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Book.(1) Sambrook, J., Fritsch, E.F. and Maniatis, T. (1989). Molecular cloning: A Laboratory Manual (2nd ed), Cold Spring Harbour Laboratory Press, New York (pp.102-115). (2) Mettam, G.R and Adams, L.B (2009). How to prepare an electronic version of your article. In Jones, B.S. and Smith, R.Z. (Eds.), *Introduction to the electronic age,* E-Publishing Inc., New York (pp. 281-304).

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CONTENTS

CONTENTS

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STATISTICAL MODELING THE IMPACT OF SYSTOLIC AND DIASTOLIC READINGS IN RELATION TO THE MEASUREMENT OF BLOOD PRESSURE (BP).

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ABSTRACT

This study investigated the effect and the level of contributing factors of high blood pressure (HBP). A total of ninety (90) staff from three different Schools within Auchi Polytechnic were interviewed and their blood pressure (BP) was measured with a digital sphygmomanometer.

A multiple regression and analysis of covariance (ACOVA) was adopted to examine the significant effect of Body Mass Index (BMI), Age, Smoking habit and Drinking habit on Systolic and Diastolic respectively. And the analysis revealed that among the factors considered by Systolic measure of BP; BMI, and Age were statistically significant but smoking and drinking were not significant but are contributing factors. Again, by Diastolic measure of BP, the BMI was also significant but age, smoking and drinking were not significant. The researcher therefore, recommend that priority should be given to Systolic measure of BP as it captions a better reading of BP when the heart contracts. And daily caution should be taken over our weight as BMI was very significant in both respects.

Keywords: Systolic, Diastolic, Blood pressure, Body mass index (BMI), Smoking habit.

1.0 INTRODUCTION

High blood pressure (HPB) occurs when one's blood move through the arteries at a higher speed than normal. The instrument use for measuring HBP is sphygmomanometer. But the measurement and reading of HBP is being explained by systolic and diastolic readings from this instrument. From the digital sphygmomanometer, the first reading represent the Systolic reading when the heart contracted and the second reading represent the Diastolic when the heart seems relaxed. It is also known that for now there is no permanent cure for high blood pressure when it develops, (Papadakis & Maxine, 2008). However, the situation can be effectively managed with good medical attention and proper clinical follow-up.

High blood pressure (BP) is a major health issue in both developing and developed countries. It is sometime asymptomatic, common, symptomless and easily preventable if detected early, but despite advances in medical sciences, its hazardous mechanism is still unknown. If untreated, this chronic disease may result in fatal complications (Nitenberg, 2006).

High blood pressure can lead to hypertension, which is a major risk factor for overall mortality on the global scale. About 1 of 3 United States (US) adults, estimated as 68 million, have high blood pressure, which increases the risk for heart disease and stroke, leading causes of death in the US (Minino, 2011)

Studies have showed the association of various factors like obesity, age, gender, marital status, quality of married life, Drinking' smoking and being exposed to cigarette smoke, loud noise at the work place, workload, stress, diet and physical activity, and shift work, with blood pressure (Suwazono, 2008). Essentially, there are two major types of hypertension: (primary) hypertension is the most prevalent hypertension type. Although no direct cause has identified itself, there are many factors such as sedentary lifestyle, stress, visceral obesity, potassium deficiency (hypokalemia), obesity (more than 85% of cases occur in those with a body mass index greater than 25), salt (sodium) sensitivity, alcohol intake and vitamin D deficiency that increase the risk of developing hypertension. Risk also increases with aging, some inherited genetic mutation and having a family history of hypertension. Insulins resistance which is a component of syndrome X on the metabolic syndrome is also thought to contribute to hypertension (Zengc Villar, 2009). Consuming food that contains high fructose, corn syrup may increase one's risk of developing hypertension. (Jetta & Landry, 2009). Recent studies have equally implicated low birth weight as a risk factor for adult essential hypertension (Mori & Burke ,2007).

On the other hand the secondary hypertension includes kidney disease, obesity (metabolic disorder), pre-eclampsia during pregnancy, the congenital defect known as coarctation of the aorta, and certain prescription and illegal drugs (Singer & Kite, 2008).

