inhabitants of the area are predominantly peasant farmers. In this society therefore, children are a yardstick of a person's dignity, respect, honour and strength. The women in the district are also into petty trading in shear butter extraction, groundnut and rice processing.

2.2 Source of data
Data on the number of contraceptive usage was collected from the Family Planning Department from 2006-2012. The department uses the Family Planning Client cards (FPCC) which is a confidential document provided by the family planning department to their clients on first time visitors. It contained information such as date of first visit, name of client, town or place of residence, and type of Family Planning Methods subscribed.

2.3 Sample collection
Data on the number of contraceptive usage was collected from the Family Planning Department from 2006-2012. The department uses the Family Planning Client cards (FPCC) which is a confidential document provided by the family planning department to their clients on first time visitors. It contained information such as date of first visit, name of client, town or place of residence, and type of Family Planning Methods. Samle size for the study of births.

Yendi Municipal to the south-east. The municipality also shares boundaries with Karaga District to the East and West
include all names of clients whose details are captured in the records of the Family Planning Department of Savelugu Health Post.

2.4 Statistical Analysis
Regression describes and evaluates the relationships between a given dependent variable (number of births) and the independent variable(s) (contraceptive usage). It can therefore be said that regression is an appropriate statistical method in order to confirm or disconfirm a given hypotheses. With the aid of statistical packages Eviews 7 and MINTAB version 16 the data was analysed. The Eviews7 was used to break (decomposed) the annual data to quarterly data points. This was necessitated by the inadequate annual data points. The Minitab was then use to run the regression analysis and the results presented in graph and tables. Regression analysis was performed using t-test with 95% confidence interval.

3.RESULTS
3.1 Decomposition of annual data points to quarterly
Table 1 shows the decomposed yearly data on contraceptive usage in the district. The 3rd quarter of 2008 recorded the highest contraceptive usage while the 1st quarter of 2006 recorded the lowest. Fourth quarter of 2012 recorded the highest number.

Table 1: Decomposed yearly data for contraceptive use and number of births

Period	Contraceptive Use	Number Of Births Recorded
2006Q1	642	738
2006Q2	659	777
2006Q3	689	817
2006Q4	734	858
2007Q1	792	900
2007Q2	865	943
2007Q3	952	987
2007Q4	1052	1032
2008Q1	1321	1099
2008Q2	1388	1138
2008Q3	1408	1169
2008Q4	1381	1193

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2009Q1	1110	1206
2009Q2	1066	1217
2009Q3	1053	1223
2009Q4	1070	1222
2010Q1	1257	1176
2010Q2	1281	1181
2010Q3	1279	1196
2010Q4	1253	1222
2011Q1	1139	1293
2011Q2	1088	1327
2011Q3	1037	1358
2011Q4	986	1385
2012Q1	935	1409
2012Q2	884	1431
2012Q3	833	1449
2012Q4	782	1464

Source: Savelugu District Health Post 2012.

3.2 Relationship between contraceptive usage and number of births

Provide description of tables and equations

The regression equation is
Number of Births = 820 + 0.326 x Number of Contraceptive Use.

Table 2: P-Value of regression coefficient of number of contrace
Q1 – First quarter; Q2 – Second quarter; Q3 –Third quarter; Q4 – Fourth quarter contraceptive use

Predict	Coeff	SE Coeff	T	P
Const	820.2	173.6	4.72	0.000
Cont Use	0.3263	0.1641	1.99	**0.057**

S = 197.305 **R-Sq = 13.2%** R-Sq (adj) = 9.9%

Table 3 below is the fitted and diagnostic of all observations. The unusual standardise residuals are shown with **R.** these unusual observations can significantly affect the fitness of the regression model and hence its predictability.

Table 1: Decomposed yearly data for contraceptive use and number of births second, third and fourth quarter of the year respectively

Table 3 Fitted and diagnostic for all observations

Observations	No. of Birth	Fit	Resid	Std Resid
1	737.9	1029.8	-291.9	-1.60
2	776.8	1035.1	-258.4	-1.41
3	816.7	1045.1	-228.4	-1.23
4	857.7	1059.6	-201.9	-1.08
5	899.7	1078.7	-179.0	-0.94
6	942.7	1102.4	-159.7	-0.83
7	986.8	1130.7	-143.9	-0.74
8	1031.9	1163.6	-131.7	-0.68
9	1098.9	1251.3	-152.4	-0.81
10	1137.7	1273.3	-135.6	-0.73
11	1169.1	1279.8	-110.6	-0.60
12	1193.3	1270.8	-77.5	-0.42
13	1205.9	1182.5	23.4	0.12
14	1217.1	116.1	49.0	0.25
15	1222.6	1163.8	58.8	0.30
16	1222.4	1169.4	53.0	0.27
17	1175.9	1230.5	-54.6	-0.29
18	1180.7	1238.1	-57.4	-0.30

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19	1196.2	1237.6	-41.4	-0.22
20	1222.3	1228.9	-6.7	-0.04
21	1293.4	1191.9	101.5	0.53
22	1327.0	1175.1	151.9	0.78
23	1357.6	1158.4	199.1	1.03
24	1385.0	1141.8	243.2	1.26
25	1409.3	**1125.1**	284.2	1.47

26	1430.5	1108.5	322.0	1.68
27	1448.6	1091.9	356.7	1.87
28	**1463.6**	**1075.4**	**388.2**	**2.05 R**

Source: Researchers own construct
R denotes an observation with a large standardized residual.

Table 4 below is the analysis of variance. The p-value of 0.057 greater than 0.05(the significant level) is an indication of none significant of the regression model.

Table 3: Analysis of Variance

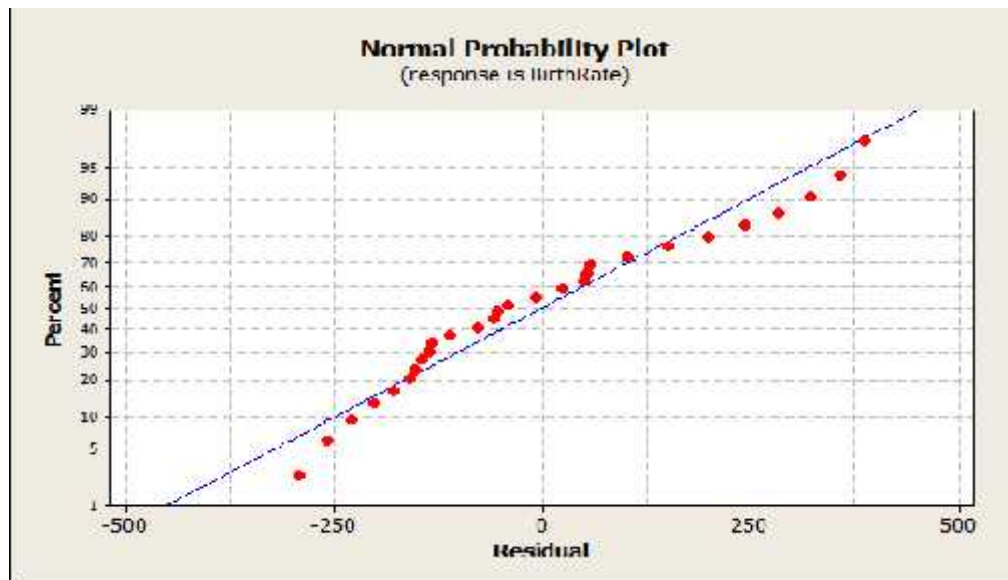| Source	DF	SS	MS	F	P
Regression	1	154003	154003	3.96	**0.057**
Residual Error	26	1012158	38929		
Total	27	1166161			

Figure 1(a): Normal probability plot.

From Figure 1, the normal probability shows a linear fit. This shows that number of births is normally distributed thus no inherent error in number of births recorded.
This was achieved by the use of time series analysis with the fitted trend equation as
$Y_t = 941.4 + 6.35*t$

3.2 Projection Analysis using time series

Where
Y_t = number of contraceptive use   t = quarterly time period

Table 4: Contraceptive use forecasts for twenty quarters

Period	Quarterly Forecast	Yearly Forecast
2013 Q1	1125	

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2013 Q2	1132	
2013 Q3	1138	
2013 Q4	**1145**	**4540**
2014 Q1	1151	
2014 Q2	1157	
2014 Q3	1164	
2014 Q4	**1170**	**4641**
2015 Q1	1176	
2015 Q2	1183	
2015 Q3	1189	
2015 Q4	**1195**	**4743**
2016 Q1	1202	
2016 Q2	1208	
2016 Q3	1214	
2016 Q4	**1221**	**4845**
2017 Q1	1227	
2017 Q2	1233	
2017 Q3	1240	
2017 Q4	**1246**	**4946**

Key: Q_1, Q_2, Q_3 and Q_4 represents 1st,2nd ,3rd and 4th quarter of the year.

4. DISCUSSION

From the results, the null hypothesis H_o (Contraceptive usage leads to a decline in the number of births in Savelugu district) was not the case. This results, contradict current contraceptive prevalence rate, which assumed that, contraceptives usage will help decrease birth rates tremendously (Ian et al., 2009). This was, however, not to be the case in Savelugu. These findings however support the literature that many contraceptive users use various methods to space birth but not necessarily to reduce number of births. Another reason that support this findings is the desire for many couples to have specific sex of children which might lead contraceptive users to still give birth to high number of children.

Both analysis of variance and the regression coefficients (Tables1 and 3) indicate a P-value of 0.057, suggesting that contraceptive usage have no significant relation on number of births in Savelugu District.

This implies that: increase in contraceptive use in a community would not automatically lead to decrease in number of births, people might be using contraceptive not only to reduce number of child births but for other reasons, and there might may be other serious underlining factors that work against the use of contraceptives to reduce number of births.

The R-square value of 13.2% is an indication that, the number of contraceptive use can only account for 13.2% of the variation in number of births in Savelugu district. This confirms the high population growth rate in Savelugu (3%) which is higher than the national rate (2.6%).

The projected number of contraceptive use in Savelugu district is estimated to be 4946 by 2017, representing 44.1% increase from 2012 figure of 1464.

This is likely to aggravate the already negative indicators such as maternal mortality rate, increasing poverty, worsening educational opportunities, etc.

5. CONCLUSION

From the findings above:

There is no significant relationship between contraceptive usage and number of child births in Savelugu District of northern region of Ghana. That is increase in contraceptive use does not lead to a decline in the number of births in Savelugu district as postulate by literature.

In five (5) years time, contraceptive usage will increase from 3433 in the year 2012 to 4946 in 2017, representing 44.1%. The quarterly change in number of contraceptive use is marginal (0.326) for five (5) years.

The family planning unit needs to find out why clients who willingly adopt these birth control methods still register high birth rate. It is possible people might seek for these measures but does not properly apply them. Clients may also be pretending to be users to satisfy the personnel of the family planning unit of what they want to hear.

Acknowledgment

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Effect of Duration of Refrigeration of Blood Samples on Glucose-6-Phosphate Dehydrogenase (G6PD) Of Some Patients Reporting At PathoMedical Laboratory, Adabraka, Accra

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Abstract
The effect of duration of refrigeration of blood samples on variability of Glucose-6-Phosphate Dehydrogenase (G6PD) was determined. Hundred (100) questionnaires were administered to the 50 females and 50 males; 15% expressed knowledge about G6PD deficiency and 85% did not; 96% admitted taking anti-malaria drugs, antibiotics or painkillers and only 4% had ever consumed fava beans but did not experienced side effect; 91% experienced side effects after taking anti-malaria drugs, antibiotics and painkillers. Findings indicate that 20% of the normal samples were stable till 96 hours. Therefore, blood samples for G6PD test should not be refrigerated beyond 72 hours. G6PDdeficiency patients should be educated to avoid anti-malaria drugs, antibiotics and fava beans. In areas where fava beans form an important part of the diet, techniques that can genetically modify fava beans to eliminate the causative agents of haemolysis should be employed.

Keywords: G6PD; Anaemia; Normal; Full Defect; Partial Defect.

1. INTRODUCTION

Glucose-6-phosphate dehydrogenaseisanimportant enzyme inthe metabolismofglucosebytheredbloodcellandoth ertissues. It represents the firststepinthe oxidativemetabolism of glucosethrough the hexose monophosphate pathway (WHO, 1966).

Glucose-6-phosphate dehydrogenase deficiency is a genetic disorder that occurs most often in males. This condition mainly affects red blood cells, which carry oxygen from the lungs to tissues throughout the body. In affected individuals, a defect in an enzyme called glucose-6-phosphate dehydrogenase causes red blood cells to break down prematurely (MedicineNet, 2014). This destruction of red blood cells is called hemolysis (Lemery, 1998).

The most common medical problem associated with glucose-6-phosphate dehydrogenase deficiency is hemolytic anemia, which occurs when red blood cells are destroyed faster than the body can replace them. This type of anemia leads to paleness, yellowing of the skin and whites of the eyes (jaundice), dark urine, fatigue, shortness of breath, and a rapid heart rate. In people with glucose-6-phosphatedehydrogenase deficiency, hemolytic anemia is most often triggered by bacterial or viral infections or by certain drugs such as some antibiotics and medications used to treat malaria. Hemolytic anemia can also occur after eating fava beans or inhaling pollen from fava plants a reaction called favism. Glucose-6-dehydrogenase deficiency is also a significant cause of mild to severe jaundice in newborns. Many people with this disorder, however, never experience any signs or symptoms (MedicineNet, 2014).

Haematological tests performed in district laboratories include the G6PD deficiency test (Cheesbrough, 2006). The distribution of the enzyme Glucose-6-Phosphate Dehydrogenase (G6PD) deficiency is linked to areas of high malaria endemicity due to its association with protection from the disease. G6PD deficiencyis an X-linked disorder with more than 400 variant enzymes identified (Beutler, 1988). Therefore males are mainly affected. Occasionally homozygous females are also affected clinically (Cheesbrough, 2006).

Most persons with G6PD deficiency are asymptomatic but exposure to oxidant drugs, such as the anti-malarial drug Primaquine, may induce hemolysis (Cappellini, 2008). Therefore, the administration of this drug to individuals requires test for G6PD deficiency.

The standard operating procedure (SOP) of haematological tests states that G6PD should be tested immediately blood samples are taken (Cheesbrough, 2006). However, under normal circumstances, samples are sometimes stored at 2 - 8°C for three (3) days or more before they are

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analysed. The current power crisis poses a challenge to haematological laboratories which do not have alternative power sources.

Prolonged sample storage can be a pre-analytical source of variability. It is recommended that hematological analysis be performed shortly after blood collection. However, delayed analysis can occur when blood is couriered to a reference laboratory. Blood collected on a Friday is not analyzed until the following Monday, or circumstances do not allow for timely analysis (Cora et al., 2012).

The aim of this research was to determine the effect of duration of refrigeration of blood samples on variability of Glucose-6-Phosphate Dehydrogenase (G6PD).

2. METHODOLOGY
2.1 Research area
The work was conducted at Patho Medical Laboratory at Adabraka in Accra. The work could have been done in any standard laboratory and at any age. This is because age and location do not affect the test. The samples were however taken from individuals between 18 to 40 years.

2.2 Sample collection and storage
A total of 100 patients were involved in this research. Patients were divided into 10 batches consisting of 5 males and 5 females for weekly analysis. 8 ml of blood was taken from each patient into ethylenediaminetetra acetic acid (EDTA) vacutainers. The tubes were covered and mixed gently. 1.5 ml of each fresh blood sample was taken immediately for G6PD test and the rest refrigerated at temperatures ranging from 2-8°C. G6PD test was repeated for 24, 48, 72 and 96 hours for the rest of the week. The procedure was repeated each week for the period of 10 weeks. Patient's ages ranged from 18 to 40 years and consists of healthy 50 male and 50 females.

A questionnaire was also prepared to determine patient's knowledge of G6PD deficiency. The questionnaire was administered to each the patients after blood samples was taken.

2.3 Procedures for themethaemoglobin reduction test
Three (3)tubes were labelled Test, Normaland Deficient. The following were pipetted into each tube as indicated in the table below:

Tube	Test	Normal control	Deficient control
Freshly prepared sodium citrate	50	-	50
Methylene blue reagent (µl)	50	-	-
Patient's blood (µl)	500	500	500

The tubes were covered and mixed gently.All the three samples were incubated at 37°C and examined every three hours for the period of 90minutes.

In order to observe different colours clearly, each test was diluted using distilled water. 10 ml of distilled water was pipetted into three clean 15ml test tube. 100µl of well mixed sample was transferred from each of theTest,Normal, and Deficient tubes into the 10 ml of distilled water and labeled accordingly. The contents were mixed well and the colour of the solution in each tube examined as indicated in the table below.

Result	Interpretation
Colour of test solution is similar to the red colour of	Normal
Colour of test solution is similar to the Deficient	Reduced G6PD activity (G6PD deficiency in
Colour of test solution is different from	Full defect

3. RESULTS
Table 1: Weekly analysis grouped into males and females
Week1

Sex: Males	Storage periods (hours) at 2-8 °C				
	0	24	48	72	96

1.	Normal	Normal	Normal	Normal	Normal
2.	Normal	F.D	F.D	F.D	F.D
3.	Normal	Normal	Normal	Normal	F.D
4.	F.D	F.D	F.D	F.D	F.D
5.	Normal	Normal	Normal	Normal	Normal
6.	Normal	Normal	Normal	Normal	Normal
7.	Normal	Normal	Normal	Normal	Normal
8.	Normal	Normal	Normal	Normal	Normal
9.	F.D	F.D	F.D	Normal	F.D
10.	Normal	Normal	Normal	Normal	Normal

Week 2

Sex: Males	Storage periods (hours) at 2-8 ºC				
	0	24	48	72	96
11.	Normal	Normal	Normal	Normal	Normal
12.	Normal	Normal	Normal	Normal	Normal
13.	Normal	Normal	Normal	Normal	Normal
14.	Normal	Normal	Normal	Normal	F.D
15.	Normal	Normal	Normal	Normal	Normal
16.	Normal	Normal	Normal	Normal	F.D
17.	Normal	Normal	Normal	Normal	Normal
18.	Normal	F.D	Normal	Normal	F.D
19.	Normal	Normal	Normal	Normal	Normal
20.	Normal	Normal	Normal	Normal	Normal

Week 3

Sex: Males	Storage periods (hours) at 2-8 ºC				
	0	24	48	72	96
21.	Normal	Normal	Normal	Normal	F.D
22.	Normal	Normal	Normal	Normal	F.D
23.	Normal	Normal	Normal	Normal	Normal
24.	Normal	Normal	Normal	Normal	Normal
25.	Normal	Normal	Normal	Normal	Normal
26.	Normal	Normal	Normal	Normal	Normal
27.	Normal	Normal	Normal	Normal	F.D

28.	Normal	Normal	Normal	Normal	F.D
29.	Normal	Normal	Normal	Normal	F.D
30.	Normal	Normal	Normal	Normal	Normal

Week 4

Sex: Males	Storage periods (hours) at 2-8 °C				
	0	24	48	72	96
31.	F.D	F.D	F.D	Normal	F.D
32.	Normal	Normal	Normal	Normal	Normal
33.	Normal	Normal	Normal	Normal	Normal
34.	F.D	Normal	Normal	Normal	F.D
35.	Normal	Normal	Normal	Normal	Normal
36.	Normal	Normal	Normal	Normal	Normal
37.	Normal	Normal	Normal	Normal	Normal
38.	Normal	Normal	Normal	Normal	Normal
39.	Normal	Normal	Normal	Normal	Normal
40.	Normal	Normal	Normal	Normal	F.D

Week 5

Sex: Males	Storage periods (hours) at 2-8 °C				
	0	24	48	72	96
41.	Normal	Normal	Normal	Normal	Normal
42.	Normal	Normal	Normal	Normal	Normal
43.	Normal	Normal	Normal	Normal	Normal
44.	Normal	Normal	Normal	Normal	Normal
45.	F.D	F.D	F.D	Normal	F.D
46.	Normal	Normal	Normal	Normal	Normal
47.	F.D	F.D	F.D	Normal	F.D
48.	Normal	Normal	Normal	Normal	F.D
49.	Normal	Normal	Normal	Normal	Normal
50.	F.D	F.D	F.D	Normal	F.D

Week 6

Sex:	Storage periods (hours) at 2-8 °C

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Females	Fresh	24 hours	48 hours	72 hours	96 hours
51.	Normal	Normal	Normal	Normal	Normal
52.	Normal	Normal	Normal	Normal	Normal
53.	Normal	Normal	Normal	Normal	Normal
54.	Normal	Normal	Normal	Normal	F.D
55.	Normal	Normal	Normal	Normal	F.D
56.	Normal	Normal	Normal	Normal	Normal
57.	Normal	Normal	Normal	Normal	Normal
58.	Normal	Normal	Normal	Normal	F.D
59.	Normal	Normal	Normal	Normal	Normal
60.	Normal	Normal	Normal	Normal	Normal

Week 7

Sex: Females	Storage periods (hours) at 2-8 °C				
	Fresh	24 hours	48 hours	72 hours	96 hours
61.	Normal	Normal	Normal	Normal	Normal
62.	Normal	Normal	Normal	Normal	F.D
63.	Normal	Normal	Normal	Normal	Normal
64.	Normal	Normal	Normal	Normal	Normal
65.	Normal	Normal	Normal	Normal	Normal
66.	P.D	P.D	F.D	F.D	F.D
67.	Normal	Normal	Normal	Normal	Normal
68.	Normal	Normal	Normal	Normal	Normal
69.	Normal	Normal	Normal	Normal	Normal
70.	Normal	Normal	Normal	Normal	Normal

Week 8

Sex: Females	Storage periods (hours) at 2-8 °C				
	Fresh	24 hours	48 hours	72 hours	96 hours
71.	Normal	Normal	Normal	Normal	Normal
72.	Normal	Normal	Normal	Normal	Normal
73.	Normal	Normal	Normal	Normal	Normal
74.	F.D	F.D	F.D	F.D	F.D
75.	Normal	Normal	Normal	Normal	Normal

	Normal	Normal	Normal	Normal	Normal
76.	Normal	Normal	Normal	Normal	Normal
77.	Normal	Normal	Normal	Normal	Normal
78.	Normal	Normal	Normal	Normal	Normal
79.	Normal	Normal	Normal	Normal	Normal
80.	Normal	Normal	Normal	Normal	Normal

Week 9

Sex: Females	Storage periods (hours) at 2-8 ^{o}C				
	Fresh	24 hours	48 hours	72 hours	96 hours
81.	Normal	Normal	Normal	Normal	F.D
82.	Normal	Normal	Normal	Normal	Normal
83.	Normal	Normal	Normal	Normal	Normal
84.	Normal	Normal	Normal	Normal	Normal
85.	Normal	Normal	Normal	Normal	Normal
86.	Normal	Normal	Normal	Normal	Normal
87.	Normal	Normal	Normal	Normal	Normal
88.	Normal	Normal	Normal	Normal	F.D
89.	Normal	Normal	Normal	Normal	Normal
90.	Normal	Normal	Normal	Normal	Normal

Week 10

Sex: Females	Storage periods (hours) at 2-8 ^{o}C				
	Fresh	24 hours	48 hours	72 hours	96 hours
91.	Normal	Normal	Normal	Normal	Normal
92.	Normal	Normal	Normal	Normal	Normal
93.	P.D	P.D	P.D	F.D	F.D
94.	Normal	Normal	Normal	Normal	Normal
95.	Normal	Normal	Normal	Normal	Normal
96.	Normal	Normal	Normal	Normal	Normal
97.	Normal	Normal	Normal	Normal	Normal
98.	Normal	Normal	Normal	Normal	F.D
99.	Normal	Normal	Normal	Normal	F.D
100.	Normal	Normal	Normal	Normal	Normal

The percentages of normal, full defect and partial defect of patients are summarized below.
Table 2: Percentages of normal, full defect and partial defect of patients

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Sex	(%) N	(%) P.D	(%) F.D	Total (%)
Males	43	0	7	50
Females	47	2	1	50
Total (%)	90	2	8	100

Table 3: Demographic data and knowledge of G6PD

No.	Question	Respondents
1.	**Gender**	Males: 50 Females: 50
2.	**Age**	18-40
3.	**Occupation**	Government workers: 93 Traders: 7
4.	**Education**	Primary: 0 JHS: 5 SHS: 7 Tertiary: 89
5.	**Have you ever heard of glucose-6-phosphate dehydrogenase (G-6-PD) deficiency?**	Yes: 15 No: 85
6.	**Do you know your G6PD status**	Yes:15 No. 85
7.	**Have you taken any of the following food and drugs?**	Anti-malaria rugs: 96 Have ate fava beans: 4
8.	**How do you feel when you take** **a)** Anti-malaria rugs, antibiotics or painkillers **b)** Fava beans	Experience side effect: 9 No side effect: 91

Table 4: Patients positive for G6PD with side effects

	Side effect		
	Male	**Female**	**G6PD status**
Anti-malaria rugs, antibiotics or painkillers	7	2	All positive
Fava beans	0	0	All negative

Key:
N - Normal
P.D - Partial defect
F.D – Full defect

4. DISCUSSION OF RESULTS
From the results, all normal samples remain normal until 96 hours when some became full

defect. This indicates that refrigeration beyond 96 hour at 2-8 °C does not favour the enzyme. 43% of males tested normal, 7% were full defect and none were tested partial defect. 47% of females tested normal, 2% tested partial defect and 1% tested full defect.

The percentage of males with FD was higher (7%) compared with that of females (1%). This is because the activity level of the G6PD enzyme is genetically determined. The G6PD gene is located on the Xchromosome (a man has XY and a woman has XX). A man with a defective gene (hemizygote) and a woman with 2 defective genes (homozygote) are affected. A woman with just 1 mutant gene (heterozygote) is a carrier, but normally does not display any symptoms.

A total of 100 questionnaires were administered to 50 females and 50 males. 93% respondents were government workers and 89% had tertiary education. 15% respondents expressed their knowledge about G6PD deficiency and 85% did not know anything about G6PD deficiency. 96% of respondents admitted taking anti-malaria drugs, antibiotics or painkillers but only 9 have experienced side effect. 4% knew fava beans and have consumed it. 91% did not experienced side effect after consuming fava beans. All patients with full defect experienced side effect after taking anti-malaria drugs, antibiotics or painkillers.

There was only refrigerator in the laboratory. Refrigeration temperature of 2-8 °C could not be maintained because other samples were also stored in the same fridge. There was intermittent opening and closing of the fridge. So the temperature sometimes reads between 10 and 15 °C. Even though there was temperature variation outside the range set, the red blood cells (RBCs) remain stable for 96 hour.

5. CONCLUSION

Findings indicate that prolong storage of blood sample can result in haemolysis of the red blood cells. This is observed after 96 hours.

Majority of respondents are educated but lack knowledge of G6PDD. This can increase the risk of haemolytic anaemia.

Two (2) male samples showed F.D, became normal within forty-eight (48) and then defective again till 96 hours. This situation could not be accounted for and therefore need further research.

Finally, anti-malaria drugs, antibiotics or painkillers and fava beans should be avoided by persons with G6PD Deficiency.

6. Recommendation

Blood samples for G6PD enzyme test should be done immediately samples are taken. However, where it is not possible to conduct the test immediately, samples can be refrigerated at 2 - 8°C for not more than 72 hours but not beyond.

Estimates ofthegenefrequencymustbebased onsurveyscarried outonmales.

G6PDdeficiency patients should be educated to avoid fava beans and drugs that cause allergy.

In areas where the fava beans are important part of the diet, techniques that can genetically modify fava beans to eliminate the causative agents of haemolysis should be employed.

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Design and Implementation of Bamboo Umbrella

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Abstract
Umbrellas of different kinds have been in use since generations as either for sun shade or for the rain cover and even as traditional symbols for many ethnic groups in Ghana. However, most of these umbrellas are made of metallic frames which easily corrode under the influence of atmospheric conditions. The aim of this research work is to design and implement a corrosive proof umbrella that will not suffer any weather effect using bamboo stick as the base material for all the mechanisms required. The bamboo umbrella is an innovation of the metal type developed manually and evaluated at the Koforidua Regional PWD engineering shop. The handle, stick, ribs, spokes and spring mechanisms were all designed using bamboo while calico is used to form the canopy. Even though, further work on the Bamboo umbrella is recommended and proposed, the present and subsequent works can be used as a sun shield with its resistance against any weather effect giving it advantage while the abundance of bamboo makes it cheaper and therefore, a preferred choice for sun shield.

Keywords: Bamboo; Traditional Symbols; Metallic Frames; Corrosive Proof Umbrella; Mechanisms

1.INTRODUCTION

The use of umbrella started many years ago and so it is a common practice in the present Ghanaian culture where traditional chiefs are flanged under umbrellas, asymbol of Authority during festival cerebrations. In fact, the ethnic Krobos demand an umbrella when paying a bride price to the father in-law, a tradition which has been in existence for many years. Therefore, umbrella forms part of the traditional symbols for many clans in Ghana. It is with much discomfort seeing pregnant women and nursing mothers carrying their babies at their backs trekking long distances in the scotching sun to attend antenatal clinics without using umbrella to shield the sun rays, due to high cost of umbrellas.

Interestingly, the availability of bamboo shrub growing naturally in many parts of the country has led to its economic deployment in areas such as roofing materials, fencing materials, and in recent times as floor support in the construction industry.

Empirically, the deployment of bamboo as building support in constructional works is indisputable evidence, proving the strength and durability of the material and can therefore be used in varieties of applications (www.asian-bamboo.com, 2014).

The design and implementation of a corrosive proof umbrella for sunshade that will not suffer any weather effect using bamboo stick as the base material will go a long way to bring comfort to its users during the sunny weather seasons. Additionally, the bamboo umbrella can serve as beach paraphernalia.

The geographical location of our country – Ghana within the tropics is not without challenges.
One such example of these challenges is the usual hot sunny conditions associated with the harmattan season. The extreme temperatures of close to 45^0C with strong warm breezes experienced in the area turn live the inhabitants with several illnesses like Cerebrospinal Meningitis (CSM). The hamathan is equally felt in the Southern part of the country as well but with less condition. Coincidentally, the social status of the majority of who happened to leave within these areas, in general, are quite poor and they therefore rely mostly walking for most of their transactions. Pregnant Women and nursing mothers alike are seen trekking long distances in the scotching sun to attend clinics with so much discomfort, however, the difficulties experienced under this condition can be minimized if they use a durable and

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affordable umbrella over their head (http://matadornetwork.com, 2014).

1.3 Design Objectives

The design objectives that propelled this research project are:

- To design and produce a sunshade umbrella which can be used on a typical sunny day walk.
- To take the advantage of the abundance of bamboo shrub growing naturally in the country-side and turn it into usable product.
- To help eliminate or reduce the incidences of cerebrospinal meningitis of the people of the north.

3. MATERIALS AND METHODOLOGY

3.1 Materials Specification

The following are the main materials that were used in the construction of the bamboo umbrella;

- A piece round seasoned wood block measuring 5cm in length and diameter of 6cm.
- A piece of seasoned/ fully grown bamboo of length measuring 40cm and diameter 8.5cm.
- A suitable seasoned smaller size bamboo measuring 59cm in length and 1.5cm in diameter.
- A suitable length of Nylon cord of 0.5mm diameter and length 4572cm.
- A suitable piece of cloth of 45cm radius.
- One container of bonded white glue such as top bond.

3.2 Tools Specification

The tools that are required in the construction of the artifact include the following:

- A suitable sharp knife

- A hand drilling machine /1mm² (drill bit equal in size with bamboo post).
- A hacksaw/blade.
- A hammer
- A punch

3.3 Architecture of Bamboo Umbrella

The understanding of the architecture of an umbrella is paramount in preparing the various parts that constitute the bamboo umbrella shown in figure 1

Figure 1 Umbrella Architecture
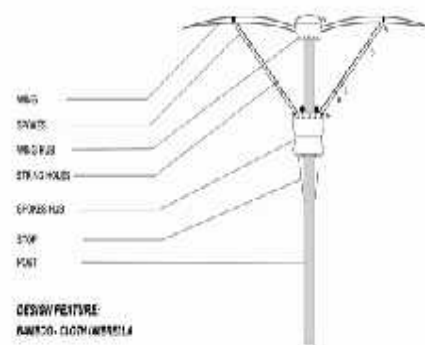
3.4 Design Specifications(Geometrical Data)

The inter dependence nature of the various parts were the focal point in determining the geometrical data in this cutting list.

Thus, if the number of Wings (Wg), Spokes (Sp) and Slots (St), then

Wg = Sp = St.

Table 3.1 is therefore the design specification for the various parts of the artifact in consideration. In this case, **Wg = Sp = St = 40.**

These lengths specified are quite enough to produce a sizeable spread for sun shade.

Table 3.1 Geometrical Data

Serial No.	Part Specification	Geometrical Data (Dimension)
1	Wing	No. of wing = No. of Spokes = No. of Slots = 40
		Length (L) = 42 Cm
		Thickness (T) = 0.2 Cm
		Distance between Hole Centres (E F) = 10.5 Cm
2	Spokes	Length (L) = 15.5 Cm
		Thickness (T) = 0.2 Cm
		Distance between Hole Centres (A B) = 4.5 Cm
		(B C) = 2.0 Cm
		(C D) = 4.0 Cm
		(D E) = 5.0 Cm
		Spread Angle = 90º
3	Post	Length (L) = 60 Cm
		Diameter (D) = 1.5 Cm
4	Stop Mechanism	Height (Ht) =3.4 Cm
		Spread Diameter (SD) =2.2 Cm
5	Wing Hub	Diameter (D) = 4.5 Cm
		Height (Ht) = 2 Cm
		No. of Slots = 40
6	Spokes Hub	Diameter (D) = 4.5 Cm
		Height (Ht) = 3.5 Cm
		No. of Slots = 40

Formula: Circumference of canopy (cm) = $2r\pi$, where r is the radius and π given as $\frac{22}{7}$

7   piece of cloth cut to radius, r = 45cm

≡ Circumference of cloth cut = $2(45) (\frac{22}{7})$ = 282.85cm

3.5. Method of Implementation
This stage of the process describes the systematical approach that the implementation of the umbrella went through. The activities involve cutting the bamboo to size and forming the required shapes, most often using knife. These have to be followed by the weaving of the various sections. In effect most of the activities are manually done.

The implementation therefore involves two major activities namely;
- Cutting the Bamboo Parts to Size and Shape
- Weaving Process

3.5.2 Cutting the Bamboo Parts to Size and Shape
Hub: A block of wood is first designed into equal space slots at one end at a depth of 7mm, width of 1.5mm, and equal in number with the wings or spokes, thus 40. In this particular design, forty is chosen. A central hole is next created in both hubs with a drill bit of 1.6cm

diameter, ensuring the free sliding of the spoke hub, with the wing hub slightly smaller, to fit tight on the end of the bamboo post.

Wing: The wing is the main feature designed to form the canopy of the umbrella. The length of each pair of wing measuring 41cm and placed across the wing hub determines the span or size of the canopy.

The preparation of the wing is started by splitting the matured bamboo into blade form about 5mm thickness and given that special shape (trim) so as to give it strength at the two location point where maximum stress is more pronounced.

The two location points are the one to the end which fits into the hub and the other, locates the end of the spokes. The distance between the two holes relates to the conical angle formed between each opposite pair of spokes when fully spread out. This will eventually relate to the stop distance between the two hubs with a conical angle of 90⁰.

Spring Stop: This is a specially shaped two piece unit of the split bamboo shaped and with exposed length measuring 3.4cm into a location in the post to form a spring locker to the spoke hub. The complete shape of the assembly is such that the bottom-end closes up while the top-end opened out slightly as in figure 2.

Figure 2.   Bamboo Spring

Spokes: The spread length of opposite pair of spokes wings measured across the spokes hub determines the size of the canopy. The spokes designed from the split bamboo is shaped into slightly thicker thus 5mm across mid-section, 4mm thinner inner-end and 2mm thinner outer-end respectively.

Five holes of 1mm diameter, one at each end with three others located at specific points in between, forms the main feature of spokes design, and, into which runs the nylon woven string.

3.5.3. Weaving Process: This is the stage where all bamboo parts which have been prepared as described earlier are brought together for the weaving. The process is put in these five stages;

Stage 1- Linking Spokes to Hub

The first stage involves the weaving of the spokes into their respective slots on the hub, forming a ring on the hub and ready for 'Holder' stage 2 to commence. See figure3. From this stage, it is convenient to place the circle of spokes assembled on the hub over any conical shape equal in shape with the intended spoke-cone to be produced.
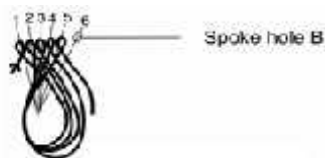
Figure 3 Spokes link to hub

Stage 2- Weaving the Holder

The weaving is now made easier and should follow systematically as outlined in the diagrams of figure 4.
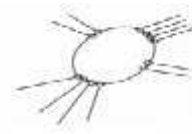
Figure 4 Weaving the Holder

Stage 3- Weaving the Locker

The Locker Stage is located at the spokes hole 'B' and the weaving is as shown in figure 4&5 respectively.
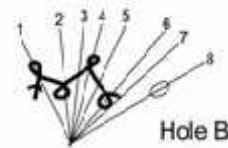
Figure 5 Weaving the Locker

Stage 4- Weaving the Tensioner

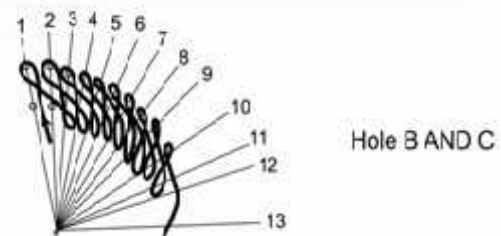At this stage, the weaving is done such that holes B & C are inter woven as shown in figure 6.

Figure 6 Tensioner

Stage 5- Stabilizer

At this stage, the weaving is done such that the Spokes holes C & D are inter-woven strands as shown in figure 7.
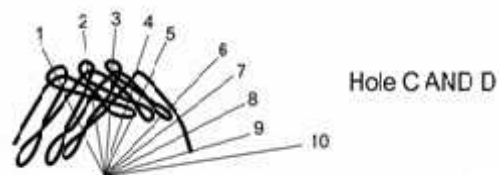

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Figure 7 Stabilizer

Stage 6- Linking Wings into Hub
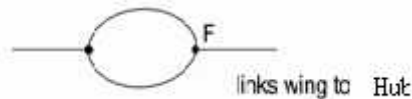The sixth stage is to link the end of the Wings into the Wing Hob as shown in figure8.

Figure 8 Linking Wings to Hub
Stage 7- Linking Spokes to Cone
The next activity which is the seventh stage weave; is to fix the woven spokes cone on to the post and lock each spoke-end into the
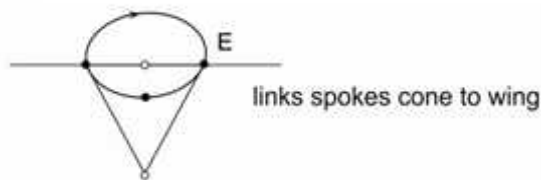

Figure 9 Fixing Woven Spokes to Wings
slot wings at point 'E'. A stop pin (bamboo) is then, fitted above the spokes hub at rest position. This is illustrated in figure 9.

Stage 8- Bonding of cloth (Canopy)
The cloth is cut to size of radius 45cm to fit the wing span, when spread over the fully. The wing is spread out and the cut cloth stuck onto it using suitable white glue. The ends are finally given a tight lock using suitable threads for the complete assembly. The required finishing could be either polishing or painting of the post for aesthetic value. However, in this particular design, the Post was given a brown polish. This activity is illustrated in figure 10.
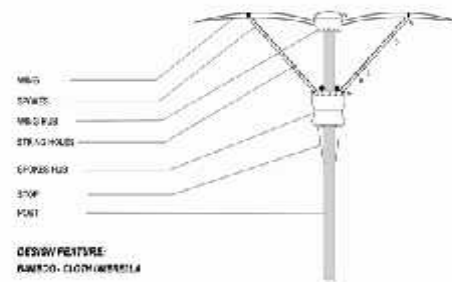
Figure 10. Bonding of cloth (Canopy)

Umbrella
The picture shown in figure 11 is a demonstration of the use of the bamboo umbrella that has a Dye Cotton canopy.
The operation is same as the metal type. The operation is same as the metal type. It involves using fingers to push up the hub until it engages with the bamboo spring

3.5.4 Finish Product of Bamboo

Figure 11. Finish Product of Bamboo Umbrella (Erected)
Picture of folded Bamboo Umbrella
This picture is a typical demonstration to illustrate the folding of the umbrella when not in use.
The operation is same as the metal type. It involves using two fingers to disengage the bamboo spring while pulling down the hub.

Figure 12. Folded Bamboo Umbrella

4.0 DISCUSSION
4.1 Method
The method adopted to test and evaluate the performance of the completed work was to subject the Umbrella to a continuous use since 1987 and undergone physical inspection to detect whether there were any failures, loosen ends, ware and tire, etc.

The product was exposed and subjected to regions of both marginal cold and high temperatures in the southern (thus, Accra and Koforidua) and northern region (i.e. Tamale) for ten year use period (1987 to 1998 and 1989 to 2010) respectively.

4.2 Observations and Findings
After a thorough observation of the artifact during the test period, the following observations were made:

- Remarkably, the product has remained in good shape. It was however, observed that exposure of the product to rain or any form of moist condition affected the cloth covering and not the rest of mobile parts
- The artifact remained firm without any distortion or any sign of mechanical stress such as bending or dislocation or loose unit within the assembly.
- The wing, spokes, hub and the canopy all remained firmed at their engaged positions when the umbrella was fully spread as the extreme temperature of up to 45^0C failed to impact negatively on it.

5. 0. CONCLUSION
The Bamboo Umbrella as shown in the figure 12, followed a simple design process where the almost unlimited resource of bamboo found in the south of Ghana but marginal used and with the aid of simple components such as spokes made of bamboo; a resource abundant locally, cloth, glue, and thread that are assembled to produce an umbrella. This surely would help reduce poverty in the country as more people will find job. The umbrella was tested through a continuous use over a 27 years period. During this period, the umbrella shared a life span of not less than nine years in the southern and northern part of Ghana with variable climate. The successful implementation of the artifact is a plus to a new cottage industry since the major raw material is readily available in our localities.

It is expected that the people of the northern region during the hamathan season when taking cover from adverse sun rays can resort to the bamboo umbrella. This will limit the seasonal Cerebrospinal Meningitis diseases recorded.

In addition, pregnant women attending antenatal clinics could make use of this as the larger majority trek to the clinics on foot all across the country.

5.1. Recommendation
The artifact was designed and produced with tools and materials which include readily available Bamboo as the base material.

The following are recommendations necessary after evaluations and conclusion;

- The technology must be deployed by Government to boost the ongoing cottage industry agenda in creating a sustainable economy for the rural dwellers.
- Furthermore, the artifact should be use during the hamathan period to provide shelter from the sun and must avoid exposure to moist conditions.
- The product could be suitable for all weather conditions with water-proof choice cloth covering.

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The Desire For Last Birth Among Ghanaian Women: The Determinants

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Abstract
This study examines the desire for last birth among Ghanaian women and the determining factors associated with such desire. The study used a data set based on a longitudinal study from the fourth round Multiple Indicators Cluster Survey (MICS). This was a national survey conducted by the Ghana Statistical Service (GSS) in 2011 to monitor progress of women and children. A sample of 10,963 women within the reproductive age (15 – 49) years across the country between 2009 and 2011 were selected for the survey.In this study, a multiple logistic regression and bootstrap techniques were used to determine the relationship of maternal factors and desire for more children. The estimated women who expressed no desire for the last birth was about 33.7% out of the 2873 women who gave birth within the survey period. This means that more than 3 in 10 women get pregnant when they are not prepared. The factors observed to be highly significantly associated with desire for more children among Ghanaian women included marital status (p-value = 0.000), parity (p-value = 0.000), mothers' age (p-value = 0.000) and region of residence (p-value = 0.000).The results show that childbearing among more advantaged women are better planned than less advantaged women. The findings further reveal that about 30.7% of married women have an unmet need for family planning (unmet need for family planning defined as the percentage of married women who want to space their next birth or stop childbearing entirely but are not using contraception).

Keywords: Desire for Last Birth; Unmet Need; Maternal Factors; Determinants

1. INTRODUCTION
Several economists and sociologists have emphasized the value (role of the demand) for children as an important source of change in the reproductive behaviour of individuals. Children are perceived by parents as other durable goods and the changes in income and prices will predictably influence the demand of couples for children. Child-bearing and rearing involve a significant amount of time and money. Parents who choose to have more children weigh the rewards from having another child as against the rewards of other goods and services that could have been attained instead, thus making the demand for children change with the income and time costs (Becker, 1960 and 1965).

Demographic research has shown that socio-economic and cultural factors influence fertility through biologicaland behavioural mechanisms such as the use of contraception, which has a direct effect on fertility (Bongaarts & Potter, 1983).Changes in the demand for children and greater accessibility to contraception are important conditions for fertility transition (Cleland and Wilson, 1987 and Casterline, 2001) and it is generally argued that the traditional social and economic structure of certain societies keep the value of children relatively high and the demand for contraceptive relatively low, resulting in the persistence of high fertility in these countries (Mahmood, 1992).

From a reproductive health and rights-based perspective, all women should have access to methodsthat allow them to avoid unintended pregnancies (United Nations, 1995). Additionally, HIV-positivewomen have particular needs for contraception to avoid unintended pregnancy: to preserve their own health (Van der Paal et al., 2007). The proportion of women who intend to limit child bearing is one of the most important conditions because it bears directly on population growth and designates a segment of the population that may be at risk of having an unwanted birth. This proportion of women of childbearing age who want no more children is also an important predictor of fertility levels and trends (Bongaarts, 1997 and Westoff, 1995).

Female fertility declines with advancing age (Steril, 2008:Perheentupa and Huhtaniemi, 2009), and the reproductive phase in women is

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relatively short in comparison to their entire lifespan. To some degree, there is individual variation in female reproductive ageing, which is determined mainly by genetic factors (Alviggi et. al, 2009). However, all women show a natural decline in fertility by the age of 40 years. Furthermore, advanced maternal age can adversely affect the outcome of a desired pregnancy and cause health problems in both mother and child. The variation in fertility of women between rural and urban areas calls for attention. According to the 2005 Ethiopian Demographic and Health Survey (DHS), fertility in rural Ethiopia is nearly two and half times greater than in urban centres (6.0 versus 2.4).

1.1 Fertility Situation in Ghana

In Ghana, childlessness is regarded as a tragedy. The value placed on children is evident in linguistic labels, especially those found in proverbs, names and tales. An example is the saying that "a delinquent child is better than childlessness" (Batse, 2010). As far back as 1950, Fortes stated that among the Ashantis, "prolific childbearing is honoured and a mother of ten boasts of her achievement and is given a public ceremony of congratulations, in contrast, a barren woman is looked upon with pity not unmixed with scorn". Childlessness is felt by both men and women as the greatest of all personal tragedies and humiliation.

This stands to reason that women in Ghana attach so much importance to childbearing and will use all possible means to bear children. It is no surprise that total fertility rate (TFR) is high in Ghana compared with countries in the sub region especially in Democratic republic of Congo and Egypt (El-Zanaty and Way, 2009). The very few who are enlightened about the modern methods of contraceptives and would want to plan their childbearing have difficulty accessing these facilities whilst the greater majority may not have any knowledge at all. It is, therefore, no surprise that the various interventions initiated by the Government of Ghana to address and contain high fertility are yet to produce the desired outcomes.