The number of people with high blood pressure is on the increase and research has shown that this condition is heightened by BMI, age, smoking, drinking, and some others (Mori, 2007). There is a symbolic relationship between those risk factors and being hypertensive or having high blood pressure. It is in the interest of people who are likely to develop high blood pressure (over-weight people) to seek out ways of managing their weight, as this research work will try to bring out the effects of weight of such people with high blood pressure.

2.0 LITERATURE REVIEW

Hypertension (HTN) or high blood pressure (HBP) is a chronic medical condition in which the blood pressure in the arteries is elevated. It is classified as either primary (essential) or secondary. About 90-95% of the cases are termed "primary hypertension" which refers to high blood pressure for which no permanent medical cure can be found. The remaining 5-10% of cases (secondary hypertension) are caused by another conditions that affect the kidneys, arteries, heart or endocrine system (Mulatero, Bertello, 2009). Persistence hypertension is one of the risk factors for stroke, heart attacks, heart failure and arterial aneurysm and is a leading cause of chronic kidney failure. Moderate elevation of arterial blood pressure leads to short life. Both dietary and lifestyle changes as well as medicines can improve blood pressure control and decrease the risk of associated health complications (Sacks, Svetkey ,2008).

Over-weight here will be described or rather defined based on a calculation called "Body mass index" (BMI). According to this formula, one is regarded as over-weight if his BMI is greater than 25.Mancia G. (2007). It is the duty of health personnel to warn and educate adults who are more prone to high blood pressure, about the dangers of over-weight in the management of high blood pressure. This awareness is expected to affect the feeding habit of these people, since it has been observed that poor feeding (that is, poor combination of the classes of food, not necessarily the quantity) is one of the causes of over-weight.(Sacks, 2008).

Statistics has it that between the years 2000 and 2008, there has been about fourty percent (40%) increase in the number of people having high blood pressure. (Manson, 2009). Another statistics show that in 2005, sixty percent (60%) of people suffering from high blood pressure were suffering also from kidney failure and heart disease, and that high blood pressure was identified as the remote cause of the disease that later led to the death of a greater percentage of the patients (Manson, 2009).

According to recent World Health Organization (WHO) estimates, the prevalence of HBP in adults (≥25 years) is 29.2% of males and 24.8% of females leading to worldwide prevalence of hypertension estimated at more than 1 billion individuals. About 54% of strokes and 47% of coronary heart disease worldwide are attributable to HBP, which is also a risk factor for heart failure, diabetes, chronic kidney disease, cognitive decline and other diseases. Overall, about 80% of the HBP-related burden of disease occurs in low-income and middle-income countries, where the prevalence of hypertension has been rising and rates of awareness, treatment and control are lower than in developed countries.

2.1 MEASUREMENT OF BLOOD PRESSURE

Physicians use two measurements to describe blood pressure, systolic pressure measures blood pressure as the heart contracts to pump out blood. Diastolic pressure measures blood pressure as the heart relaxes to allow blood to flow into the heart. An instrument called a sphygmomanometer measures systolic and diastolic pressure using units of millimeter of mercury (mmHg). The Blood pressure is classified into four categories; Hypotension, normal, pre-hypertension, stage one hypertension. The normal blood pressure in an adult is 120/80mmHg. Other types of hypertension can be distinguished by the systolic and diastolic readings of the sphygmomanometer.

Hypotension (low blood pressure)
Normal
Systolic mmHg 90 or less
Systolic mmHg 99 - 119 and
Diastolic mmHg 60 or less
Diastolic mmHg 60 - 79

Prehypertension
Stage 1 Hypertension
Systolic mmHg 120-139, or
Systolic mmHg 140-159, or
Diastolic mmHg 80 - 89
Diastolic mmHg 90 -99

If the hypertension is not treated or controlled the excessive pressure on the artery walls can lead to damage of the blood vessels (cardiovascular disease), as well as vital organs. The extent of damage depends on two factors; the severity of the hypertension and how long it goes on for untreated.

In trying to study the effect of weight on high blood pressure, the Body Mass Index (BMI) is a useful tool to estimate a healthy body weight based on the height. The BMI can inform individual to know if underweight, Normal, overweight or Obese etc. However, it not appropriate to use this as the only or final indication for diagnosis. The table below represents (WHO) recommended body weight based on BMI values for adults.