The 2008 Ghana Demographic and Health survey (GDHS) report by the Ghana Statistical Service (GSS) indicates that about 35% of women still have unmet need for family planning. This has brought about an increase in total fertility rate (TFR) especially among rural and less privileged women in society. This is a serious challenge since women give birth to children they are not prepared for or did not desire or would have delayed if they had knowledge about access to modern family planning methods. The 2010 Population and Housing Census (PHC) and the 2011 MICS put the adjusted TFR based on Brass relational Gompertz model for Ghana as 4.57 and 4.3 respectively. The low contraceptive rate of 34.7% for any method for 2011 is however not commensurate with a TFR of 4.3. The role of induced abortion in the fertility decline in the country has become increasingly significant over the years. (Rockson,2010; Tutu, 2008).

According to the 2008 GDHS, 13% of women age 15-19 are already mothers or are pregnant with their first child: women with no education are much more likely to have begun childbearing at an earlier age than women with secondary or higher education (31% compared with 1%) (GSS, 2008).

In the same report, modern contraceptive use also increases with women's education. Nineteen percent of married women with more than secondary or higher education use modern methods of contraceptives compared with 11% of women with no education. Use of modern methods also increases with household wealth. Twelve percent of women in the poorest households use a modern method of family planning compared with 21% of women in the wealthiest households.

Fertility also varies with mother's education and economic status; Women who have more than secondary education have an average of 2.1 children, while women with no education have 6.0 children (GSS, 2008) and studies show that fertility is lower among better educated women and is often higher among women whose families own more land and assets (Schultz, 2005).

Appropriate family planning is important for the health of women and children through: 1) preventing pregnancies that are too early or too late; 2) extending the period between births; and 3) limiting the number of children. Access by all couples to information and services to

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prevent pregnancies that are too early, too closely spaced, too late or too many is critical.

1.2 Contraceptive Use in Ghana

Current use of contraception was reported by about one third (35%) of the women currently married or in union in Ghana (MICS, 2011).Contraceptive prevalence is highest in the Greater Accra Region at 44% and Eastern at 43%. In terms of modern methods however, 29% married women in Central Region, and 27% in both Greater Accra and Brong Ahafo recorded the highest use. In Volta and Northern regions, contraceptive use is lowest; only one in five married women (20%) reported using any method. Adolescents are far less likely to use contraception than older women. Only 17% of married or women in union aged 15-19 currently use a method of contraception compared to 37 % of women aged 20-24 year old and 38% of women aged 25-39 years (GSS, 2011).

Women's educational level is strongly associated with contraceptive prevalence. The percentage of women using any method of contraception rose from 26% among those with no education to 34% among women with primary education, 39% among women with middle/ JSS education, and to 42% among women with secondary or higher education. Furthermore women with secondary or higher education are more likely to have higher negotiation power for abstinence compared with those with lower education (GSS, 2011).

The low contraceptive prevalence rate of 23.4% for any modern method for 2011 shows that the 1994 Revised Policy target of 28% by 2010 could not be achieved (GSS, 2011; Republic of Ghana, 1994).This study therefore seeks to examine the determinants for additional children among women in the reproductive age. How their desire for more children are affected by such factors as age, parity, education, region of residence, household wealth among others. This is influenced by the question whether a woman who gave birth within the survey period had a desire for that child then or not.

2. Data

The 2011 Multiple Indicator Cluster Survey (MICS) data was used in this study. This is a fourth round of the survey which is conducted every five years to monitor the situation of children and women in Ghana. In this survey about 10,963 women who were within the reproductive age (15 – 49 years) were selected across the ten Regions of Ghana. The subjects were interviewed reference to two years preceding the survey. The selection procedure was based on a representative probability sample of households nationwide from a frame of Ghana 2010 Population and Housing Census Enumeration Areas (EA's). For comparability, the MICS used an internationally standardized sampling of two-stage stratified sample design. At the first stage, a number of EA's were selected from the regions which were considered as clusters. The households in each region were then selected using systematic sampling with probability proportional to size in the second stage. Of the 12,150 households selected for the sample, 11, 925 households were contacted and duly interviewed. In the households interviewed, 10,963 women aged 15 – 49 years were identified for interview.

3. METHODOLOGY

This paper uses a data set based on the 2011 MICS. The survey was carried out on a sample of 11,925 households from a selected household of 11,970 in all the ten administrative regions of Ghana giving about 100% response rate. The households were selected due to the sizes of the regions. The survey used both qualitative and quantitative methods of data collection aimed at providing basic data for measuring the progress of children and women in the country. Data used for analysis in this paper was based on information on all births and deaths that had occurred two years prior to the survey period. Statistical package for social scientists (SPSS version 20) and SAS system version 9.1 were used for extraction and the eventual analysis of data. Descriptive statistics and frequencies of the background characteristics of the mothers and the respective households the children belonged to were generated. The association between the independent and dependent variable was established using chi-square analysis procedures. The dependent variable selected was the outcome of a question asked: whether a woman wanted that last child then. The independent variables include Wealth index quintiles,region, area of residence, religion and mothers' characteristics including; education, marital status, parity and age. A

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critical level of significance of 5 percent (p<0.05) was used to identify the most statistically significant determinants of desire for more children among the women.

The binary logistic regression model was used to study whether the independent factors affected a woman's desire for an additional child or not. The parameters of the model were estimated using the maximum likelihood method as shown below in the formula;

$$P(\pi) = \frac{\ell^z}{1 + \ell^z}$$

(1)

Where P(π) = the probability of an event occurring
Z = is the linear combination of independent variables and is expressed as;

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_j$$

(2)

β_i = are the coefficients
Xs = are the independent variables 95% confidence interval and ℓ= is the error term.

The odds of an event is the ratio of the probability that it would happen to the probability that it would not occur and the likely number of times. In this paper it is the probability that a mother desires the last child to the probability that she does not desire that child. This means that the outcome variables in the logistic regression should be discrete and dichotomous. Logistic regression was found fit to be used because the outcome variable was in binary form that is a woman wanted that child then, or otherwise. In addition, there were no assumptions to be made about the distributions of the explanatory variables as they did not have to be linear or equal in variance within the group. The model suggests that the likelihood of a woman wanting an additional child at the time of pregnancy or otherwise varies across all the independent variables to be studied. After fitting the model, the outcomes were used to interpret the existing relationships between a woman's desire, household location and mothers' characteristics.

4. RESULTS

Table 1 shows the descriptive statistics about the households. Out of the 2,873 women who delivered during the survey period, more than one third (33.7%) indicated they were not ready for the pregnancy. This means that more than 3 in 10 women gave birth for which they were not ready. More women (69.1%) in rural areas than in urban areas (30.9%) did not want their last birth. Women from the Central Region of Ghana are more likely to give birth to unplanned children (23%) and those from Greater Accra Region, the least likely to give birth to unplanned children (6%). Mothers from the northern sector of the country also have a higher proportion of not being ready for the last birth. Women from rural households, those from the poorest households and those who have a maximum of Middle/Junior High School (JHS) education are more likely than more advantaged mothers to give birth to unplanned children. For example, the proportion of unplanned birth among women who have a maximum of middle/JHS education is 87%, compared to 13% of mothers who have a minimum of secondary school education. Women from the wealthiest households are more likely to have a good plan of giving birth than women from the poorest households. The possibility of giving birth to an unplanned or an unexpected child among women who have at most three children is higher than those who have more children (about 52% versus 48%). This means that women who have more children already tend to plan their next child birth than women who have few children. Again, as women age they tend to plan giving birth than when they are young. For instance about 60.2% of women within 20 – 34 age bracket said they were not ready for their last birth and 22% within the 25 – 29 age group alone also indicated they did not desire the last birth. However, only 3.8% of the mothers within the 44 – 49 years group indicated they did not desire the last birth. Desire for last birth among mothers who are currently married or living with a man is quite alarming. More mothers in these categories never wanted the last birth (51.7 and 31.1% respectively). Tables 2 and 3 depict the results of multivariate logistic regression analysis of household and mothers' characteristics associated with the desire for more children among women within the reproductive age.

The factors observed to be highly significantly associated with women's desire for more children included marital status (p-value = 0.000), parity (p-value = 0.000), mothers' age (p-value = 0.000) and region of residence (p-value = 0.000).

Confounder control by multiple logistic regression analysis revealed that significance factors (in ascending order of odds ratio) were marital status, parity, age, region, residence, educational level and economic status. The highly significant variables were however marital status, parity, age and region.

5. DISCUSSION

The descriptive statistics show that mothers in rural areas tend to give birth to unplanned children than women in urban areas. Women who have higher education plan giving birth more than women who are not educated or have low levels of education. Here, we speculate that those educated women may have knowledge about modern methods of family planning. Women whose economic status is high also plan their pregnancies probably because they can afford modern family planning methods than those who live below the poverty line. Women who are currently married do not seem to take family planning seriously compared to those who are living with a man or in a relationship but not married. The association of children ever born, age and location with desire for more children observed in this study has also been reported from other developed and developing countries. Again, more than one-half of married Ghanaian women (51.7%) want no more children. The results further reveal that about 30.7% of married women have an unmet need for family planning (unmet need for family planning defined as the percentage of married women who want to space their next birth or stop childbearing entirely but are not using contraception). Even though this is a reduction from 35% in the 2008 GHDS results, it should still be a source of worry to the nation as it indicates a strong policy issue.

The desire for not wanting more children was higher among mothers who have higher education, high economic status, live in urban areas, between the 20 -34 age brackets, already have more children and are currently married or in a union. The bootstrap results (table 3) also confirm the model in table 2. By extension, it shows that childbearing among more advantaged women are better planned than less advantaged women.

6. CONCLUSION

The results of this study suggest that for reducing unmet need among married women, the strategy needs to focus attention on modern family planning methods to facilitate better understanding of contraceptive usage focussing more on the sexually active population, intensify education on pre-marital sex, regular supply of contraceptives to accredited institutions and discouraging teenage and old person pregnancies as well as formulating policies that will reduce poverty among rural women. Accessibility issues regarding modern contraceptives must be critically looked and addressed as a country. The girl child education policy must also be given all the needed resources it requires to achieve the desired set targets. The whole issue of unmet need must be tackled holistically to reduce it to the barest minimum.

The low variability in desire for more children that was explained by independent variables used in all the regression models suggests that there were some confounding factors not accounted for. Within the limits of this research however, marital status, parity, age and region of residence contributed significantly in predicting women's desire for last birth.

Table1. Characteristics of mothers' by desire for last birth

Variable	Wanted last birth		Total
	Yes	**No**	
	N (%)	**N (%)**	**N (%)**
Residence			
Urban	492 (25.8)	299 (30.9)	791 (27.5)
Rural	1412 (74.2)	670 (69.1)	2082 (72.5)
Total	**1904 (100)**	**969 (100)**	**2873 (100)**
Region			
Western	101 (5.3)	72 (7.4)	173 (6.0)
Central	162 (8.5)	223 (23.0)	385 (13.4)

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Greater Accra	97 (5.1)	58 (6.0)	155 (5.4)
Volta	72 (3.8)	70 (7.2)	142 (4.9)
Eastern	65 (3.4)	71 (7.3)	136 (4.7)
Ashanti	83 (4.4)	93 (9.6)	176 (6.1)
Brong Ahafo	84 (4.4)	69 (7.1)	153 (5.3)
Northern	629 (33.0)	120 (12.4)	749 (26.1)
Upper East	286 (15.0)	77 (7.9)	363 (12.6)
Upper West	325 (17.1)	116 (12.0)	441 (15.3)
Total	**1904 (100)**	**969 (100)**	**2873 (100)**
Wealth index quintiles (Economic status)			
Poorest	988 (51.9)	332 (34.3)	1320 (45.9)
Second	351 (18.4)	229 (23.6)	580 (20.2)
Middle	194 (10.2)	199 (20.5)	393 (13.7)
Fourth	191 (10.0)	130 (13.4)	321 (11.2)
Richest	180 (9.5)	79 (8.2)	259 (9.0)
Total	**1904 (100)**	**969 (100)**	**2873 (100)**
Marital status			
Yes Currently married	1475 (77.5)	501 (51.7)	1976 (68.8)
Yes, living with a man	336 (17.6)	301 (31.1)	637 (22.2)
No, not in union	93 (4.9)	167 (17.2)	260 (9.0)

Total	**1904 (100)**	**969 (100)**	**2873 (100)**
Children ever born			
1	280 (14.7)	216 (22.3)	496 (17.3)
2	322 (16.9)	144 (14.9)	466 (16.2)
3	332 (17.4)	141 (14.6)	473 (16.5)
≥4	970 (50.94)	468 (48.297)	1438 (50.05)
Total	**1904 (100)**	**969 (100)**	**2873 (100)**
Age			
15-19	49 (2.7)	106 (10.9)	155 (5.4)
20-24	272 (14.3)	191 (19.6)	463 (16.1)
25-29	487 (25.6)	213 (22.0)	700 (24.4)
30-34	508 (26.8)	180 (18.6)	688 (24.0)
35-39	357 (18.8)	163 (16.9)	520 (18.5)
40-44	177 (9.3)	78 (8.0)	255 (8.7)
45-49	54 (2.8)	38 (3.8)	92 (3.2)
Total	**1904 (100)**	**969 (100)**	**2873 (100)**
Educational level			
JHS and below	639 (80.3)	557 (87.0)	1196 (83.2)
Secondary school +	158 (19.9)	83 (13.0)	241 (16.8)
Total	**797 (100)**	**640 (100)**	**1437 (100)**

Table 2 Determinants for last birth – Multiple Logistic regression model

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	**Upper**	**Wald Chi-Square**	**df**	**Sig.**
(Intercept)	-1.269	.6420	-2.527	-.010	3.905	1	.048
Age	.102	.0166	.070	.134	37.949	1	.000
Parity	-.360	.0550	-.467	-.252	42.701	1	.000

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Marital Status	-.739	.1018	-.938	-.539	52.708	1	.000
Area of Residence	.121	.1675	-.208	.449	.519	1	.471
Region	.127	.0250	.078	.176	26.001	1	.000

Table 3 Bootstrap for parameter estimates

Parameter	B	Bootstrap*a			95% Confidence Interval	
		Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
(Intercept)	-1.269	.014	.655	.043	-2.583	-.073
Age	.102	.001	.018	.001	.070	.140
Parity	-.360	-.005	.061	.001	-.487	-.248
Marital Status	-.739	-.012	.108	.001	-.964	-.530
Area of Residence	.121	-.005	.164	.498	-.188	.427
Region	.127	.001	.025	.001	.082	.177
Wealth Index Quintiles	.003	-.002	.067	.958	-.129	.130
Educational Level	-.014	.000	.070	.829	-.149	.129
(Scale)	1	0	0		1	1

Bootstrap results are based on 1,000 bootstrap samples

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Managing Network Congestion to Expedite Flow Finish through Protocols from the User Point of View

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Abstract
It has been proved by a lot of researchers that the present operation of TCP which is the main internet control protocol will suffer poor performance in future high speed networks. It has also been established that performance issues are very crucial in computer networks, for example when many computers are interconnected, complex interactions arise with unforeseen consequences. This complexity leads to degradation of performance if the system is not managed properly. It has also been affirmed by most researchers that when application and network experience performance erosion, employees become less productive and organisations spend more money on bandwidth with diminishing returns. To arrest the situation, various factors which affect network performance were examined. Characteristics of congestion Control Protocols were described. Congestion Control Protocols like Transmission Control Protocol (TCP) and Explicit Congestion Protocol (XCP)were evaluated. The proposed congestion control protocol, Adaptive Rate Congestion Protocol (RCP) was also evaluated. The NS2 simulator was used under different scenarios to evaluate the performance of RCP and proved that it outperforms other congestion protocols such as TCP and XCP in terms of speed.
Keywords: Rate Control Protocol (RCP); Explicit Control Protocol (XCP); Processor Sharing (PS); Network Simulator 2(NS2); Transmission Control Protocol (TCP).

1 INTRODUCTION

This study is meant to address congestion and also increase the rate of flow of traffic in computer networks which leads to performance related issues in most organisations in general and the Internet in particular. Performance issues are very crucial in computer networks, for example when many computers are interconnected, complex interactions arise with unforeseen consequences. This complexity leads to degradation of performance if the system is not managed properly. There is also degradation of performance when imbalances in structural resources, the Central Processing Unit cannot handle the inbound packet quickly enough, thus some will get lost. The lost packets in an attempt to be retransmitted, add delay and bandwidth wastage, and generally cause a reduction in performance. Another problem associated with performance that happens with of bandwidth consumption for each of the applications.

time – critical application like video and audio is jitter (Tanenbaum, 2003).Subramanian (2000) describes Network performance as nebulous term and defines performance management as management of traffic (data) which involves data monitoring, problem isolation, performance tuning, analysis of statistical data for trends recognition and resource planning. According to a technical paper published by Packeteer Company (www.packeteer.com), administering application performance on an Internet link can be quite demanding. There is a drop in productivity and end-user frustration when performance becomes unpredictable, slow and inconsistent. IDC affirmed that a typical large United States enterprise spends $26,626,600 annually on Wide Area Network circuits. Fig 1.1 depicts one of such organisation's top applications running across the Wide Area Network and the percentage
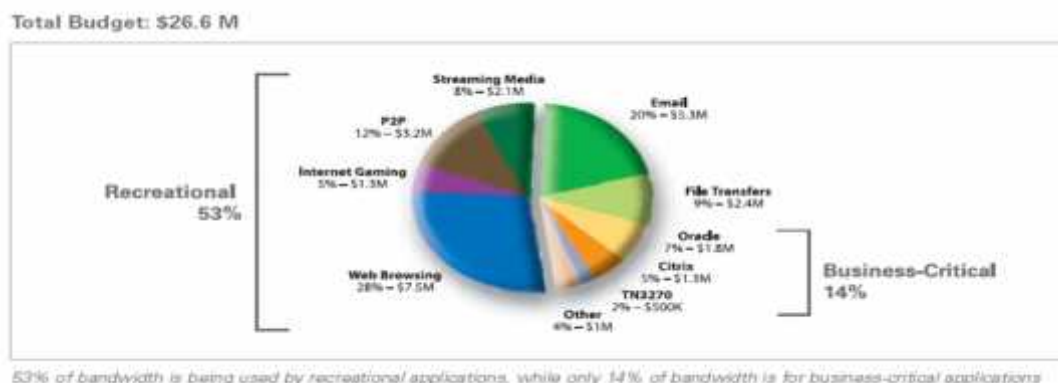
Fig1.1 **Distribution of bandwidth consumption per applicatication before bandwidth increase**
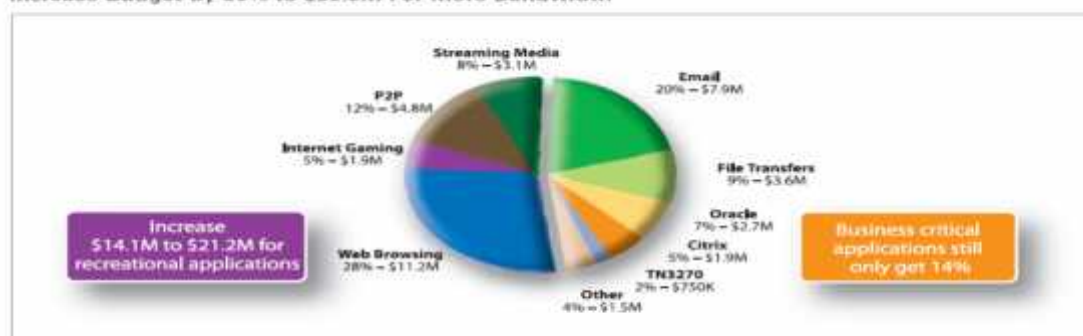
As could be imagined, getting more bandwidth has always been the common response to the problem of too much traffic. The Fig 1.2 depicts the increase in bandwidth by the organisation.
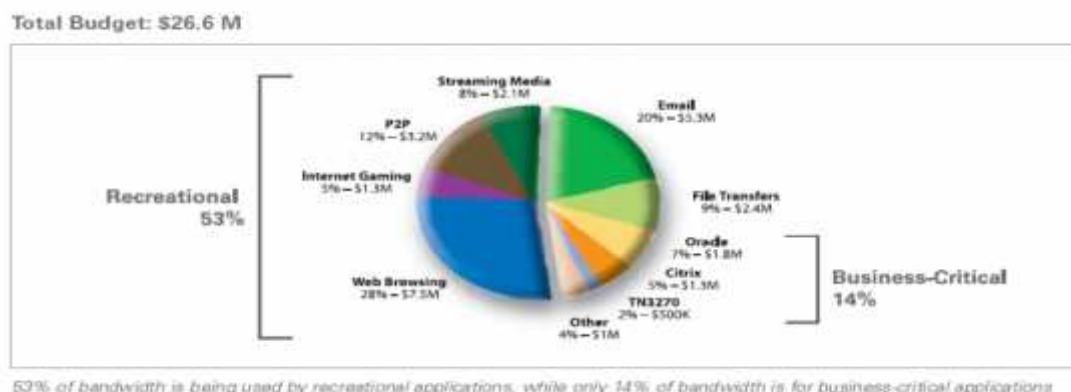
Fig.1.2**Distribution of bandwidth consumption per applicatication after bandwidth increase**

It could be inferred from the Fig 1.2 that the increase in bandwidth has not changed the percentage for the business - critical applications. Since more bandwidth is not the solution, then network managers need more visibility and control to find a solution. The design objective of an efficient congestion control protocol is to guide the network to an equilibrium point which is stable and manifested by high-network utilisation, small queue sizes, max-min fairness and no packet drops (Paganini et al., 2005). There is also a need for scalability with respect to the number of users, delays and changing of bandwidth. The protocol must show pleasant dynamic properties like smooth responses with fast convergence and no overshoot. These issues are more relevant to the service providers and managers more than users. Users concern are more of quick flow completing time as most

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transactions on the internet demand that. This type of transactions seems to dominate in the future high speed network.

1.1 General and Specific Objective

The general objective of the research is to contribute to the general body of knowledge in the area of computer network performance to enhance productivity at workplaces in general and internet in particular.

To achieve the general objectives, the research addressed the following specific objectives:

- To reduce round-trip time of packet flow in the network.
- To enforce congestion control and fairness inside the network.
- To ensure efficient and fair bandwidth allocation on high bandwidth delay product networks while maintaining low queues and near-zero packet drop rate.
- Propose an efficient and effective window based control protocol which uses a feedback mechanism and allows explicit exchange of information between the end user and the network.

1.2 Problem Statement

The Internet is a global infrastructure for information exchange that has transformed the social, economic, and political aspects of our lives. One of the most crucial building blocks of the Internet is a mechanism for resource sharing and controlling congestion on the Internet. When end-hosts access a certain resource (such as a webpage from CNN, a video on YouTube, etc.,) on the Internet, it is important to ensure that they do not overwhelm network elements (such as routers), are able to efficiently utilize network resources, and achieve fairness in some agreed-upon sense. Today, congestion control for most of the traffic is provided by the Transmission Control Protocol (TCP)(Jacobson,1988). However, TCP is now showing significant performance limitations and the need for new transport protocol designs has become increasingly important (Alizadeh, et al 2010).This need has arisen from TCP's inability to meet the challenges brought about by the tremendous growth in the range of link capacities, latencies, and Bit-Error Rates (BER) as well as due to increased diversity in applications and their requirements.

1.3 Significance of Study

The results of this research study will categorically benefit all stakeholders of internet facility. Users will have their downloads and uploads times reduce drastically. Queue build ups on links are going to be reduced to nearly zero. Productivity at most organisations will increase as more organisations deploy their commercial activities on the internet. Social network activities on the internet will be enhance. More software vendors will go into designing delay sensitive applications. The future high speed network envisage by all to manage triple play look bright. With RCP more packets can be managed on the network without congestion.

1.4   Limitation   and Delimitation

1.4.1 Limitation

All studies have inherent limitations and delimitations. Limitations refer to limiting conditions or restrictive weaknesses. The research uses primary data for it analysis, this call for generation of the data. In studies of computer networks, it is highly expensive if not impossible to deploy real devices for experiments. To reduce the cost considerably and avoid damage of devices, simulation models are used. Despite the advantages of simulators, like most tools, do have their drawbacks. Many of these problems can be attributed to the computationally intensive processing required by some simulators. As a consequence, the results of the simulation may not be readily available after the simulation has started -- an event that may occur instantaneously in the real world may actually take hours to mimic in a simulated environment. The delays may be due to an exceedingly large number of entities being simulated or due to the complex interactions that occur between the entities within the system being simulated.

1.4.2 Delimitation

There are several means of handling congestion in computer network. Some of these are, over provisioning which is increasing capacities of devices attached to the network. This means is very expensive. Another means of ensuring that the network is not congested is to

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employed security approach. This method can also limit the availability of the network. The study is delimited to the control theory. The control theory approach offer an efficient means of handling congestion in computer networks. The study will not use secondary data because the researcher will generate data for analysis through simulation. Real devices like nodes and links will not be used because they are expensive and can get damage. These devices could be generated artificially through simulation. Data collection tools like questionnaire and interview will not be employed because simulation is employed to gather data needed for analysis.

2 METHODOLOGY
2.1 Research Design and Method
The researcher used Descriptive method. According to Glass and Hopkins (1984), Descriptive research can be either quantitative or qualitative. It can involve collections of quantitative information that can be tabulated along a continuum in numerical form,such as scores on a test or the number of times a person chooses to use a-certain feature of a multimedia program, or it can describe categories of information such as gender or patterns of interaction when using technology in a group situation. Descriptive research involves gathering data that describe events and then organizes, tabulates, depicts, and describes the data collection. It often uses visual aids such as graphs and charts to aid the reader in understanding the data distribution. The researcher in this case used NS2 simulator to generate data which is depicted in a graphical form.

2.2 Research Format
The researcher adopted Causal process. The rationale behind the choice being that Causality (also referred to as causation) is the relationship between an event (the cause) and a second event (the effect), where the second event is understood as a consequence of the first. In common usage, causality is also the relationship between a set of factors (causes) and a phenomenon (the effect). Anything that affects an effect is a factor of that effect. A direct factor is a factor that affects an effect directly, that is, without any intervening factors (Intervening factors are sometimes called "intermediate factors"). The connection

between a cause(s) and an effect in this way can also be referred to as a causal nexus (Pear, 2009).The outcome of the simulated values of the protocols are evaluated against standard indicators like flow size, flow completing time, average flow completing time, maximum flow completing time under different traffic loads.

2.3 Key Assumptions
The main assumption is that packet drop within the network indicates that the network is congested. This work is also based on the assumption that simulation could be used to mimic real network topology with nodes representing host like routers, links representing transmission medium like copper, fiber or air and agents representing protocols like TCP, RCP, XCP etc.

2.4 Research Technique
The researcher adopted simulation to come out with the results of the research. The rationale for the choice is as follow: Network simulators provide a variety of needs. Judging against the time involved and the cost in creation of an entire test bed having multiple networked data links, routers and computers, network simulators are relatively inexpensive and fast. Network simulators permit engineers to test settings or scenarios that might be expensive or difficult to emulate employing real hardware. Simulators can aid in design of hierarchical networks employing various types of nodes like routers, computers, bridges, hubs, multicast routers, mobile units etc. We chose to use NS2 for this research, among other simulators, based on the fact it is the best-supported simulator, open source and includes a research community that consists of more than two hundred institutions worldwide (Breslau et. al. 2000). NS2 offers an attractive software platform in terms of its research interest for the study of congestion control algorithm. One part of the ns-allinone package is 'xgraph', a plotting program which can be used to create graphic representations of simulation results

2.5 Solution Strategic/Approach
For one to setup and model a network using NS2 simulation there is a need to write an OTCL script which will facilitate the procedure. The crucial stage of modeling a network is to define its topology. In NS2, the topology is

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defined by the use of three primitive blocks, which are agents, links and nodes. Nodes represent end hosts, that could be wired or wireless, that allow packets to be exchanged between other nodes. Links on the other hand are the physical transmission medium, either by air or wire which interconnects the nodes. Agents act as transport process that runs on the hosts. Once there is a definition of the topology, agents are then attached to the nodes and the traffic sources and sinks attached to the agents to send data. The traffic source nodes are where data emanates and sink nodes are where data is received. NS2 uses C++ to implement it as C++ is fast to run but slow to modify, thus making it appropriate for detailed protocol implementation. It makes it easier for reduction of packet size and event processing time. The Tcl for TCP, XCP and RCP are written and run. When the outputs are created, they can be visualised using either graphical representation called xgraph or a network animator known as nam (http://www.isi.edu/nsnam/ns/).

3RESULT

In this section we present a simulation result that briefly depict how we increase the flow size against the average completion time and against the maximum flow completing time.
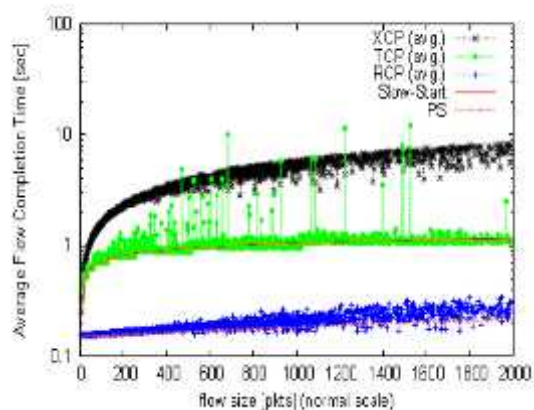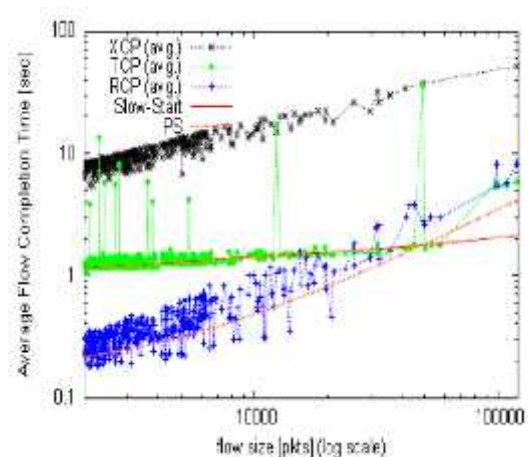

Fig 3.1Flow duration (secs) versus flow size
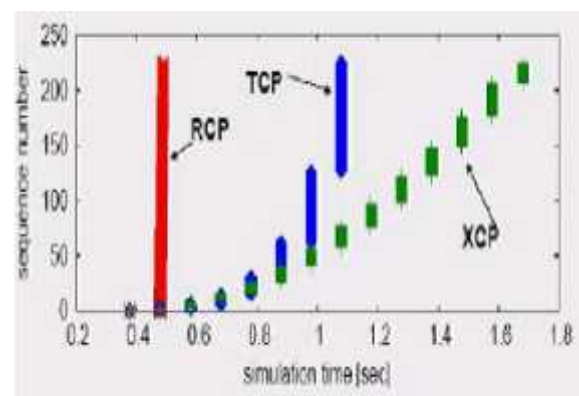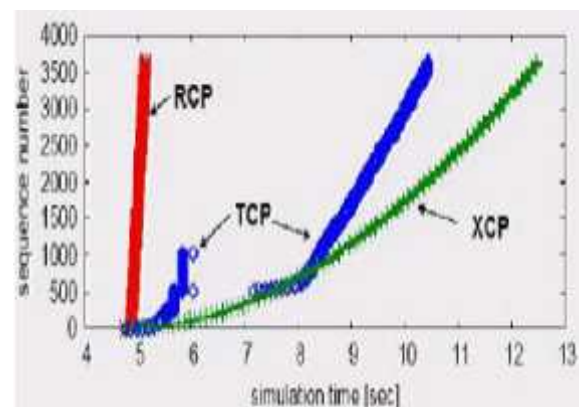

Fig 3.2Flow duration (secs) versus flow size

FIG 3.3**RCP VRS TCP VRS XCP**

4 DISCUSSION

A well-known and simple method that comes close to minimizing flow completing time is for each router to use processor-sharing. In processing sharing, a router divides outgoing link bandwidth equally among all the flows for which it currently has queued packets. If all

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packets are equal-sized, the router can maintain a queue for each flow, and simply round-robin among the non-empty queues, serving one packet at a time. If packets are not equal sized, the router can use packetized processor sharing or fair queuing. In view of this, the above simulation is used to compare how close the protocols are able to minimize flow completion time with respect to flow size as compared to routers processor sharing.

TCP flows start too slowly and are therefore artificially stretched over multiple round-trip times. Fig 3.1 depicts that the average flow completing time of TCP is about 10 times the flow completing time for PS average completing time. TCP also shows instability as the packet flow size increases in Fig 3.2.

XCP is even more conservative in giving bandwidth to flows – particularly to new flows – which is why there are always more active, incomplete flows. It gradually reduces the window sizes of existing flows and increases the window sizes of the new flows, making sure there is no bandwidth oversubscription. Even though XCP depicts some form of stability as the flow size increases in both Fig 3.1 and 3.2, the average flow completing time is about 30 times that of PS average flow completing time. Thus making it unnecessary too long.

Rate Control Protocol (RCP) greatly reduces flow completing times for a broad range for network and traffic characteristics. RCP achieves this by explicitly emulating PS at each router. It is depicted in both Fig 3.1 and 3.2 that RCP average flow completing time is almost equal to the PS of the routers. In RCP, a router assigns a single rate, $R(t)$, to all flows that pass through it; i.e. unlike XCP, it does not maintain and give a different rate to each flow. RCP is an adaptive algorithm that updates the rate assigned to the flows, to approximate processor sharing in the presence of feedback delay, without any knowledge of the number of ongoing flows. It has three main characteristics that make it simple and practical:

1) The flow rate, $R(t)$, is picked by the routers based on very little information (the current queue occupancy and the aggregate input traffic rate).
2) Each router assigns a single rate for all flows passing through it.

3) The router requires no per-flow state or per-packet calculations.

The basic RCP algorithm operates as follows.
1) Every router maintains a single fair-share rate, $R(t)$, that it offers to all flows. It updates $R(t)$ approximately once per RTT.
2) Every packet header carries a rate field, R_p. When transmitted by the source, $R_p = 1$. When a router receives a packet, if $R(t)$ at the router is smaller than R_p, then R_p $R(t)$; otherwise it is unchanged. The destination copies R_p into the acknowledgment packets, so as to notify the source. The packet header also carries an RTT field, RT_p, where RT_p is the source's current estimate of the RTT for the flow. When a router receives a packet it uses RT_p to update its moving average of the RTT of flows passing through it.
3) The source transmits at rate R_p, which corresponds to the smallest offered rate along the path.

Fig 3.3 shows that load increase does not affect the completion time of RCP. TCP becomes unstable when the load increase exceeds 500, packets drop, establish equilibrium and starts increasing sharply. XCP on the other hand increases steadily with load increase.

5.CONCLUSION

The research confirm through extensive simulation that it is possible to use protocol to speed up transmission of packets on the network than always the demand for increase in bandwidth which is very expensive and does not give the needed solution. It was observed that as more delay sensitive traffic are injected into the network, the main transmission control protocol (TCP) becomes suspect and the feedback mechanism employed is implicit thus using packet drop as a means to manage congestion. In attempt to resend the drop packets cause delay and further congestion. Explicit Control Protocol (XCP) which manages the congestion better also take longer time to do so. It is inferred from the simulation that Rate Control Protocol (RCP) expedite flow ten times faster than TCP and thirty times faster XCP. This make RCP a preferred choice as we move into triple play   more delay sensitive applications are been developed and users want to get their downloads faster.

In line with this, I wish to thank almighty God for bring me to this far and express my appreciation and indebtedness to all who contributed in diverse ways to make this research successful.

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**Mechanical Investigations and Survey an Locally Welded Mild Steel Joints
(Case Study: Suame And Sunyani Magazines)**

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Abstract
The welding industry in Ghana keeps on growing each day, however little or no check is carried out to ascertain the quality of the work done by artisans in our local mechanical/fabrication shops (magazines). Welding is a science and technique which when not adequately executed can result in catastrophic consequences. Pieces of mild steel rods were given to three welders to be welded together. The mechanical properties of the welded joints were then tested. It was found out that the ultimate tensile strength of the welded joints reduced drastically in most of the rods. The joints showed inconsistency in the welders' techniques. This is attributed to the fact that the quality of the welds is dependent on the mood and skills of the welders. Due to this, there should be proper systems put in place to regulate the quality of welds in the country to help reduce the rate of motor accidents on our roads.

1.0 INTRODUCTION

In the day to day manufacturing of vehicle parts and other components in Ghana, manual Arc welding is employed. The strength of the joints and the physical integrity of the structures depend on the quality of the weld. Although welding is done for a good course, poorly executed welding can result in the loss of life and property.

Manual Arc welding is mostly employed in the fabrication industries because it is relatively cheap and simple to practices. Welding is a fabrication process that joins metals together by the application of heat and pressure. Manual arc welding is a type of welding where the metals to be joined together are melted by an electric arc (which is generated between the electrode tip and the work-piece) to form a pool of molten metal (weld puddle) which solidifies to produce a weld. (Modern Welding Technology).

 In manual arc welding, the quality of the weld depends on the skills and the mood of the welder. The quality of the weld also depends on the choice of electrode, the type of joint, the orientation of the joint, the materials to be joined and the medium in which the weld is cooled after welding. (Hicks and John 1999) It is therefore obvious that welding is not just an art but a metallurgical process where the welder needs an in-depth knowledge to carry it out.

However in Ghana, this operation is seldom done by experts but left to artisans whose skills are based on years of experience and apprenticeship. These artisans do not follow any standards of operation (code of ethics) and also they do not have any means of checking the quality of the weld (that is defects analysis and mechanical strength analysis). This has resulted in the production of poor quality welds which fails easily upon impact.

A poor quality weld in fabrication can lead to the manufacturing of weak joints and structures which can fail easily and result in fatal accident. A credible example is the ban which was imposed on the use of Mercedes Benz model 207 as a commercial passenger vehicle in this country. The ban was imposed because of the high casualty that occurred when these vehicles were involved in accident. The Mercedes Benz model 207 are originally meant for carrying goods but when imported into the country, they are transformed into commercial passenger vehicles. During this process most of the parts especially the seats are cut and welded back. Due to the poor quality of the welds, in the event of an accident with high impact they fail easily resulting in the loss of life and properties. The casualty recorded was found to be relatively high when compared to other vehicles involved in an accident. (Daily Graphic 2007).

Similarly in Sunyani in the Brong-Ahafo region, a pressure vessel used in a vulcanizing shop exploded killing a 14 year old boy. Upon examination of the vessel it was found that, the vessel exploded due to the failure of the welded joint. It is obvious that the welding was done by a welder who did not take into account the pressure generated in the vessel and the strength of the welded joint. (Daily Graphic, 2007).

It is obvious from the above discussion that the quality of the weld when compromised can lead to serious problems. Welds are always point of weakness in a metallic structure. It is therefore important to carry out series of tests to analyze its mechanical properties before using them in service.

All materials are subjected to loads and stresses under service conditions. Due to this, it is very important to know the inherent characteristics of the material so as to design a member which has the ability to withstand imposed stresses in order to prevent failure. This phenomenon can be investigated by studying the response of a material to external stimuli like an applied load and temperature. The response of a material to externally applied load is termed mechanical behaviour.
From the mechanical behaviour of the material important mechanical properties such as strength, ductility, hardness, toughness, fracture toughness and stiffness can be measured.

The mechanical properties of a material can be measured by performing designed laboratory experiments that replicate as nearly as possible the service conditions. Some of this experiment include; tensile testing which measures strength, ductility, toughness and stiffness. Hardness and impact testing measure hardness and fracture toughness of the material respectively. (Callister, 2004).

The presence of a weak weld within a metallic structure can have diverse impact on its mechanical properties thereby limiting its performance under service conditions. The objective of this work is therefore to investigate the mechanical properties of manual arc welded mild steel joints.

Mild steel is a plain carbon steel with low carbon content varying approximately from 0.05–0.29%wtC. Mild steel has relatively low tensile strength, but it is cheap, ductile, malleable and weldable. The weldability of steel is inversely proportional to hardenability. Steel produced with large amount of carbon and other alloying elements can be easily hardened but not easily welded. Mild steel, because of its high weldability accounted for its choice of this work.

In this work, mild steel rods and bars were cut into samples (pair) and joined together by manual arc welding by three different welders from three different workshops at Suami (Kumasi). A control sample which was not welded was also prepared; the samples were then subjected to tensile, impact and hardness testing to investigate their mechanical properties.

1.1 Objectives
This project seeks to investigate into the mechanical properties of mild steel welded bars and also to do a survey about general welding practices.

2 METHODOLOGY
A quantitative analysis of test results from a tensile test experiment was conducted. A qualitative analysis of results from a survey using an interview guide was also conducted. Content analysis of the survey results was used.

2.1 Scope
Suami magazine was selected for the samples to be welded and the Sunyani magazine was selected for the survey.

2.3 EXPERIMENTAL
2.3.1 Welding
Nine mild steel rods of average rough diameter 17.98 mm and smooth diameter 16.03 and of length 500 mm were given to three welders to cut them into two equal parts (225 mm each) and then weld them back together. The welders were code named Ar, Br and Cr ('A' referring to first welder and 'r' referring to rod); all of them used manual arc welding. They all used butt joints to weld the metals together and the electrode they used was E6013. The welding position was horizontal.

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After the welding process was done all the samples were allowed to air cool. The samples were then taken to the lab and tensile test experiment was carried out on seven rods (including an unwelded rod). Only seven rods were tested because the machine broke down after that. Chemical analysis and hardness test were also done on two different samples.

2.3.2 Tensile Test

The hydraulic Avery universal tensile testing machine was used for testing the tensile strength of the steel rods. The tensile test was carried out on the unwelded and the welded steel rods. A gauge length of 2 inches was used throughout the tensile test. The steel rod was then clamped into the vice and subjected to tensile loading at a strain rate of 50 tonnes per minute and the appropriate load against extension were recorded. This test was carried out at the Mechanical Engineering Laboratory at KNUST.

2.3.3 Chemical Analysis

A mass spectrometer which uses the x-ray diffraction principle was used to analyze the welded section and a piece of the parent metal were sampled to find out its chemical compositions. The analysis was carried out at Tema Steels Company Limited, Tema. The surface of the sample was cleaned before the test carried out. After this, the protective lid of the spectrometer was then raised and the samples clamp and adjusted so that sufficient room was provided for the sample to fit underneath the clamp head. The sample was then positioned so that it completely covered the electrode aperture. Finally, the protective lid was lowered and power button pressed for the spectrometer to carry out the analysis.

2.3.4 Hardness Test

The hardmatic hardness testing machine was used to carry out the hardness test on the steel rod at the welded joint and the unwelded parts. To begin the test, the operator ensures that the needle on the dial is set to the initial position. The indenter is positioned on the material to be tested, making sure that it does not slip on the surface. The operator then pushes down the indenter until a dead stop is achieved and the hardness value is read from the C scale on the dial.

3.0 RESULTS AND DISCURSION
3.1 Welding

Upon visual examination of the welded samples, some welding defects such as spatter, surface holes(porosity and shrinkage voids), slag inclusions and incomplete fusion (this was observe after the failure of the joint) were observed as indicated in the figures in Figure 1.1.
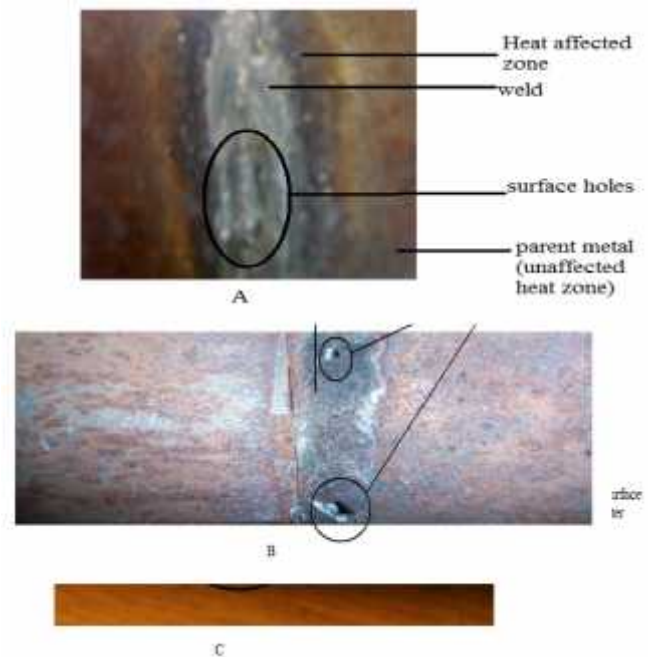

Fig. 1.1 showing (A) a welded plate with heat affected zone and some defects (B) a butt welded flat bar with surface holes. (C) A butt welded rod indicating sputter on the surface.

The sputter was caused by the welders' inability to keep a uniform welding speed and arc strikes during the welding process. This resulted in the sputtering of the molten metal on the surface of the rod and the plates. The surface holes are caused by the escape of entrapped gases in the welded joint during solidification. The slag inclusion is also caused by the entrapment of slag in the weld. The presence of these defects affected the mechanical properties of the weld after the welding operation; this was proven after the tensile test experiment.

3.2 TENSILE TEST RESULT
3.21 The Unwelded rod

The stress – strain curve of the original rod as shown in fig. 1.2 exhibits a material of UTS 243.931 MPa and ductility up to a strain of 0.2 before fracture.
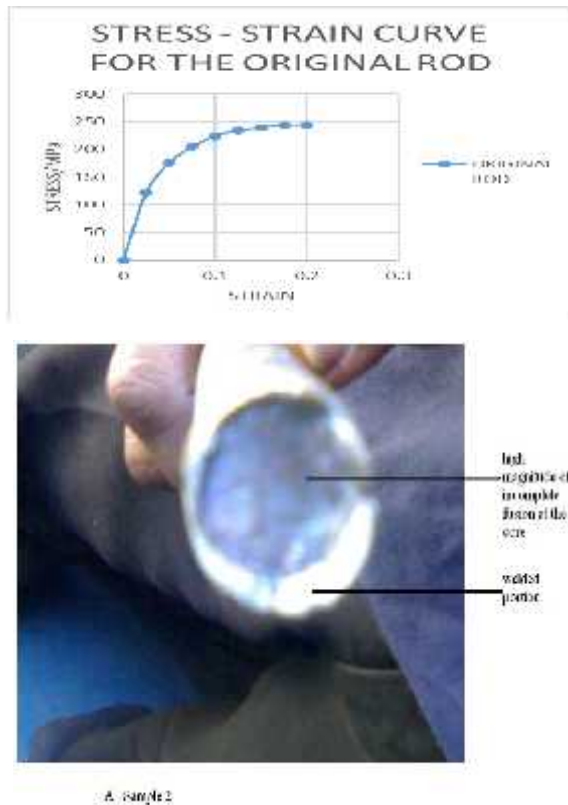

Fig. 1.2 showing the stress – strain curve of the tensile test results of the original sample.

This results exhibit a material that is very tough and strong. The mechanical properties are however not expected to remain the same after the welding process due to the cooling and heating methods, speed of welding, arc voltage and other influential factors involve in the process. (Bahman and Alialhosseini, 2010)

3.22Welder Ar

This welder welded five samples but in the cause of the tensile test experiment, only two samples were tested; the engineering stress – strain curve of the results from the experiment is shown below in figure 1.3 The table containing the results can be found at the appendix in table A 2.1 and A 2.2.

From the tensile test experiment sample one attained an ultimate tensile strength (UTS) of 195.146 MPa which is lower than that of the UTS of the original rod (243.931 MPa). This

then indicates that the mechanical properties of the bar has been modified after the welding process. The reduction in UTS was attributed to the presence of a defect known as incomplete fusion which was discovered through visual inspection of the cross – section of the bar after failure of the joint during the experiment.
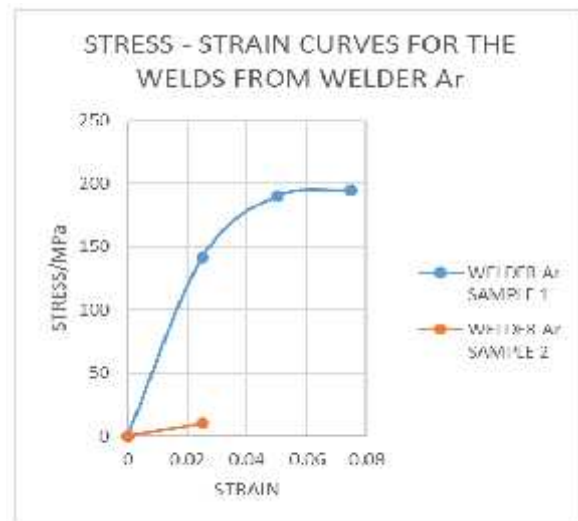

Fig. 1.3 showing the engineering stress – strain curves for samples 1 and 2 of welder Ar

From the visual inspection it was found out that 6mm (as shown in figure 1.4) of the cross – section was not covered by molten metal during the joint formation and this contributed to the reduction in mechanical properties of the bar.

On the other hand the stress – strain curve for sample two is short and indicates a bar with weak mechanical properties. The UTS for the welded joint was 9.957 MPa which prompted an immediate visual inspection of the failed cross – section. It was found out that 14mm which represent 77% of the diameter of the bar (as shown in figure 1.4) was not covered by the molten metal during the welding process. This is catastrophic and fatal accidents may result from these types of welded joints if they are done on vehicles that move on our roads daily. The welder was inconsistent in the application of his welding techniques and this led to the difference in mechanical properties of the two samples.

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Fig. 1.4 shows (A) sample 1 having less magnitude of incomplete fusion(33%) and (B) sample 2 having a high magnitude of incomplete fusion(77.77).

3.23 Welder Br

This welder managed to obtain complete fusion for all the welded joints and therefore the UTS for both sample one and two are 243.931MPa and 253.689MPa respectively (from fig 1.5). This means that the welder was able to acquire values of UTS that are equivalent to and greater than that of the original rod after the welding process.

Upon observation of the welded joint it was found out that the joint had a more compact and well done welding beads; which also served as reinforcements for the joints. The welder was therefore classified as the best welder among the three welders.
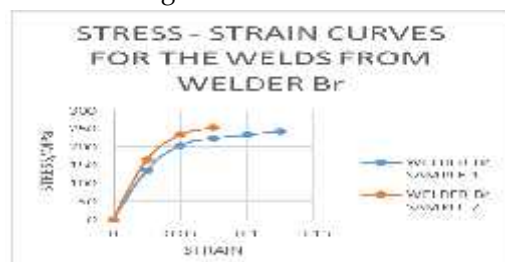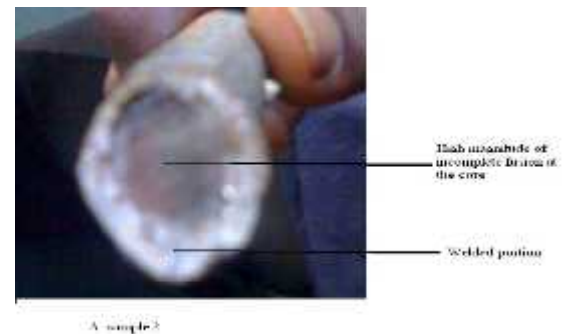

Fig. 1.5 showing the stress – strain curve of the tensile test results of sample 1 & 2 from welder Br

Even though the UTS of the bars were comparable to that of the original rod, there was a change in the ductility and the toughness of the bar as can be deduced from the amount of strain (0.2 for the original rod, 0.125 for sample one and 0.075) it took for the rods to fail.

Fig. 1.6 Indicating complete fusion obtained by welder Br

3.24 Welder Cr

This welder was able to attain UTS values similar to that of welder Ar. Sample one had a UTS value of 239.053 MPa (fig. 1.7) which was slightly lower than that of the UTS of the original rod (243.931 MPa). The cross – section

showed some degree of incomplete fusion (6 mm) justifying the slight reduction in UTS. On the other hand sample two was poorly welded and as indicated in the graph gave a very short stress – strain curve.
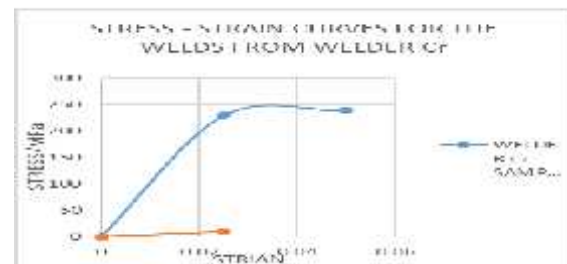

Fig. 1.7 showing the stress – strain curve of the tensile test results of sample 1 & 2 from welder Cr
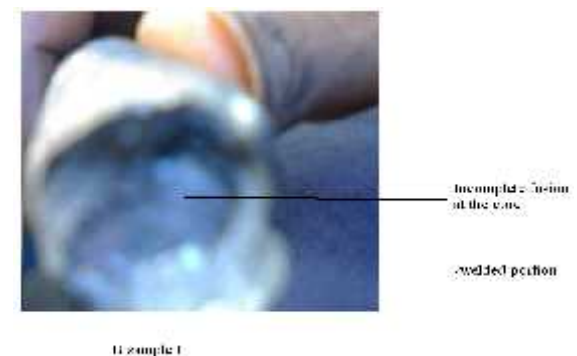

Fig. 1.8 showing (A) high magnitude of incomplete fusion at the core of sample 2 (B) lower magnitude of incomplete fusion in sample 1

The size of the incomplete fusion in this sample was 15mm which represents 83.3% of the diameter of the sample. This explains the low UTS value of 9.757 MPa as shown in the graph below. The welder's inconsistency and shabby is noticeable.

3.3 Toughness

Toughness is the ability of a material to absolve energy up to fracture. It is deduced by the area under the stress – strain curve. Materials with high UTS and high strain are tougher than materials with less.

The graph below (fig 1.9) clearly indicates that the curve for the original rod has a UTS value of 243.931MPa and a strain value of 0.2 which happens to be the highest among all the curves. It is therefore the rod with the highest toughness. This proves that the welding process has reduced the toughness of the material and this can be corrected by heat treatment of the welded joint. The local welders lack the technical knowhow and the capacity to perform heat treatments to correct this common phenomenon.

Welder Br was able to weld to obtain the toughness that is close to that of the original rod. That coupled with the consistency in the UTS values from his welds proved that he is the best welder among the three welders.

Welder Cr had a curve that had high UTS value (239.053 MPa) but a low strain value of 0.05 before fracture. This is an indication that the welded joint is very brittle with little plastic deformation and that is a drastic change in mechanical properties of the material after the welding process. This is a common concept in welding and the local welders need to be educated on it.

Welder Ar had the joint with the lowest UTS (195.146MPa) among all the curves. The strain value was 0.075 which is also low as compared to that of the original rod. This welder had the lowest mechanical properties of all the welders.

Fig 1.9 a graph of Load against extension showing the tensile test results of the best results of the welders together with the unweldwed rod.

3.4 Hardness Test Results

All the hardness points indicated in the results below (table1.1) show low hardness values for the welded joint than those for the unwelded parts. This happens because of the cooling process that takes place after the welding process. The original rod is cold rolled after casting and this induces strain hardening on the surface of the rod hence its high hardness values. (Ehab et al, 2000) During welding, the metal is melted at the joint and solidified, therefore the strain hardening mechanism is eliminated from the surface. This explains the low hardness values for the welded rod.

Table 1.1 Represents the results of the hardness test for the steel rod. The readings are in HRC.

WELDED SIDE (HRC)	UNWELDED SIDE (HRC)
40	50
37	51
43	51
33	44
34	46

3.5 CHEMICAL ANALYSIS
Table 1.2 Represents the chemical analysis of the welded portion and that of the unwelded portion.

SAMPLE IDENTIFICATION	C%	Mn%	Si%	S%	P%
Parent Metal	0.14	0.28	0.08	0.029	0.047
Weld Metal	0.15	0.29	0.12	0.036	0.045
Electrode	≤0.12	0.3-0.6	≤0.35	≤0.035	≤0.040

This results indicates some degree of dilution of the composition of the parent material after the welding process was carried out. (Bracarense and Liu, 1993)

All the percentage composition of the elements in the steel has been increased except P% which reduced slightly due to evaporation. This dilution came as a result of the contamination of the joint by the electrode used for welding.

This dilution came as a result of the contamination of the joint by the electrode used for welding.

The oxygen in the immediate environment also has the ability to oxidize the elements during the melting process. This is prevented by the flux that is used to coat the electrode.

3.6 FIELD OBSERVATION
In the cause of this project a survey was conducted at the Sunyani Magazine to assess welding practices that are carried out there. There were four welding shops and five welders that participated in this survey. An interview guide was used to interact with the welders in order to assess their general knowledge on the field and methods of their knowledge acquisition. The following topics formed the basis for the interview:

1. To assess the method of knowledge acquisition
2. To assess the technical knowledge of the welder
3. To assess mood of the welder as a form of distraction
4. To assess the quality control done by welder
5. To assess ways of carrier development
6. To assess the health hazards involved in welding operations

3.61 To Assess the Method of Knowledge Acquisition
The purpose of this assessment was to know whether there was a laid down syllabus used by the informal sector to train apprentices or there were institutions that are involved in the training process. On this, one welder said that he attended the Presbyterian Youth Training Centre at Sunyani to attain some theoretical and practical knowledge in welding for six months but ultimately his training was at the magazine. The rest of the welders were all trained by their masters for a duration of three to seven years without any laid down syllabus. They therefore learn from them by observing and practicing until their masters have confidence that they can be on their own then they are graduated.

3.62 To Assess the Technical Knowledge of the Welder
This obviously is a very sensitive assessment of any welder's work; it was done to evaluate the technical knowhow of the welders. The welders were therefore questioned on the types of welding in Ghana, joints used in welding, electrodes, cooling methods and general knowledge in welding.

On types of welding, the participants were quick to answer that there are two types of welding normally used in our magazines and those are gas welding and manual metal arc welding. When asked about the types of joints that they use in their work, all the welders claimed they use butt joints for all their welds. They didn't know of any different types of joints there are and their advantages over butt welding. Incomplete fusion is one defect that is predominant with butt joints and this can be inferred from the results of the tensile test experiment. Butt joints are quick to weld and easy to learn but its main disadvantage is luck of fusion(Jovanovic and Rihar, 2006) which can have catastrophic consequences (as shown by the second samples from welder Ar and Cr) if the welder is not experienced.

With respect to the types of electrodes used by the welders they all said they use AWS E6013/MT 12 (10 and 8) for all their welding purposes. Two welders on the other hand could point out the fact that a different type of electrode known as 'cast iron electrode' is needed to weld cast irons.

The cooling methods employed by each welder to cool welded joints after welding was also interrogated and all the welders claimed they use air cooling most of the time. Some of them attested to the fact that they sometimes use mad, water and oil, but the main scientific bases for that reason could not be accounted for. The rate of cooling and the cooling medium is very critical in terms of the quality of the weld. All the welders know that rapid quenching in water introduces cracks in the material and that is not advisable. One of the welders could explain how to rapidly cool some steels without cracks; to dip the metal in the water in stages.

With regards to questions pertaining to general knowledge in welding the welders were asked among others whether there was any part of vehicles that are not supposed to be welded. All the welders could not point out any scientific reason why a specific part of a vehicle could not be welded as long as it is a metal joint. This is dangerous since for instance, car seats are not welded but bolt and nuts are used to fix them to the chases because welded joints are susceptible to impact and in case of accidents the seats will break and increase the fatality rate. The welders don't know some of these reasons and that in itself is dangerous. All the welders however knew that cracks and defects make the joint weak.

3.63 To Assess Mood of Welder as a Form of Distraction
To test the hypothesis that the mood of the weld can determine the quality of the weld this assessment was carried out. All the welders agreed that conditions emanating from medical, weather, hearing of a bad news and problems at home could affect their welding skills. They also admitted that they do weld when these conditions exist. Even though this results could add to the understanding of this hypothesis experiments would have to be conducted on welded joints welded under these conditions to prove it further.

3.64 To Assess the Quality Control Done by Welder
All the welders inferred that they follow up on their work and call to verify the performance of their welded joints. They attributed some of the complaints they normally encounter to defects such as cracks and slag inclusions as well as inaccurate measurements. They also admitted that the only method of checking the quality of the weld they have done is by striking the joint with chisel or hammer.

3.65 To Assess Ways of Carrier Development
This assessment was to verify if there was any way the welders upgrade their skill in their profession but they all said they didn't know of any formal way to do so. They just rely on experience and observations to improve their skill. Two of them nevertheless claim that they have been involved in some workshops about safety organized by the Garages.

3.66 To Assess the Health Hazards Involved in Welding Operations
The welders mentioned eye problems from viewing the arc directly, injuries from burns and cutting tools, lung problems from fumes when inhaled (OSHA, 2013), electrical shocks as some of the health hazards they normally encounter in the cause of their work.
Even though they know wearing protective clothing can help prevent them they said the clothes make them uncomfortable when welding.

4.0 CONCLUSION AND RECOMMENDATION
4.1 Conclusion
This project sought to investigate into the mechanical properties of mild steel welded bars and also to do a survey about general welding practices. The tensile test results show that, the toughness and in some cases the UTS of the bars were drastically affected by the welding process and the quality of the welded joints varied from one welder to the other. There is therefore an uncertain guarantee that one will get a safe and quality work done when one visits a welding shop.

The survey established the fact that even though the welders have the practical knowledge of welding techniques they lack the scientific knowledge and insight into these techniques. It also showed that there is a pass on of experience from one welder to the other without any formal control of the process.

For a sensitive technique such as welding on which people's lives are dependent these conclusions are disturbing.

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4.2 Recommendation

From the above conclusions it looks like we all have a role to play to help educate the welders in the magazines. Institutions with mechanical engineering and materials engineering departments are supposed to organize workshops to engage welders on a one on one bases to interact with them in order to help answer some of their challenging questions and also to help them understand the scientific backgrounds of some of the welding practices. There should also be a form of control for welding practices in the country as this will help create guidelines for the practice at the various workshops.

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APPENDIX

TENSILE TEST RESULT

Table A 2.1 indicating a tensile test result of Welder Ar sample 1

e/in	load/Tonnes	load/newtons	Stress/N/m²	Stress/MPa	strain
0	0	0	0	0	0
0.05	2.9	28437.5885	141480539.8	141.4805398	0.025
0.1	3.9	38243.6535	190266932.8	190.2669328	0.05
0.15	4	39224.26	195145572.1	195.1455721	0.075

Table. A 2.2 represents a tensile test result of Welder Ar sample 2

e/in	load/Tonnes	load/N	Stress/N/m²	Stress/MPa	strain
0	0	0	0	0	0
0.05	0.2	1961.213	9757278.607	9.757278607	0.025

Table A 2.3 indicating a tensile test result of Welder Br sample1

e/in	load/T	load/N	Stress/N/m²	Stress/MPa	strain

0	0	0	0	0	0
0.05	2.8	27456.982	136601900.5	136.6019005	0.025
0.1	4.2	41185.473	204902850.7	204.9028507	0.05
0.15	4.6	45107.899	224417408	224.417408	0.075
0.2	4.8	47069.112	234174686.6	234.1746866	0.1
0.25	5	49030.325	243931965.2	243.9319652	0.125

Table A 2.4 indicating a tensile test result of Welder Br sample 2

e/in	load/T	load/N	stress/ N/m²	Stress/MPa	strain
0	0	0	0	0	0
0.05	3.4	33340.621	165873736.3	165.8737363	0.025
0.1	4.8	47069.112	234174686.6	234.1746866	0.05
0.15	5.2	50991.538	253689243.8	253.6892438	0.075

Table A 2.5   representing tensile test results for the original rod

e/in	load/T	LOAD/N	stress/N/m²	Stress/MPa	strain
0	0	0	0	0	0
0.05	2.5	24515.1625	121965982.6	121.9659826	0.025
0.1	3.6	35301.834	175631014.9	175.6310149	0.05
0.15	4.2	41185.473	204902850.7	204.9028507	0.075
0.2	4.6	45107.899	224417408	224.417408	0.1
0.25	4.8	47069.112	234174686.6	234.1746866	0.125
0.3	4.9	48049.7185	239053325.9	239.0533259	0.15
0.35	5	49030.325	243931965.2	243.9319652	0.175
0.4	5	49030.325	243931965.2	243.9319652	0.2

Table A 2.6 indicating a tensile test result of Welder Cr sample 1

e/in	load/T	load/N	stress/N/m²	Stress/MPa	strain
0	0	0	0	0	0
0.05	4.7	46088.5055	229296047.3	229.2960473	0.025
0.1	4.9	48049.7185	239053325.9	239.0533259	0.05

Table A 2.7 indicating tensile test results of Welder Cr sample 2

e/in	load/T	load/N	stress/N/m²	Stress/MPa	strain
0	0	0	0	0	0
0.05	0.2	1961.213	9757278.607	9.757278607	0.025

The Effects of Number of Apprentices on Financial Performance of Firms in the Furniture and Wood Industries of Ghana

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Abstract

This study examined the relationship between the number of apprentices in a firm and the financial performance of the firm, using the RPED/CSAE Ghana Manufacturing Enterprise Survey (GMES) covering the period of 1991 to 2002. The dynamic panel model estimation technique was employed to investigate the effect of the number of apprentice on gross profit per capital of firms in the furniture and wood processing industry of Ghana. The findings of the study indicate that firm's financial performance; deteriorate during the apprenticeship period, as they take up more apprentices. Other dynamics of the apprentice and master were discovered to be important variables in explaining firm's financial performance. The average age of an apprentice in the Furniture industry was about 24 years while that of the Wood industry was about 29 years which is clearly on the high side. It has been suggested that firms may need incentive other than the services of the apprentice to increase their demand for apprenticeship. The incentive may include tax exemption which should be proportional to number of apprentices engaged and a proper contract must be signed that will allow apprentice to serve the firm for a specified period after training before being released. The youth must also be advised to begin the apprenticeship process early

Keywords: Apprenticeship; Financial performance; Dynamic panel model; Gross profit; Contract.

1. INTRODUCTION

Should we hire a 'lemon' and give him/her some small training or we should train an apprentice to take up the job in the near future? This is the kind of question that confronts organized firms who are after the worker with the right skills to work with. Apprenticeship provides a firm with the option to employ a tailor made worker who is in tune with the goals and aspiration of the firm that made the skill acquisition possible. However, apprenticeship comes with both monetary and opportunity cost that most firms would not want to bear. The monetary cost includes the financial commitment that is necessary to maintain and develop an apprentice. The real or opportunity cost includes the time and space that the master must allot to the individual apprentice. But apprenticeship process can be very beneficial to the firm in the long run if the apprentice is retained as a form of internal recruitment. Kriechel et al. (2012) related the cost and benefits of training and apprentice in the theoretical framework which was adopted for this study.

The study of Sonnenberg (2012) on apprenticeship in Ghana and Senegal confirms that apprenticeship is not a new concept in Ghana but rather formal apprenticeship is an up and coming phenomenon among firms in Ghana. Traditional/informal apprenticeship seems to be dominant in Ghana purely due to the fact that the kind of training received from such traditional firms are usually firm specific, which may not be generally applicable elsewhere. Activities in formal firms may be generally identical such that an apprentice from one firm may with little training work in another firm after the training process. Thus on the grounds of external diseconomies of scale, traditional/informal firms may demand more apprentice than formal firms. In other words, both firms may demand apprentice if the return to apprenticeship to the firm exceed the cost of apprenticeship to the firm. Hence, though return to apprenticeship to individual apprentice can encourage the general public to supply more apprentice (Frazer (2006): Monk et al., 2008), the demand for the apprentices depends on the firms perceived effects of apprenticeship to overall performance.

In an empirical work on net cost puzzle of apprenticeship training in Germany,Mohrenweiser and Zwich (2008)

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observed that the proportion of apprentices in trade, commercial, craft and construction occupations has a direct positive impact on firms performance: the companies cover their training costs immediately. In contrast, the authors found out that companies with apprentices in the manufacturing occupations face net training costs during the apprenticeship period but gain by the long-term employment of its graduate apprentices. These outcomes were one of the major motivations this study chose a relatively homogeneous industry. Fougère and Schwerdt (2002) examined the contribution of apprentices on firm performance in Germany. They found a positive effect of apprentices on value added only in the medium-size firms. Askilden and Nilsen (2005) asserted that apprentices are substitutes for skilled workers and are recruited primarily in boom phases.

Zwick (2007) estimated the contribution of changes in the proportion of apprentices on changes in firm performance in Germany. His findings revealed an insignificant and a negative effect of the share of apprentices on productivity which would be expected in a pure investment strategy and concluded that the investment and the substitution strategy may outweigh each other on average and that the cost benefits study of Beicht et al. (2004) might underestimate the substitution strategy.

Earlier studies on apprenticeship in Ghana have concentrated on the return of apprenticeship to the individual with little or no attention paid to the returns to the involved firms as have been discovered in other parts of the world. The two most recent studies on apprenticeship in Ghana have both focused on the returns of apprenticeship to the apprentice leaving out the returns to the firms involved (Frazer, 2006; Monk, 2008).The main objective of this study is,therefore, to examine the effects of number of apprentices on the financial performance of firms in the furniture and wood industry. The choice of the two industries was motivated by their active involvement in the apprenticeship business and to ensure homogeneity.Since there has not been much work in the scholarly literature on returns of apprenticeship to the firms in the local scene, the mixed nature of the review literature gives enough justification for the study.

2. METHODOLOGY

2.1 Theoretical Framework

The study adopted the theoretical frame work proposed by Kriechel et al. (2012) as presented below.The costs and benefits of apprenticeship training within the firm can be summarized in the following framework. The firm aims to maximize the total benefits of training, which consist of benefits during training (Bt) and expected benefits after training (E[Bt+1]).Because training also involves costs (Ct) during the training period, the principal maximization problem can be formulated as: maxBt − Ct + E[Bt+1].

First, benefits during the training period (Bt) are the result of the apprentice performing unskilled work to which he devotes (hu) hours of his working time. Apprentices also perform "hs" hours of skilled work with a relative productivity of $X < 1$ as apprentices are not yet as productive as skilled workers in the training occupation. The total time an apprentice spends with productive work is given by

hw = hu + hs…………. (2)

The apprentice's involvement in skilled and unskilled tasks is valued at the within-firm wage rate of skilled (ws) and unskilled workers (wu). The benefit of an apprentice during the training period is, therefore, given by Bt = hu · wu + hs · X · ws………….(3)

The costs for the training firm (Ct) consist of the wage of the apprentice wa, the wage of training personnel wt for the number of hours ht during which the training personnel was not able to pursue other productive tasks. Other expenses for an apprentice, such as materials, infrastructure, external training courses, recruitment and administrative costs are denoted by X:

Ct = wa + ht · wt + X……………………….. (4)

Finally, there is a possibility that a firm generates returns in the period following the training program. Such post-training benefits (Bt+1) crucially depend on whether apprentices are retained and, if so, for how long these workers remain with the training firm. The retention rate of apprentices is denoted by │ .The sources for post-training benefits are given by (i) reduced hiring costs H(│) and (ii) reduced firing costs F(│). Retaining former apprentices reduces both the firm's need to hire

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skilled workers, and through employer learning, the likelihood of having to fire an internally trained worker, which is due to the employer's information advantages regarding the worker's ability and motivation. A further channel for post-training benefits is (iii) a compressed wage structure.

In this case, the firm is able to extract a rent $∪9‡:$ from paying a wage below productivity. The size of that rent must be positively affected by employing former apprentices as skilled workers. One could imagine that the retained apprentices have superior abilities compared with skilled workers from the external labor market ("lemons"). Due to information asymmetries, even the most talented apprentices are willing to stay with the training firm despite the below market-value wage.Post-training benefits Bt+1 can thus be summarized as

Bt+1 = H(|) + F(|) + $∪9‡:$ ………………………….. (5)

Total training benefits consist of net benefits (costs) during the training period t as well as a potential post-training benefit in period t+1. The maximization problem in Equation (1) thus extends to:
maxBt[wu,ws, X , hu, hs] − Ct[wa, ht,wt,X] +

I[Bt+1(H(|) + F(|) + $∪9‡:$)]…………..(6)

The maximization problem in Equation (6) suggests that characteristics of apprentice and their master are important variable in explaining firm performance. The size of apprentices in a firm can affect variables in both the benefit and cost aspect of the maximization problem, the overall effect canbe empirically established over some time periods of which this study intends to do, by employing panel data on firms and workers to analyze the relationship between number of apprentice and firm performance.

2.2 Data Source
The main data source was the RPED/CSAE[1] data set which contains a panel survey of firms operating within the Ghanaian manufacturing sector. It covers 12 years (waves) of data, collected in seven rounds over the period 1991 to 2002. Rounds I–III was annual surveys collected under the Regional Program on

Enterprise Development (RPED) organized by the World Bank. Rounds IV-VI covers two years each and round VII covers three years. The data was collected by a joint effort of the following organizations: the Centre for the Study of African Economies (CSAE), the University of Oxford, the University of Ghana, Legon and the Ghana Statistical Office.

The original sample of 200 firms, which were first surveyed in 1991, was drawn on a random basis from firms contained in the 1987 Census of Manufacturing Activities. The firms constituted a panel which was intended to be broadly representative of the size distribution of firms across the major sectors of Ghana's manufacturing industry. These sectors include food processing, textiles and garments, wood products and furniture, metal products and machinery. Firms in ten three-digit manufacturing sectors were interviewed. This study focused on the data set on the wood product and furniture industries. The data covers the four major urban areas of Ghana; namely Greater Accra, Kumasi, Takoradi and Cape Coast.

The data set was employed for the main reason that it has complete information on firm and workers characteristics than any other survey data on Ghana manufacturing industries (Teal, 2011).

2.3 Measurement of variables,model specification and estimation techniques.
The dependent variable is financial performance which is proxied in this study by gross returns on capital invested (ROCI). Gross profit was estimated as real manufacturing value added minus wages and later divided by total capital to arrive at ROCI. Number of apprentices is the main explanatory variable of interest and is measured by the number of apprentices engaged by a firm (i) at a given time period (t).

Other dynamics of the apprentice such as age (apprage), potential experience (apprpex) and wage(apprm) were introduce alongside some firm dynamics like size (emp) measured in terms of number of number of employees excluding apprentice, potential experience (firmpex) and age of the firm in years (firmage) were introduced as control variables. The

RPED/CSAE data set is well dressed and all the aforementioned variables are clearly defined in the data set (Teal, 2011). Size of the firm is defined to include firm of even one employee as Micro(less than 5 workers), Small (5 to 19 workers), Medium (20 to 99 workers) and large enterprise (more than 100 workers)(see Teal, 2011).

Since the lag values of ROCI can affect current value of ROCI, we specify and estimate a dynamic panel model as in Equation (7).

$$ROCI_{it} = r_i + wROCI_{it-1} + s_i' X_{it} + v_{it} \dots\dots(7)$$

where s_i is the vector of slope coefficients

X_{it} is the vector variable as defined above.

v_{it} is the error term which is normal distributed.

$t = 1, 2, 3, \dots 12$

$i = 1, 2, 3, \dots,$

The model in Equation (7) follows the AR (1) dynamic model specification which can best be estimated by an instrumental based estimation. That is, the introduction of the first lag of the dependent variable in the right-hand-side of the model creates an inherent endogeneity since the lag variable is proven to be correlated with the error term. For a relatively small time period, the static estimator shall be biased. The available alternative options are the GMM instrumental variable (IV) estimator and direct bias corrected estimators (Behr, 2003). In the case of endogenous predetermined regressors, the system-estimator proposed by Blundell and Bond (1998) is unbiased and most efficient, while the direct biased corrected estimators perform similar to the GMM-estimator proposed by Arellano and Bond in 1991 (Behr, 2003). The difference and system GMM estimators are the opposite sides of the same coin and hence both estimators were employed and the most consistent results adopted for the study. The selection of the appropriate model was based on the two proposed post estimation tests after GMM dynamic model estimation. The first is the Arrelano and Bond test of autocorrelation and
the Sargan test of valid over-identifying restrictions both of which are available in STATA 12 which is adopted for the estimations (Stata Corperation ,1985-2009).

3. RESULTS

Table 1: Descriptive statistics of number of apprentices and their age.

Industry	Number of apprentices	Mean	Standard Deviation	Mean age of apprentice	Standard Deviation
Furniture	452	10	12	24 years	7
Wood	258	3	10	29	10

Source: Author calculation based on RPED/CSAE data sets

Table 1 presents the descriptive statistics of the number ofapprentice and their age. From the table, it can be observed that apprenticeships are more popular in the furniture industry than the wood industry (mean of 10 against 3 apprentices respectively). Also, apprentices are generally older in the wood industry than in the furniture industry (the mean age of 24 years against 29 year respectively).

Table 2: Descriptive statistics according to size categories (number of employees)

Size	Furniture			Wood		
	No. of Apprentices	Mean	Age of Apprentice	No. of Apprentices	Mean	No. of apprentices
Micro	47	1	21	20	1	21
Small	173	5	23	43	4	23
Medium	164	16	26	86	3	36
Large	68	12	32	109	4	34
Total	452	-		258	-	

Source: Author calculation based on RPED/CSAE data sets

The results suggest that small and medium enterprises dominate the apprenticeship process in the furniture industry while medium and large enterprises dominate in the wood industry. Medium and large enterprises employ older apprentice than micro and small enterprises. The firm size categories already

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exist in the data set. A recent paper by Teal (2011) noted that the firm size in the dataset was categorized based on the number of employees in the firm; Micro businesses (0–4 employees; includes self-employed persons); smallbusinesses(5–19 employees); medium enterprises(20-99 employees); large firms (100 or more employees).

3.1 Dynamic panel regression analyses

Both the difference GMM estimator by Arrelano and Bond and the system GMM estimator by Blundell and Bond were employed and the results indicated that the two-step system GMM estimator is more consistent with the model. The two-step system GMM estimation passed both the autocorrelation test and sargan tests which are the two major post estimation tests after dynamic GMM estimation. Fail to reject the sargan test of valid over-identifying restrictions

suggests that the use of GMM estimator was appropriate. The wald test further suggests that together the variables in the model are appropriate in explaining the financial performance of firms in the furniture and wood industry of Ghana. Since the R-square is the good mean of fitness in instrumental based estimators, it is concluded that the model is fit to be interpreted and used for policy recommendations. The results are presented in Table 3 and it is followed by interpretations and discussions.

The outcome of Table 3 suggests that the first lag value of returns on capital invested (ROCI) significantly explain current value of ROCI. That is, a cedi increase in the ROCI in current period can increase the value of ROCI of the next period by about 7.81 pesewas in the furniture and wood industry of Ghana.

Table 3: Two-step system GMM estimation of ROCI on explanatory variables.

Dependent variable: Return on Capital Invested (ROCI)			
Variables	Coefficients	t-value	P-value
First lag of ROCI	0.0781	14.78	0.000
Numberof apprentices	-0.1135	-3.26	0.001
Apprentice wage	0.0059	6.03	0.000
Apprentice age	0.0701	3.51	0.000
Apprpex	-0.1108	-6.14	0.000
Number of masters	-0.0147	-2.38	0.018
Mastage	-0.1083	-8.16	0.000
Mastpex	0.0785	5.66	0.000
Firmpex	0.0647	3.57	0.000
Firmage	-0.0714	-3.21	0.001
Size	0.0054	3.88	0.000
Iexport_1	0.4718	5.66	0.000
Ianyfor_1	2.3305	1.54	0.124
Wald test	Wald chi2(15)= 1941.56	Prob > chi2 = 0.0000	
Autocorrelation test	Order 1: t=-2.7201 P-value0.0065	Order 2: t -.05265 P-value=0.9580	
Sargan test	chi2(33) = 39.23165	Prob > chi2 = 0.2106	

Source: Author calculation based on RPED/CSAE data sets

4. DISCUSSION

Number of apprentices depicts a negative relationship with ROCI which suggests that increasing number of apprentices have the tendency of lowering a firm's financial performance. That is, a unit increase in the number of apprentices in a firm can reduce the ROCI by about 11.35% in a year. The result is significant at the five percent level of significance. From the theoretical model adopted for the study, this outcome can be

interpreted to mean that masters receive less return on the devoted to train apprentice than the returns the apprentices generate by doing both skilled and on skill jobs in the firm. In order words, firms spend more in financing master to train apprentices than what the joint activities of both master and apprentices generate for the firm. The relationship can better be understood by observing the coefficients of the other dynamics of both the apprentices and the masters in the model.

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It was expected in the framework that apprentice experience shall increase with time and this shall increase the apprentice involvement in skilled task and hence impact positively on profitability. The coefficient of the potential experience of apprentice (apprpex), however indicates that increase in the potential experience of apprentice have negative effects on financial performance. One possible explanation to this paradox is that as the experience of an apprentices increase, the apprentices begin to assume the role of the master by training other junior apprentices and hence rather devote less time to productive work than they use to do. Thus the effects of the potential experience of the apprentices can reflect in the joint effects of the potential experience of both the master and the apprentice. The interaction term in Table 3 suggests that the effects of the potential experience of an apprentice pass through the master's experience to affect financial performance positively. It could be inferred that the potential experience of the master can impact positively on profitability through increasing number of apprentice since the traditional supply of apprentice to a firm in creative industry like furniture and wood industry shall depend on the perceived experience of the master. Thus more experience masters can engage more apprentices over time with the more experience senior apprentices training the junior apprentice so that the master's experience becomes an asset to the firm.

Also, the wage of the apprentice had direct significant effect on financial performance. This result is consistent with both theory and empirical findings. Theoretically, wage services as motivation to the apprentice who may also feel appreciated. Thus increase in wage may not only motivate the apprentices to give off their best but shall also reduce the amount of time they give to personal jobs outside the firm as they become more experienced (Monk et al., 2008).Number of male apprentices also depictsdirect significant effects on financial performance.

Other control variable such as potential experience of the firm, size of the firm, age of the firm, export decision of the firm and presence of foreign ownership were introduced to reduce the effects of omitted variable bias and creates a more stable dynamic model. The outcome confirm the literature since all the variables had the appropriate sign with the exception of the presence of foreign ownership (anyfor) which although had the appropriate sign was not significant. The insignificant coefficient can explain from the descriptive statistics which suggest that medium and small enterprises are the major actors in the apprenticeship business in the furniture industry but most foreign investment in Ghana are made into large enterprise.

5. CONCLUSION

The main conclusion from the discussion of the results above is that the dynamics of apprentices and their masters are important variables in explaining the financial performance of manufacturing firms in the furniture and wood industry. The main variable of the study, which is number of apprentices in a firm have negative effects on the financial performance of a firm during the training period such that firms may not want to engage more apprentices at a time. However, the results further suggest that increasing the number of apprentices have both direct and indirect consequences for the firm during the training period. Most of the indirect consequences such as peer training among apprentices have positive impacts on profitability. A final apprentice gives off their best when they are well motivated.

The main recommendation is that stakeholders must support firms that are willing to take up more apprentices during the training period to ensure the success of apprenticeship as an alternative means to skill acquisition. Also, firm must strive to maximize the after training benefit by engaging the services of apprentices after the training process.

The main limitation of the study is the inability to effectively measure the after training benefit to obtain the net benefit of apprenticeship contained in the theoretical framework. This was as a result of data limitation which can be addressed in future studies by using primary data or a data source with such details.

of the paper. The authors of course take full responsibility for comments, claims and any errors in the paper.

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Socio-Ecological Importance of Aquatic Macrophytes to Some Fishing Communities in the Northern Region of Ghana

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Abstract
The research was conducted to identify types of aquatic macrophytes that grow in and around reservoirs, their uses, and the impacts of the macrophytes on fishing communities at Bontanga, Golinga, and Libga reservoirs, the Buipela dam, and the Black Volta at Buipe in the Northern Region of Ghana.The principal methods were ocular observation, photography and semi-structured interviews using questionnaires.The predominant macrophytes identified and their uses were:*Vossiacuspidata, Elodea canadensis*, and *Echinochloastagnina*used asfodder for livestock;shoots of *Ipomeaaquatica,Panicumhemitomon*, and *Phragmiteskarka*were used as roofing material, and for making hats, mats and necklaces**;***Nymphoidindica, Nympheae lotus, Elodea canadensis, Alternantherasessilis*, *Pistiastratiotes*and *Hydrocharitaceaespp*were being used to treat stomach ulcer, rheumatism, malaria, flu and boils;*Ludwgiastolonifera and Ludwigiapeploids*were used as feed and as food for human consumption.*Eichhornianatan and Triglochindubia*were identified without any known uses.It was also observed that the macrophytes impeded fishing operation at the study areas by entangling the fishing net of the fishermen. Exploding masses of macrophytes such as *Ludwgiastolonifera*were observed to redirect paddling, making fishing operation tedious. Nevertheless, some of the macrophytes were being used as bait to catch fishand as soap (*Ludwigiapeploid*) to wash fishing gears. Sustainable use of the reservoirs require active mechanical, chemical, biological, or integrated control methods and the commercial exploitation of the macrophytes for production of useful products in local industries.

Keywords: Spawning; Paddling; Entangling; Exploding; Sustainable

1. INTRODUCTION

Aquatic macrophytes are seen as plants that complete their life cycle in water and cause harm to the aquatic environment (Thomas and Compson, 1980). However, aquatic macrophytes are plants that may be adapted as hygrophytes or as hydrophytes (true aquatic plants which must always be in water) and should not necessarily be seen as plants that are invasive, nuisance and harmful to the aquatic environment. Aquatic macrophytes characteristically grow in water or in wet areas and are quite a diverse group. Some are rooted and anchored in the substratum while other aquatic macrophytes are emergent and some are also found floating on the water surface.Aquatic macrophytes are an important components of many watercourses, providing structure and habitat for fish and invertebrates, offering protection against currents and predators and forming a substrate for the deposition of eggs. As primary producers macrophytes represent an important food resource and they also play a significant role in the oxygen balance and nutrient cycle of many watercourses (Goeggel, 2007).

Aquatic plants are especially sensitive to changes (increases) in nutrient concentrations notably phosphorus and ammonium and to organic pollutants. Aquatic macrophytes are among those factors which a fisheries manager will try to understand and include in his strategies for optimizing capture fisheries in inland waters. Plant species composition, distribution and percentage cover of aquatic plants may determine the fish species composition, individual fish species production, access to fish stocks by fishermen, fishing gear selection and sometimes may also be an efficient indicator of water quality. Their presence may enhance water quality due to their ability to absorb excessive load of nutrients.

Aquatic macrophytes are present virtually in all fresh water bodies. The study of aquatic plants in a lake provides useful information about the productivity of a habitat (Kwarfo and Ipinjolu, 1995). Obligatory and non-obligatory plant spawners (phytophlis) stick adhesive egg envelopes to submerged live and dead macrophytes. In Africa, *Heterotisniloticus* build nest in flooded plants at the margins of flood

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plains, catfishes such as *Clarias*species scatter it eggs among submerged aquatic plants. Some other fish stick their eggs to submerged plants but other substrates are utilized in their absence (Welcomme, 1985).

Socio-economic importance of the macrophytes cannot be underestimated. Macrophytes are important sources of fodder for animal production. Some macrophytes are used as roofing materials. Aquatic macrophytes serve as food and as medicine herbs. Lately, some aquatic macrophytes are useful raw materials for industries (mature silky inflorescence of the spike of typha). Some aquatic macrophytesare used in making dressing accessories such as necklaces, handbags, and hat are being made from aquatic macrophytes. Aquatic macrophytes have potential use in fertiliser production.

A fish swims into a gill net and passes only part way through the mesh. When it struggles to free itself, the twine slips behind the gill cover and prevent escape. Gill nets are so effective that their use is closely monitored and regulated by fisheries management and enforcement agencies. Mesh size, twine strength, as well as net length and depth are closely regulated to reduce by-catch of non-target species. These nets sometimes indiscriminately and destructively kill an enormous amount of by-catch along with the targeted species. However, macrophytes can affect the use of gill net by clogging into the net making it difficult to pull after the fish has been caught by the net. Freshwater organisms use aquatic macrophytes for shelter and refuge as well as food sources either direct or indirect, in the form of periphyton and associated invertebrates, as a spawning and nursery sites. Crowx and Welcomme (1988) listed a number of characteristics of aquatic plant which make them important to fish:

1. Spawning areas and sites of oviposition for many cyprinid and percid fish.
2. Food source (living and dead).
3. They create discrete habitat which is as functional as physical structure.

Aquatic macrophytes have a great effect on physical environment, especially light penetration at the water column, water temperature, water flow and substrate.

The littoral zone of many nutrient-enriched water bodies, such as, Bontanga, Golinga, and Libga reservoirs, Buipela dam, and Buipe stretch of Black Volta, all in the Northern Region of Ghana are often clogged with excessive growth of aquatic macrophytes which directly or indirectly affect the inhabitants.They impair recreational and industrial activities, as well as altering the structure of the food web. The problems associated with them is of significant importance as the aquatic macrophytes impede fishing activities in those areas since some of the macrophytes trap and entanglefishing nets making fishing activities tedious and difficult. This could result in low harvest or catch in these water bodies even though much effort is applied.Exploding masses of aquatic macrophytes also affect the quality (taste and odour) and quantity (volume) of the water and reduce the volume and the flow of water in irrigation canals.

Regardless of the problems and uses of aquatic macrophytes, little research has been conducted on the various waterbodies in the country except a few on the downstream of the Volta Lake, Weija and Owabi dams. No significant research on aquatic macrophytes has conducted on Bontanga, Golinga, and Libga reservoirs, the Buipela dam, and on the Black Volta at Buipe, all in the Northern Region of Ghana.The dearth of knowledge on socio-ecological importance of aquatic macrophytes to fishing communities in the Northern region of Ghana necessitated this research. Little research has been conducted on aquatic macrophytes on the various water bodies, regardless of these problems and uses. And none has been done on the Bulpiela dam.The research was conducted with the aim of identifying various types of macrophytes, and then assessing their social and ecological importance to the inhabitants of the fishing communities in the study areas.

2. METHODOLOGY
2.1. Study area
The study was conducted at Bontanga reservoir lies on the latitude 9°30' N and 1° 15' W; Golinga reservoir lies on the latitude 9°25 N and longitude 1° and 2' W in the Guinea Savanna zone of Ghana. Libga reservoir lies within latitude 9º45' and 10º8'N and on longitude 1º10´W. Buipela dam is within the

Tamale metropolis which lies between latitude 9°15'30'' N and longitude 0°15'10''W. The last study site is Black Volta stretch at Buipe. Buipe which is the Central Gonja District Capital in the Northern Region of Ghana. Buipe is about 104 km from Tamale (Northern regional capital) and lies within the latitude 08° 47'N 01° 32'W and8.783°N 1.533°W. Buipe is located on the upper reaches of Black Volta.

2.2.Method of data collection
2.2.1 Observation
As part of the objectives to identify the various types of aquatic macrophytes, critical observation was adopted to identify the common aquatic macrophytes which were then compared to various macrophytes in a hand book (Encyclopaedia of medicinal plants). A publication titled ''Aquatic Weeds &their Management'' by Lidia Lancar and Kevin Krake (2002) also aided the identification of unfamiliar aquatic macrophytes.

2.2.2 Photography
Photographs of aquatic plants were taken by a Samsung smart digital camera (16MP) and compared with a hand book on various macrophytes.

2.2.3 Sampling and questionnaire administration
Semi-interviews were conducted using questionnaire.Thirty respondents were selected from each fishing community to know the uses of the macrophytes and the effects macrophytes on fishing operation. The sample size had fair representation of occupation, gender, age and educational level. Semi-structured questionnaire (Appendix 1) was used for the interviews.

2.3.Data analysis
The data obtained was analysed using Microsoft Excel 2013 and Statistical Package for Social Science (SPSS) and the results were presented in plates, pie chart and tables

3. RESULTS
3.1Aquatic Macrophytes Identified at the Buipe stretch of the Black Volta River

A total of seventeen (17) aquatic macrophytes belonging to twelve (12) families were identified from the Bontanga, Golinga, and Libga reservoirs, Buipela dam, and the Black

Volta atBuipe during the study periods. A floating-leaved macrophytes *Nympheae lotus*(commonly called water lily.A photo of it available in Appendix 2: Plate 1) from the family Nymphaeaceae was the only aquatic macrophyte identified in all the five study areas.Emergent macrophytes*Vossiacuspidata* (belongs to the family Poaceae. A photo of it available in Appendix 2: Plate 2)*Ludwgiastolonifera*(belongs to the family Onagraceae. A photo of it available in Appendix 2: Plate 3) and a Floating leaved macrophyte*Ipomeaaquatica*(Convolvulaceae) were observed in three of the five study areas. The following aquatic macrophytes occurred in only one of the five study areas: *Elodea canadensis, Echinochloastagnina, Nymphoidindica, Pistiastratiotes, Hydrocharitaceae spp., Ludwigiapeploids,Triglochindubia, Neptuniaoleracea and Nymphaeamicrantha.* Table 1 shows a summary of the aquatic macrophytes identified from the study areas.

Table 1: Aquatic macrophytes identified in the study areas

Type of Macrophytes	Species	Family	Common Name	Location				
				Bontanga Reservoir	Golinga reservoir	Libga reservoir	Bui pela dam	Black Volta
Emergent	*Vossiacuspidata*	Poaceae	Hippo grass	x	x	X		
Submerged	*Elodea canadensis*	Hydrocharitaceae	Water weed					x
Emergent	*Echinochloastagnina*	Poaceae	Burgu Millet					x
Floating leaved	*Ipomeaaquatica*	Convolvulaceae	Water spinach	x	x		x	
Emergent	*Panicumhemitomon*	Poaceae	Maidencane	x				
Emergent	*Phragmiteskarka*	Poaceae	Common reed	x	x			
Floating-leaved	*Nymphoidindica*	Menyanthaceae						x
Floating-leaved	*Nympheae lotus*	Nymphaeaceae	Water lily	x	x	X	x	x
Occasionally Floating-leaved/Emergent	*Alternantherasessilis*	Amaranthaceae		x			x	
FreeFloating	*Pistiastratiotes*	Araceae	Water lettuce		x			
Emergent	*Hydrocharitaceaespp*	*Hydrocharitaceae*						x
Emergent	*Ludwgiastolonifera*	Onagraceae			x	X	x	
Emergent	*Ludwigiapeploids*	Onagraceae						x
Emergent	*Eichhornianatan*	Pontenderiaceae			x		x	
Emergent	*Triglochindubia*	*Juncaginaceae*						x
FreeFloating	*Neptuniaoleracea*	Fabaceae	Water mimosa		x			
Floating-leaved	*Nymphaeamicrantha*	Nymphaeaceae			x			

3.2. **Social importance of the aquatic macrophytes to the fishing communities**

Fig. 1 presents the responses obtained on the uses of aquatic macrophytes in the study area. Forty one percent of the respondents reported that aquatic macrophytes were used as fodder for animal production while 22% of the respondents interviewed indicated that aquatic macrophytes were used as food. Another 21% of the respondents reported that aquatic macrophytes were used as roofing materials for mud houses. About 13% of the respondents said that aquatic macrophytes were used as medicinal herbs while the remaining 4% indicated that aquatic macrophytes were used as accessories (necklaces, bags, etc.).
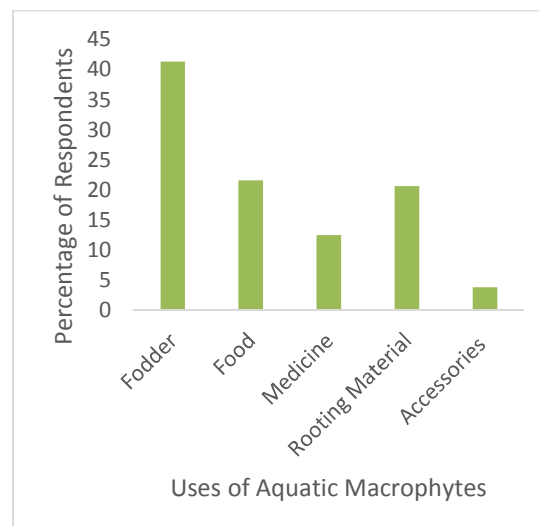

Figure 1: Uses of Aquatic Macrophytes from the Bontanga, Golinga, and Libga reservoirs, Buipela dam, and the Black Volta atBuipe

Table 2: Comparison of the uses of the aquatic macrophy

Species of macrophytes	This Study			Similar Findings by Other Authors			
	Part used	Uses	Place	Part used	Uses	Reference
Vossiacuspidata	Shoots	Fodder for livestock	Nigeria	Leaves, stem/bark	Fodder for livestock; Thatching	Burkill (1985); Ita (1994)
Elodea canadensis	Leaves	Used by fish as food	-	-	It used extensively by insects and invertebrates	Department of Wildlife & Fisheries Sciences
Echinochloastagnina	Leaves and stem	Fodder for livestock	Kainji lake, Nigeria		Serve as fodder and spawning grounds for different classes of economically important fish	Balogun et al. (1995)
Ipomeaaquatica	Leaves	Fodder for livestock	Nigeria	Whole plant	Medicine, Food	Ita (1994)
Panicumhemitomon	Shoots	Roofing materials Fodder for livestock	United State	Leaves	Fodder for livestock	U.S. Department of Agriculture
Phragmiteskarka	Shoots	Roofing materials Fodder for livestock	India	-	Compost/fettiliser	Sushil (2012)
Nymphoidindica	Whole	Treat stomach ulcer and rheumatism				

Nympheae lotus	Fresh stalk and inflorescence	As part of concoction for treating fever and food.	Nigeria	Stem, bark, floral parts and roots	Curing urethral discharges and fever; food	Ita (1993);Ita (1994); Kwarfo-Apegyah and Ipinjolu (1995)
Alternantherasessilis	-	-	Nigeria		Medicinal: Headaches and dizziness	Hellesvig-Gaskell (2013)
Pistiastratiotes	Leaves	As part of concoction for the treatment of flu.	Nigeria	Whole plant, Leaves	Food; Fish feed; fodder;	Ita (1994)
Hydrocharitaceaespp	Whole	Use to treat boils				
Ludwgiastolonifera	Leaves	Rooting material and as fodder for livestock	Nigeria	-	Food	Ita (1994)
Ludwigiapeploids	Leaves	As soap to wash fishing gears				
Eichhornianatan	-	-	West Africa	-	Medicinal uses	West African Plant (200)
Triglochindubia	-	-				
Neptuniaoleracea	Leaves	Fodder for livestock			Medicine	Nakamura et al. (1996)
Nymphaeamicrantha	Fresh stalk	As part of concoction for treating fever.				

3.3 Macrophytes and fishing operation

3.3.1 Fishing gears

Fig. 2 illustrates the survey responses on types of fishing gear in the study areas. Forty six percent of the fishermen indicated that they used gill nets as their main fishing gear. This was followed by 29% of the respondents who reported that they used cast nets. Survey results also indicate that 13% of the respondents used baskets while 12% of the respondents used hook and line as fishing gears.
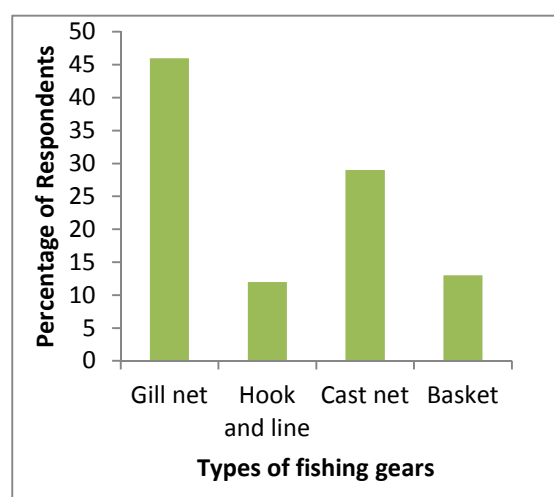

Figure 2:Types of fishing gears

3.3.2 **Macrophytes on fishing operation and practices**

Figure 3 depicts the responses from the fishermen in the study areas. Thirty percent of the fishermen indicated that aquatic macrophytes affected their fishing operation and practices by entangling their nets when the nets were thrown while 17% said that macrophytes affected their fishing operation and practices by re-directing their paddling. About 13% of the respondents reported that macrophytes destroyed their nets in the course of pulling the nets. Another 13% of the fishermen reported that they used macrophytes as bait to catch fish while 28% of the fishermen indicated that they used macrophytes as soap to wash fishing gears.
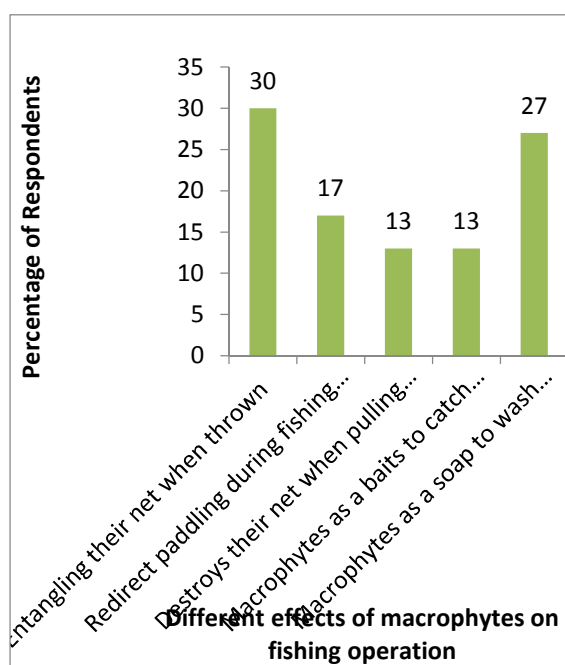

Figure 3: Macrophytes and fishing operation and practices

3.3.3. Identification of aquatic fauna

Table 3 shows the aquatic fauna identified in the macrophytes at the Golinga Reservoir. Five fish species and five invertebrates were observed at the Golinga Reservoir.

Table 3: Aquatic fauna found in the macrophytes in Golinga Reservoir.

Fish species	Invertebrates
Tilapia zillii	Moths
Sarotherodon galilaeus	Weevils
Hemichromisfasciatus	Yolatuberculata
Malapteruruselectricus	The great diving beetle (Dytiscusmarginalis)
Oreochromisniloticus	Neptosternusguignotum

4. DISCUSSION

The results from this study indicate that aquatic macrophytes exist in and around the Bontanga, Golinga, and Libga reservoirs, Buipela dam, and the Buipe stretch of the Black Volta.

Carfrey (1974) reported a variety of macrophytes in aquatic environments which included Pistiastratiote, Nymphae lotus, Impomeaaquatica, Hydrillaspecies among others. The findings of Carfrey (1974) are similar to this study since Pistiastratiotes and Nymphae lotus were also observed in this study. The Volta (including the Buipe stretch of the Black Volta) has been reported to be an eco-region which supports extensive floodplains containing relatively diverse levels of aquatic and semi-aquatic flora.Typical species reported by the authors included Nymphaea lotus, Vossiacuspidata, Aeschynomenenilotica, A. indica, Oryzabarthii, O. longistaminata, Nymphoidesezannoi, Cyperusdigitatus, Panicumsubalbidum, Cynodondactylon and Acacia nilotica (Hughes and Hughes 1992; Guyotet al., 1994; Sally et al., 1994).In ponds, species such as Echinochloastagnina, Oryzabarthii, O. longistamina, Vetiveranigritana are found (Claude et al 1991). Flooded meadows are dominated by Echinochloa spp., Oryzabarthii and Vossiacuspidata, whereas Pistiastratiotes, Ceratophyllumdemersum, Nymphaeaspp. and Ludwigia spp. are common

on the edges of Lake Volta (Davies and Walker, 1986).Five of the species the authors reported; namely *Nymphaea lotus, Vossiacuspidata, Echinochloastagnina, Pistiastratiotes*and *Ludwigiaspp*were also observed in this study. It

is indicative that some of the macrophytes species may have been in existence for decades yet no comprehensive studies were done about their social and ecological importance until this research was carried out.

Macrophyte cloggingthe net of fishermen in the Bontanga, Golinga, and Libga reservoirs, Buipela dam, and the Buipe stretch of the Black Volta(Appendix 2: Plate 5) is major impediment to the fishing operation as indicated by sixty percent (60%) of the respondents. It conforms to what Smith (1991) reported,that a gradual or fast increase of aquatic macrophytes of an invasive character can results in threat to commercial or recreational fishery. Furthermore, it costs fishermen a lot of money to repair or replace their damaged nets. This can make their fishing occupation unprofitable. When macrophytes entangle the fishing nets,the nets sometimes become damaged in the course of pulling. Fast increase in macrophytes may become a major problem to fishing with net in the Bontanga, Golinga, and Libga reservoirs, Buipela dam, and the Buipe stretch of the Black Volta. Fish caught is released back to the river when an entangled net is torn in the course of pulling and thereby reducing fish catches. Plate 5 shows fishermen struggling to pull an entangled net at the Buipe stretch of the Black Volta.

Macrophytes directing the paddling of canoes lead to a lot of time being wasted during fishing operation and practices. Durocher *et al.*(1984) observed that fish production increase with an increase in aquatic plants density up to a certain point, after which further increase in plants density results in decline in fish production. It is therefore likely that a continuous increase in aquatic macrophytes density at the Bontanga, Golinga, and Libga reservoirs, Buipela dam and the Buipe stretch of the Black Voltamay bring about an increase in fish production to a certain level, after which a further increase in the macrophytes density may lead to decline in the fish population. It is therefore important to look at a balance of control of these aquatic macrophytes in order to maintain the macrophytes' provision of socio-economic benefits to the fishing communities while preserving the ecological functions of the aquatic macrophytes.

The observation by respondents that some fishes hide in macrophytes during the day time is similar to whatCrowx and Welcomme (1988) observed that aquatic plants are important to fishes since they serve as spawning areas, oviposition sites and sources of food. Reduced fish catches during the dry season as reported by fishermen could be an indication that fishes hides under the macrophytes for shelter or as breeding grounds or for food, or for protection against bad weather or for protection from predators. Shell *et al.* (1993) stated that aquatic vegetation provides breeding substrates for numerous fish and invertebrates and serves as fish feed which is comparable to the observations of this study. Shell *et al*(1993) observed that herbivorous fishes like *Tilapia zilli*and *Tilapiarendalli*feed on aquatic macrophytes.Moreover, it agrees with Lambert and Moore (1984) that Cichlids use aquatic vegetation directly for feeding and spawning of their sticky eggs.

Furthermore, aquatic macrophytes are used as bait to catch fishes. Respondents indicated that some species of fish feed on *Elodea canadensis*. Similarly, Mbaugwu and Adeniji (1998) reported that some species of fish feed on *Lemnapausiacota* which is similar to fish feeding on *Elodea canadensis* as observed in this study. It was realised that macrophytes were being used as soap to wash fishing gears. Using macrophytes as soap implies that the use of inorganic soap to wash fishing gears at landing sites is significantly reduced or eliminated. This will subsequently help in maintaining the aquatic ecosystem integrity as inorganic soaps have a lot of effects on the physiochemical properties of the river.

From interviews and observations, fishermen practice hand pulling to reduce the abundance of aquatic macrophytes. In practicing hand pulling to control the abundance of macrophytes, the fishermen waste a lot of time and energy controlling the macrophytes instead of fishing. It is nevertheless, in accordance with the findings of Okezie (1984), who stated that despite the adverse effects of the macrophytes, they can still be controlled. Cafrey (1974) reported that mechanical control of aquatic macrophytes is an importance and effective method of aquatic macrophytes management especially for surface floating macrophytes. Subsequently, the manual

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removal of aquatic macrophytes in and around Bontanga, Golinga, and Libga reservoirs, Buipela dam, and the Buipe stretch of the Black Volta can be regarded as an effective and efficient mode of the aquatic macrophytes control.

Notwithstanding the adverse effects of macrophytes on fishing activities, it was realized that the inhabitants of the fishing communities use some of the macrophytes as medicinal herbs to cure ailments such as malaria, fever, rheumatism, boils and stomach ulcer. The findings of this study is similar to that of Imevbore (1971) who indicated that most of the fifty two (52) macrophytes he identified including *Pistiastratiotes* and *Nymphoidindica* can be used for ulcerative conditions of the mouth and tongue.The use of macrophytes as alternative medicine is of great importance to the rural people of Bontanga, Golinga, Libga, Buipela and Buipe since the readily available macrophytes are relatively cheaper than manufactured drugs/medicine. Macrophytes are also used as fodder to feed animals (ruminants) espeifically forcattle, sheep and goats. The use of *Echinochloastagnina* as fodder for goat and sheep as observed in this study was not surprising as Imevbore (1971) reported that fourteen of the fifty two (52) macrophytes identified in aquatic environments in Nigeria were used as fodder and *Echinochloastagnina*was one of the fourteen (14) species the author mentioned as being used as fodder.Most livestock farmers in the study area feed their animals mainly cattle, sheep and goats with dried *Phragmite*sp and *Ipomea*sp especially in the dry season when annual vegetation is dry and burnt. As reported by Boyd (1969) certain aquatic plants have significant levels of protein and can be used as livestock feed or soil amendment.
The use of *Phragmiteskarka*(Appendix 2: Plate 4 and Plate 6) as roofing material for the thatch of mud houses makes it an important raw to the rural fishing communities. *Phragmiteskarka*and *Panicumhemitomon*are readily available from reservoirs for use as roofing materials. *Phragmites* when used for roofing is as effective as aluminum roofing sheets except for rain water harvesting.

5. CONCLUSION
Seventeen species of aquatic macrophytes were observed at the five study areas. Nine of the species namely *Vossiacuspidata,*

Echinochloastagnina, Panicumhemitomon,Phragmiteskarka, Hydrocharitaceaespp, Ludwgiastolonifera, Ludwigiapeploids, Eichhornianatan, Triglochindubiawere emergent macrophytes. Four of the species namely Ipomeaaquatic,Nymphoidindica, Nympheae lotusandNymphaeamicranthawere floating-leaved macrophytes. Free-floating macrophytes were PistiastratiotesandNeptuniaoleracea. Theonly submerged aquatic macrophyte observed from the study areas was Elodea canadensis. An Occasionally floating-leaved/emergentaquatic macrophytesAlternantherasessiliswas also encountered at the study area.

Aquatic macrophytes at Bontanga reservoir, Golinga reservoir and the Buipe stretch of the Black Volta affect fishing operation and practices by entangling fishing nets and sometimes the nets get torn in the course of pulling.The macrophytes at those locations direct the paddling of the fishermen's canoes which subsequently lead to loss of energy and time. Notwithstanding, they serve as bait to catch fishes and as soap to wash fishing gears. Moreover, macrophytes at the Buipe stretch of the Black Volta River are used as fodder to feed sheep and goat, medicine to treat malaria, stomach ulcer, rheumatism and boils.

The socio-economic importance of the predominant macrophytes found in the study areas is a great indication of the potential source of livelihood improvement in the fishing communities. The use of some of the aquatic macrophytesas a roofing material to thatch houses, as mulching materialand for making necklaces and other dressing accessories presents new opportunities for the macrophytes industrial use and exploitation.

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Readiness of Teachers to Use and Adopt ICTs for Teaching and Learning in Ghana

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Abstract
Since independence successive governments have embarked on several educational reforms in an attempt to improve the education system in Ghana. Many of these reforms have been devoid of ICT interventions possibly because of the comparatively late penetration of ICTs in the country. Nonetheless, reforms undertaken beginning year 2001 have paid considerable attention to inclusion of ICTs in the teaching and learning process in accordance with current trends. The accomplishment of the objective of integrating ICTs into the teaching and learning process depends largely on teachers who are primary stakeholders in the whole process. This paper presents findings from a study on the perception of teachers on ICT use and adoption. A randomised sample of 100 male and female teachers from five public Senior High Schools in the Eastern region of Ghana were interviewed. Findings from the study revealed that, though most teachers perceive ICT and education synergy to be important, they are under-resourced with ICT infrastructure. The results also established that more than 60% of teachers lacked the confidence to integrate ICTs into the teaching and learning process.

Keywords: Perception; Teaching and Learning; ICT; Educational Reform, Ghana

1. INTRODUCTION

Information Communication Technologies (ICTs) have become a basic component of virtually all human activities in the world.. In view of this , attempts have been made by governments of many developing countries to incorporate ICTs in various sectors of their economy as a way of promoting growth and development. Ghana has not been an exception. There have been attempts to incorporate ICTs in the educational sector since the turn of the century. The educational sector has been considered as a major force through which sustainable development could be achieved (OECD, 2004; World Bank, 2003). The most recent policy initiative to create ICT and education synergy was in 2006 on the recommendation of the Anamuah-Mensah's Committee (Ghana Ministry of Education, 2006). Embedded in this recommendation is an initiative to integrate ICTs into teaching and learning in the whole educational system. This move is expected to boost the skills of students, and equip them with requisite skills for the global economy and the information world (Haddad & Draxler, 2002; UNESCO, 2003).

Inclusion of ICT in teaching and learning is expected to bridge the gap of social disparity through the enhancement of knowledge sharing, adoption of cultural creativity and increment of democratic participation to the benefit of all (Kozma, 2008). For instance Chile in the 1990s, made a remarkable use of the educational ICT reform to rectify social inequities in the country (Cox, 2006; Kozma, 2008). An integral part of the policy was the huge introduction of ICTs into schools, in-service training for teachers on ICT use in teaching and learning and development of internet-accessible educational website (Hepp, 2004; Laval & Hinistroza, 2002).

Others have also argued that the inclusion of ICTs in teaching and learning alone does not automatically lead to development. Some preconditions ought to be met for the expected impact to materialise. For example Cuban (2001) in his study found that, the introduction of ICT into American schools had achieved neither the transformation of teaching and learning nor the productivity gains the reform coalition had anticipated. He argued that, for fundamental changes in teaching and learning to occur, there should be widespread and deep reforms in schools and organisations. He added that, without sufficient attention to teachers and their workplace conditions, "there is little hope that new technologies will have more than minimal impact on teaching and learning" (Cuban 2001, p.197). This work by Cuban

prompted an in-depth look at the perception of Ghanaian teachers in the quest to create an ICT and education synergy.

Further justification of the study was a Kozma (2005) finding, which opined that teachers' readiness to use ICT was dependent largely on their perception. He noted that teachers would use ICT tools in their teaching process if they perceived it would have an advantage over their traditional way of teaching.

Whereas many factors, including teachers' perception, matter in the use of ICT in education, Hermans, Tondeur, van Braak and Valcke (2008) have asserted that, limited attention has been given to the accuracy of teachers' perception as a relevant variable in many ICT use and adoption studies. Given this limited attention to teachers' perception as a factor in considering readiness to use ICTs in teaching and learning, there is a blurred indication on the way forward for ICT and education synergy. As a result, a study to examine the current state of perception of teachers is warranted. This paper presents research results on the subject from one of the ten administrative regions of Ghana.

1.1 Objectives
The study looked at the perception of teachers to ascertain their readiness towards the use of innovations in ICT in the teaching and learning process. Specifically this paper investigates teachers' perception on the current state of available ICT infrastructure. Itconsiders teachers' perception of the relevance of ICT and education synergy and also seeks to determine teacher's confidence to use ICT in teaching and learning.

1.2 Theoretical Framework

This paper reflects on the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis & Davis, 2003) which has asserted that individuals' perceptions of external circumstances lead to behavioural intention and actual behaviour of the acceptance and use of a technology. Four main constructs were used to explain the theory. The first is performance expectancy, which is the degree to which an individual believes that using an ICT innovation will help him or her to attain gains in job performance. The second is effort expectancy, which is the extent of ease associated with the use of a

technology. The third, social influence, measures the degree to which an individual values the importance others ascribe to him or her using a new technology. Facilitating conditions, refers to the degree to which an individual believes that an organisational and technical infrastructure exists to support the use of a new technology (Venkatesh et al, 2003)

Three, of the four constructs were found to be direct determinants of behavioural intention, which is, the person's subjective probability that he or she will perform the behaviour in question (Venkatesh et al, 2003). The final construct (facilitating conditions), directly determines the actual usage behaviour. UTAUT further states that gender, age, experience, and voluntariness of use, determines the impact of the four main constructs on usage intentions and actual usage behaviour. Based on the theory, four factors account for successful implementation of reforms to include ICT in teaching and learning. These include the existence of technical infrastructure to support reform strategies and stakeholders perception that using the technology will help them learn or gain in job performance. The third and fourth which is outside the scope of this paper are ease with which stakeholders could use and adopt to implementation strategies and the degree to which stakeholders perceive that others believe he or she should use a particular system.

1.2.1 Infrastructure and Technical Support as Factor of Use and Adoption
Readily available ICT technical support for teaching in schools is essential for effective implementation of ICT reforms (Ofsted, 2004; Schiller, 2003 & Pelgrum, 2001). ICT competency trainings for teachers are mainly meant to make them apply the learnt skills to their teaching practice and not to solve technical problems that may arise from teaching. For this reason, it is necessary technical support is on stand-by to assist teachers to rectify glitches to avoid disruption to lessons.

Aside technical support, infrastructure in terms of adequate hardware is another crucial factor that affects use of ICTs in teaching in schools. For instance, Goktas, Gedik and Baydas (2013), in their study on ICT use in primary schools in Turkey, identified inadequate hardware to be a

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major setback to the use of ICT for teaching and learning.

1.2.2 Perception as Factor of Use and Adoption
According to UTAUT, perception is an inevitable factor for the successful use and adoption of technology. Wagner (2008), defined perception as the "sensory experience of the world around us". He explains that through the perceptual process, information about properties and elements of the environment that are critical to us are gathered. The information gained helps people to create an experience of their environment and allows action within the environment. Collingwood (1979), Fullan & Pomfret (1977), Hughes & Keith (1980) and Pelgrum (2001) put this better by describing perception as occupying the centre stage to initiate changes in teaching and learning.

Hughes and Keith (1980), identify several attributes of perception. One of them in sync with UTAUT is the Perception of Relative Advantage. This attribute of perception states that potential users would use and adopt innovations under implementation if it is able to address their needs much better than old practices. They argue that in this scenario, the potential users of an innovation, in this case teachers, would be eager to abandon old practices in favour of the innovation.

3. METHODOLOGY
The study triangulated methodologically to sample views of teachers from five out of the seven public senior high schools in the New Juaben District of the Eastern Region of Ghana. A numbered list of all teachers in the five selected schools was put together as a sampling frame from which 100 teachers were randomly selected from a total of 186. Four in-depth interviews were conducted to gather opinions of headteachers and a representative from the Ministry of Education.

Two data collection instruments were used to gather data in the study. The first, a questionnaire, was used to gather the views of teachers. Interviews were also conducted to seek the opinion of key informants in the study using interview guide.

4. RESULTS
This section presents finding of the study based on five key variables including adequacy of computer hardware, extent of technical support, relevance of ICT in teaching and learning and likelihood to use ICT for teaching and learning.

Table 1: Summary of Findings

Variable	Category	Percentage
Adequacy of Computer hardware	Yes	34%
	No	66%
Relevance of ICT in Education	Yes	60.3%
	No	39.7%
Likelihood of Incorporating ICT in teaching	No	65.8%
	Yes	34.2%

1.1 Does your school have enough computer hardware for teaching and learning?

From the study, 66% of teachers were of the opinion that, computer hardware in their schools was inadequate for the effective inclusion of ICT in teaching and learning.

Nonetheless, the remaining 34% thought otherwise (See Table 1). This response pattern was also visible in the words of key informants.

> "As I speak to you today, there has not been enough deployment of computers to the schools. Years of the implementation and we have not met our computer deployment targets" [Interview at Ministry of Education]

> "The implementation process should have gone hand in hand with the supply of enough computers to the various schools; because the reform will be very ineffective without the practical aspect of it." [Interview with a headteacher]

> "The reform implementation process did not cater for the needed infrastructure for the programme to be effectively implemented. No tangible facilities have been put in place for the programme to take off

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properly" [Interview with a headteacher]

4.2 Do you have Adequate Technical Support in using ICTs for Teaching?

The teachers (61%) disagreed there is enough technical support for inclusion of ICTs during class lessons but some (39%) thought there was enough technical support for inclusion of ICT into classroom lessons.

4.3 Do you agree ICT could improve Teaching and Learning?

Results showed that 60% of the teachers believed that the inclusion of ICT in education, would improve teaching and learning in their schools but some 40% had different opinion. One of those in the minority gave the following for his position "In general, I strongly believe that this ICT educational reform is just a populist move or strategy to win the masses".

4.4 Are you likely to use ICT for teaching and learning?

A total of 66% of the teachers involved in the study indicated they were not likely to incorporate ICTs in their teaching practice because they lacked confidence. In contrast, some 34% said they had the confidence to use ICT innovation for teaching. Reasons ascribed to lack of confidence include:

> "I do not understand why policy makers at the ministries think they know the ICT skills we need more than ourselves. I wonder why it's too hard for them to give us the chance to choose which ICT skills we need and how we should get the training we chose…" [Teachers' Questionnaire]

> "I have no problem using computers for simple "copy and paste" administrative tasks, but you will agree with me that it takes more than "copy and paste" skills to be able to effectively integrate ICT in class lessons but, if I know I will get ICT technical assistance, I would not be scared to try something I have not done before in my lessons" [Teachers' Questionnaire]

> "I have not taken part in any ICT training, neither do I know much

about ICT in this school and I'm not bordered though. But, if you think otherwise why should I? After all, I am not the ICT teacher. I only go to the computer lab if I want to have letters printed for me." [Teachers' Questionnaire]

5. DISCUSSIONS

The UTAUT (Venkatesh et al, 2003) model argues that facilitating conditions such as the extent to which an individual believes technical infrastructure is adequate influences their use of technology. The aim of ICT-education synergy, i.e., to develop a learner's digital competency and technological fluency, depends so much on the availability of, and accessibility to adequate ICT infrastructure (Vallance, 2008). From the findings, the teachers perceived there is inadequate ICT infrastructure in Senior High schools in the study area. That means based on the UTUAT model teachers are not likely to use technology in their practice because of inadequate hardware. This confirms findings in Turkey by Goktas et al (2013).

5.1 Perception of teachers toward the inclusion of ICT in regular teaching activities

The importance of ICT for teaching is clearly visible to majority of teachers. They perceived ICT would make their work easier and effective. Given the fact that the UTAUT models asserts that people will use and adopt technology if they consider it useful to their work, there is a high success rate as far as the implementation of the policy for the inclusion of ICT in education is concerned. However, there were teachers in the minority who were sceptical the synergy will be successful. They perceived that though the synergy is relevant, they do not trust the seriousness with which it is being implemented based on past failed policy implementation.

5.2 Teacher's confidence to use ICT in teaching

Many teachers perceived the importance of ICT in education, yet they lack the confidence to use it in their practices. It appeared though some teachers have basic ICT skills they do not believe it is enough for teaching and learning. Another interesting thing to note is that some teachers had the perception that inclusion of ICT in teaching and learning is not their job but that of the ICT instructor. This finding concurs

with that of Cuban (2001) and Reynolds, Treharne, and Tripp (2003). Cuban (2001) suggests that the mere implementation of ICTs in education will not necessarily result in its use for teaching and learning. In the case of Reynolds et al, they argued, technology should be used as a tool for teaching and not taught as a subject in itself. Also confirmed, is the UTUAT model's assertion that use and adoption of ICT innovations is dependent on the extent of voluntariness to use such innovations. This study confirms that because teachers, except ICT teachers, have the option not to use ICT for teaching and learning they shun away and perceive it is for ICT Teachers. Many teachers also perceived their basic ICT skills were not good enough to aid them in their practice.

6. CONCLUSION

This study sought to use perception of Ghanaian teachers to establish their readiness towards inclusion of ICT in their practice. It emerged that while most teachers (60%) have a positive perception of the relevance of a synergy of ICT and education, there remains some scepticism among many (66%) as far as the likelihood to use ICT in teaching and learning was concerned because of lack of confidence. In addition, it is also perceived by majority (66%) of teachers that, though there are some ICT infrastructures in schools, they are inadequate. Finally, there was mixed responses vis-à-vis the adoption constructs of the UTUAT model

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Challenges in the Informal Training of Artisans in the Building Construction Industry: the case of artisans working on selected building construction sites in Cape Coast Metropolis

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Abstract
Informal training of artisans to acquire the necessary skills to perform specific task on construction site is very important in the Ghanaian construction industry. Informal skill training is an ad hoc and unsystematic method of learning-on-the-job which is received within the context of day to day production activities. In the Ghanaian building construction sector, much attention has been given to the shortages and inadequacies of skilled personnel which include construction craftsmen and tradesmen. The study aims at finding out some challenges in the informal training of artisans in the building construction industry. The study used data from field investigations as primary source of data and available literature as secondary source of data.120 master artisans and 113 trainee artisans constituted the population of the study from selected construction sites working for various classes of contractors within the Metropolis. Simple random sampling was used to determine a sample size of 118 master artisans and 111 apprentices. The study revealed that most artisans trained by the system cannot easily interpret drawings on site without assistance of professional on site due to low level of education of practitioners of the system. The study concluded that the apprenticeship system in Ghana is dominated by a hands-on practical approach, preferred by the master artisans who generally claim full responsibility for training and were trained in the same way. The study recommended that in order to improve the performance of informally trained artisans, the system's participants should be continually provided with assistance from related trade associations and the government in the assessment and modeling of particular training needs.

Key words: Informal training system; Artisans; Apprentices; Construction; Craftsmen

1.   INTRODUCTION

Informal training of artisans to acquire the necessary skills to perform specific task on construction site is very important in the Ghanaian construction industry. Informal skill training is common in many construction sectors of developing countries including the Philippines, Indonesia, Egypt, India, Mexico and Brazil. As Livingstone (1999) points out, informal learning can be defined as "any activity involving the pursuit of understanding, knowledge or skill which occurs outside the curricula of educational institutions, or the courses or workshops offered by educational or social agencies." Put it in other words, the category of informal learning includes all learning that occurs outside the curriculum of formal and non-formal educational institutions and programs. Farrell et al (2000) stated that "currently there are two approaches to defining informal sector activity: the definitional and behavioural". According to the definitional approach, 'Informal sector is economic activity unrecorded in the official statistics such as the gross domestic product and /or the national

income accounts' (Farrell et al, 2000). Behavioural approach, on the other hand, maintains that 'informal sector is based on whether or not activity complies with the established judicial, regulatory, and institutional framework (Farrell et al, 2000). It can also be describe as an ad hoc and unsystematic method of learning-on-the-job which is received within the context of day to day production activities. Informal skilling mainly involves learning via observing and doing and is largely confined to initial employment training with limited continuing training and skill upgrading. In the Ghanaian construction sector, much attention has been given to the shortages and inadequacies of skilled personnel. Skilled personnel include construction craftsmen like masons, carpenters, plumbers, electricians, painters and other such tradesmen. Among construction craftsmen, shortages and inadequacies of skills largely reflect the limited number of workers possessing formally certified skills.
Anecdotal evidence gathered by the researcher indicates that the limited formal certification of

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craftsmen in the country may be due to the prevalence of informal training in the construction sector but according to Werquin (2010), due recognition of the informal learning system gives non-formal and informal learning outcome value for further formal learning. In a publication by the ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD), Werquin (2010) further emphasized that recognition plays an important role in a number of countries by providing validation of competences to facilitate entry to further formal learning. This often involves exemption from certain coursework or parts of a formal study programme. He attests that this approach lets people complete formal education more quickly, efficiently and cheaply by not having to enroll in courses for which they have already mastered the content. Allowing people to fast-track through formal education by making the most of their non-formal and informal learning can also create a virtuous circle by making it more attractive for people to engage in self-directed learning.

This study focuses on training needs, learning patterns and the influence of informal trained artisans on the quality of products in the construction industry in Ghana. The purpose is to find out why artisans trained by the informal training system in the construction industry are performing below expectation with the view of providing solutions to help them improve on their performance. Even as it is clear that millions of people in the construction industry in Ghana gain their livelihood through the knowledge they acquire which is not connected to any formal avenue of training, there is therefore the need to improve the system to optimize the performance of these artisans to the required expectations. Webster and Fidler (1996) described the informal sector as "simply shorthand for very small enterprises that use technology modes of production and management". This definition captures the key characteristics of informal system of training, which are usually small in scale but necessarily deficient in other ways. Fluitman (1989) maintains that, the term "informal sector" derives its usefulness according to stances which differ from place to place and in time. Despite the deficiencies that accompany this system of training, Werquin (2010) identified some benefits of the system. He made it clear

that the informal learning outcomes also have potential value on the labour market. He further affirms that if knowledge, skills and competences, irrespective of how they have been acquired, are more visible, market mechanisms may function more effectively. Those offering their professional services would be better placed to gain from their knowledge, know-how and competences if these are endorsed by a quality recognition process in which stakeholders – first and foremost employers – are fully confident.

Better visibility of people's knowledge, skills and competences might also encourage the organisation of formal learning periods as part of employees' continuing training. Training is of course easier to justify and organise if the demand is clear.

1.1   Aim

The aim of this study is to find out some of the challenges in the informal training of artisans in the building construction industry.

1.2   Objectives

The objectives of the study are;

i.   to identify the characteristics of the informal training offered to artisans in the construction industry

ii.   to identify the problems associated with these training

iii. to recommend a means of improvement

2.   METHODOLOGY

2.1   Research Approach

The research used data from both primary and secondary sources as the basis for the research and a descriptive survey and case study approaches. Rubin and Babbie (1997) entreat that the rationale for using the case study approach should be the availability of a special case that seems to merit intensive investigation. They further explained that a case study is conducted of event and its impact as a way of informing similar policy considerations in other areas.

2.2   Population

Considering the lack of extensive data in this area of study and the inability to estimate the exact number of artisans trained through the informal artisan training system,contractors of varying classes under which these artisans work was the basis for the determination of the sample size as they form the largest employers

of these artisans. In all, a total of 120 master artisans and 113 trainee artisans constituted the population of the study from selected construction sites working for various contractors within the Metropolis.

2.3   Sampling and Sampling Procedure

The simple random sampling method was used to obtain the sample size for the study. This method was used because the researcher wanted each respondent to have equal chance in the research work and to aid in a good analysis of the data collected. Prior to this, the respondents were categorized into two group i.e. master artisans and trainee () artisans. This was done in order to obtain views from both the trainees and the trainers. The introduction of this method allowed for effectiveness of the study, and the information gathered were of through reflection of the targeted group.

A sample size of 118 master artisans and 111 apprentices from the total population was determined for the questionnaire survey using the formula proposed by Yamane (1967) as follows: $n = N/1+N (e)^2$, Where N = the total population size; e = the standard error of sampling distribution assumed to be 0.013 and n is the sample size.

2.3   Data Collection

The study used data from field investigations as primary source of data and available

2.5   Data Analysis

The study made use of frequency distribution to present the data collected. The data collected were presented using tabulation.

3.   RESULTS

Results presented are responses from the questionnaire survey. Out of 111 and 118 questionnaires administered for trainee and master artisans respectively, 93 and 102 were retrieved respectively representing 83.80% and 86.44% response rate for each category.

3.1   Response from Trainee (Apprentice) Artisans

Below are the results obtained from the questionnaire survey presented in tables.

literature as secondary source of data on the best possible current understanding of the training needs, patterns of training and the effect of the informal system of artisan training on the quality of housing delivery in Ghana.

The study used observing and interviewing various artisans trained informally (i.e. those who are still undergoing training and their masters as well) so as to identify their depth of knowledge in the construction technology.

2.4   Data Collection Instrument

The following research instruments were adopted by the researcher in collecting relevant data for the research.

• **Observation**

The researcher usedobservation and critically inspected the sites where the research work was carried out. These were aimed at collecting primary data for the research.

• **Questionnaire**

Interview guide (check list), was used for preliminary interview as a basis for developing questionnaires in the language of the people as an instrument for collecting the required data. A closed ended questionnaire was self-administered with thehelp of field assistants to capture all the required data.

Table 3.1   Artisan's field of training

Field of training	Number	Percentage
Carpenter	22	21.57
Mason	46	45.10
Steel bender	34	33.33
TOTAL	102	100

Source: Field survey, 2013

Table 3.2 Trainee Artisans Level of Education

Level of	Number	Percentage
Basic	54	52.94
Secondary	23	22.55
No Education	25	24.51
TOTAL	102	100

Source: Field survey, 2013

Table 3.3 Conditions provided by Master Artisans that makes training conducive

Conditions	Num	%
Good master-apprentice relationship	23	22.55
Dispute resolution method	19	18.63
Occasional tips	43	42.16
Permanent workshop	13	12.74
Others	4	3.92
TOTAL	102	100

Source: Field survey, 2013

Table 3.7 Level of Education

Level of Education	Number	Percentage
Basic	57	61.30
Secondary/Technical	36	38.70
No Education	-	-
TOTAL	93	100

Source: Field survey, 2013

Table 3.4 Task that trainee artisans can undertaken after graduating

Task	No. Yes	Total No		Percentage Yes	No
Read and interpret drawing	26	76	102	25.50	74.50
Set out and work with less supervision	68	34	102	66.67	33.33
Understand the behavior of materials	10	92	102	9.80	90.19

Source: Field survey, 2013

Table 3.5 Respondents' description of the content of training they receive from their masters

Training is	Number	Percentage
Very concise	49	48.04
Too broad in scope	21	20.59
Limited in scope	32	31.37
Not relevant to my ambition	-	-
TOTAL	102	100

Source: Field survey, 2013

3.2   Response from Master Artisans

Table 3.6 Field of specialty

Field of Specialty	Number	Percentage
Carpenter	22	23.66
Mason	43	46.24
Steel bender	28	30.10
TOTAL	93	100

Source: Field survey, 2013

Table 3.8   Mode of Your Training of Artisans

Mode	Number	Percentage
Theory	-	-
On the job/Practical	63	67.74
All the above	33	32.26
TOTAL	93	100

Source: Field survey, 2013

Table 3.9   Mode of Acquiring Additional Knowledge

Mode	Numbe	Percentage
Experimentation (trial/error)	63	67.74
Consult other master	18	19.35
Consult Technical document	7	7.53
Consult experts	5	5.38
TOTAL	93	100

Source: Field survey, 2013

The results of the study also revealed that 82% of the respondents (i.e. master artisans) will opt for further training should they have the opportunity while 18% will not want any further training. Also 67% of the respondent said they are ready to pay for the training if asked to while 33% will want sponsorship for further training.

4. DISCUSSIONS

4.1 Characteristics and Learning Needs of Master Artisans in Ghana

Master artisans in the informal sector were generally quite poor and technically deprived. The sector's poverty is evident in the condition of infrastructure, materials and equipment, as well as in the quality of products and services offered. Low levels of education was a predominant observation, which was evident in the fact that the highest level of education attained from the field studies is the Secondary/Technical level of which only 38.70% of the respondents had attained.

Estimates of training needs also differ sharply between observers (trained artisans) and master artisans themselves.While most informal sector artisans are able to explain what they need to do, they are much less articulate about what they need to know in order to get such things done effectively. Their actions thus appear to be dictated by a combination of routine repetition and trial-and-error rather than by any conceptual mastery of the profession.Among master artisans, this situation appears to be due in part to the urgency of those material concerns and in part to the fact that these informal craftsmen themselves learned their trade through repetitive practice and never had occasion to study or evaluate what they did. As a consequence, technical training" is really not covered in the spectrum for the analysis of their situation.

As consequence, the attitude of informal master artisans seems a bit uncertain, on the one hand, when questioned about their interest in undergoing further training, they avow that it is a need (82% desiring additional training, while opting for short-duration varieties), and 67% even expressed a willingness to pay for good quality offerings. On the other hand, when training is ranked alongside other pressing business needs, training comes out dead last in this inventory.

Since training for these artisans is a topic of interest to this study, the questions designed sought to identify areas of technical weakness and training need. Specifically, the study observed the different actions, techniques, tools, equipment and products associated with each trade to derive a more adequate list of the skills, knowledge and attitude necessary for mastery of each trade. The result was an illustrative enumeration of what should be mastered for exemplary vocational performance, without specific reference to specific trade. The most prominent derived needs identified are as follows:

- Fundamental materials theory
- Elements of basic design
- Knowledge of the range of properties of materials and other inputs
- Organization of production operations

These circumstances, makes it a hindrance to master artisans to go about learning and upgrading their skills.

And in regards to the kind of "professional development" they ensure for themselves, the most common approach for professional advancement and learning that was observed is the use of trial-and-error method. Nevertheless, the discussion of professional development for entrepreneurs is seen in the next section on their priority need.

The master artisans were asked specifically about what they do to improve their professional knowledge. Their response, reported in Table 3.9 reveal partially for trial and error methods, but also a willingness to consult others and occasional technical documents. The modalities of learning seem to be ranked as much by accessibility for a busy and resource-strapped person as by anything else.

4.2 Characteristics and Learning Needs of Artisans under Training

The field studies also provided information on characteristics and learning needs of apprentices undergoing training in the informal sector in the construction industry. Apprentices in the informal sector in Ghana are generally young people with an average of 16.5 years at the start of their ship and most of who are male.Levels of educational attainment among apprentices in the informal sector in Ghana are quite diverse. While the studied found that a plurality of apprentices (about 52.94%) reported having had basic education, the next group (about 22.55%) had received some secondary education with the rest (24.51%) not having any education at all.

Table 4.1   Characteristics of Apprentices in the Informal Sector

Relationship to master artisan	Percentage
Family relation (nuclear)	35
Other familial	47.5
Friend of family	5.83
No previous relationship	11.67

Source: Field survey, 2013

Many apprentices spend a relatively extended time completing their apprenticeship and this is due to the fact that after graduation they find nothing doing immediately and hence returns to assist their master whiles acquiring additional skills they could not attain during their stipulated time of training. Overall, the apprentices seemed to put much more importance on training needs than did their masters. In addition, they wanted government regulation of apprenticeships. Training with another master craftsman is a way of complementingor broadening apprenticeship experience, a majority of masters questioned never encourage apprentices as an enslaved approach where master artisans usually train the way they themselves were trained, in a manner largely closed off from outside influences. Also, asindicated above, the study revealed that most of the apprentices have a family or a familial relationship with their masters. This couldcontribute to factors that extend the completion time of training of most artisans

Table 4.2   Some specific artisans in the building construction industry and their requirements

Requirement	Artisan		
	Mason	Carpenter	Steel bender
Education	This is not a major requirement for admission into the trade. Most of the artisans spoken to had little or no education at all	This is not a major requirement for admission into the trade. Most of the artisans spoken to had little or no education at all.	This was of major importance to master artisans since most of the work they did involved reading of drawings and transferring them into the work. However it was realized that most artisans spoken to had no advanced education, the highest level being the secondary level.
Age	Most artisans interviewed range between the ages of 15 and 20. However master artisans were of the opinion that age was not a hindrance since some apprentice artisans enter the trade at very tender ages	Most artisans talked to range between the ages of 15 and 20, age was of importance here since the trade involved a lot of risks such as climbing, lifting up timber members and in most cases involved taking matured decision.	Most artisans talked to range between the ages of 14 and 20, age was however not as important a consideration as education.

Tools Needed	These included; trowel, float board, spirit level, concrete hammer, line, builders' square and these were pre-requisites for admission.	These included; saw, pencil, spirit level, tape measure, hammer, line and builders' square which were all pre-requisites for admission.	These included; cutter, hacksaw frames and blades, tape measure, hammer, and line, which were all pre-requisites for admission.
Duration of training	This had the shortest overall duration which was attributed to the ease of learning the trade.	This had the longest overall duration which was attributed to the complexity of the trade, the minimum duration recorded been 3 years.	This also had a longer duration which was attributed to the complexity of the trade; the minimum duration recorded was 3 years.
Mode of acquiring skills	Mostly carried out through the following means; apprentice observe master carrying out tasks, imitating the task, repetition of the task, master aids apprentice in time of difficulty. Mostly involves on-the-job training only.	Mostly carried out through the following means; apprentice observe master carrying out tasks, master explains task to apprentice mostly using drawings, apprentice imitating the task, repetition of the task, master aids apprentice in time of difficulty	Mostly carried out through the following means; apprentice is taken through interpretation of drawings, apprentice observe master carrying out tasks, master explains task to apprentice mostly using drawings, apprentice imitating the task, repetition of the task, master aids apprentice in time of difficulty.

5.   CONCLUSION

The provision of training in the informal system in Ghana appears to be cut off from outside influences, whether it is complementary training or new techniques in construction. This depiction seems to be equally applicable to the training of apprentices under the traditional system and to the professional development of practicing master artisans: and it may also describe the exchange of information and know-how among members and within the sector. The obvious result of this sectoral close-mindedness (whether imposed or voluntary) is the promotion of a technical conservatism, pushing the system toward an endemic technological inactivity.

There seems to be little external motivation or capability for the system's trainees to progress in performance or in improving their methods. There seem, however, to be a growing recognition of the detrimental effects of these attitudes due to the efforts of government. As noted above, the apprenticeship system in Ghana is dominated by a hands-on practical approach, preferred by the master artisans who generally claim full responsibility for

training and were trained in the same way. The repetitive and still nature of this kind of training has been noted, as well as the lack of experiential methods emphasizing discovery and experimentation results. The rarity of outside, complementary training and the basic strategy of observation and imitation likely will translate into adisinterest and/or inability to learn or innovate in the workplace.

To improve the institution of apprenticeships and the technical capacity of informal sector businesses, this study envisages a stronger role

for the government, which includes the following;

- encouraging private organizations to launch initiatives in technical and professional training;
- encouraging master artisans to organize themselves, by trade or profession, into unions or association;
- sponsoring new regulations in conjunction with existing trade unions or associations to evaluate the current traditional apprenticeship system, especially in the areas of:
  - Duration of apprenticeships and working conditions of apprenticeship
  - Upgrading apprenticeship training curricula, with the possibility of master artisans granting certificates on completion.
  - Support for professional training centres to take organized groups or unions of artisans through refresher courses occasionally.

There is thus the call for government to get involved in informal sector training in order to help eliminate the occasional abuse of workers and trainees that sometimes arises, as well as the possible institution of government regulations as to the duration of apprenticeship, its training content and modes, remuneration among others.

Finally, there are several initiatives to improve training for individual in the informal sector as a way to improve the performance of the sector.

One way of improving the performance of informally trained artisans would be to continue to provide assistance to the system's participants, as well as to related trade associations and the government in the assessment and modeling of particular training needs. This assistance should continue to address the familiar issues such as specific skills, abilities, knowledge and technological know-how required in the specific trade and on individual levels.

Another way of improving the informal artisan training system would be to bring some manner of formal guidance and support to the delivery of apprenticeship training. This approach would introduce the idea that training in the informal system should follow a commonly accepted set of skills, knowledge and overall capabilities. This regulation of training might include:

- o Basic training content and methods to be employed by the master artisans
- o Materials and equipment with which apprentices must learn to work with
- o The range of products, services and other skills that should be mastered by an apprentice at the end of the stipulated time of apprenticeship

This could be documented and serve as a criteria by which to confirm that an apprentice has completed training. This document could also include norms or rules related to the duration of training, the certification of a master artisan to provide the authorized training, the official certification of a completed apprenticeship.

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