Category	BMI Range - kg / m^2
Severe Thinness	< 16
Moderate Thinness	16 - 17

Mild Thinness	17-18.5
Normal	18.5-25
Over Weight	25 – 30
Obese class 1	30 – 35
Obese class 11	35 – 40
Obese Class 111	40 >

Sources : World Health Organization (WHO)

Much discussion and review had been carried out on the causes, effect and contributing factors of HBP. However, effort would be made to examine the influence of weight, age, smoking and drinking on blood pressure among staff of Auchi Polytechnic.

3.0 AIM AND OBJECTIVE OF THE STUDY. The aim of this study is to examine the contributing effect of factors of Blood pressure. This is achieved based on these specific objectives:

(i) To investigate the most significant contributing factors of HBP among staff of the Polytechnic.

(ii) To investigate any positive relationship between high blood pressure and factors under Consideration among Auchi Polytechnic staff.

(iii) To deeply investigate the contributing effect of BMI on Blood pressure among Auchi Polytechnic staff.

(iv) To make adequate recommendations for the society in the light of the analysis.

4.0 HYPOTHESIS

H_0 : The contributing factors of HBP among staff of the Polytechnic are not Significant .

H_0: There is no relationship between high blood pressure and factors under consideration among Auchi Polytechnic staff .

H_0: The contributing effect of BMI on Blood pressure among the Polytechnic staff is not significant.

5.0 METHODOLOGY / PROCEDURAL PERSPECTIVE

The data used for this study is primary data. The work of three different practical groups were actually brought to bear in this research work. Each of the three practical teams interacted with at least 30- staff (Teaching and Non-teaching staff) from three different schools within the Polytechnic. Their BP were taken by an appropriate instrument and pertinent questions were asked regarding their smoking and drinking habit .And all this information were documented on a well design forms for the practical work. It is the entire obtained data that constitute the base for this studies.

Thus, a working sample size of 90 was taken and used for this research. A multiple regression model and analysis of covariance (ACOVA) Model was adopted to analyse the obtained primary data. The systolic and diastolic are both measurement for reading the BP. Both will be separately use as dependent variable on the other independent variables: BMI, Age, Smoking , and drinking. This is to determine the level of their

contributions and significance to both systolic and diastolic. And SPSS will be employed to run the program of analysis.

5.1 MODEL SPECIFICATION

The econometric form of the multiple regression model that includes the error term is expressed as:

SYSTONIC $= \beta_1 + \beta_2$BMI$+ \beta_3$Age $+\beta_4$Smoking $+\beta_5$Drinking $+ \mu$ ……...(1)

DIASTONIC $= \beta_1 + \beta_2$BMI$+ \beta_3$Age $+\beta_4$Smoking $+\beta_5$Drinking $+ \mu$ …….. (2)

Where: μ is the error term. The parameters for estimation are $\beta_2, \beta_3, \beta_4, \beta_5$.

And,

$$\text{Smoking} = \begin{cases} 1 & \text{if response is yes.} \\ 0 & \text{if response is no.} \end{cases}$$

$$\text{Drinking} = \begin{cases} 1 & \text{if response is yes.} \\ 0 & \text{if response is no.} \end{cases}$$

6.0 DATA PRESENTATIONS

Table 1: The table below depicts the responses and measurement of Blood Pressure of Ninety (90) Polytechnic Staff.

S/N	SYSTONIC (Y)	BMI X1	AGE X2	SMOKING X3	DRINKING X4	DIASTONIC (Y)
1	114	24.21	38	0	1	66
2	125	26.82	68	1	1	97
3	140	25.02	35	1	1	97
4	99	21.26	53	0	1	84
5	102	20.56	41	0	0	79
6	141	26.53	58	0	0	85
7	89	15	32	0	0	55
8	146	31.92	58	0	0	87
9	96	23.12	41	0	0	68
10	128	30.92	68	0	0	54
11	160	31.1	60	0	0	103

12	101	45.01	38	0	0	82
13	188	25.81	57	0	0	76
14	188	25.81	70	0	0	76
15	128	30.85	32	0	0	85
16	131	31.92	60	0	1	82
17	89	15	61	0	1	55
18	124	26.53	45	1	1	54
19	102	20.56	29	0	0	79
20	128	30.85	68	0	0	85
21	96	23.12	33	0	0	68
22	131	31.92	62	0	0	82
23	89	15.63	46	0	0	55
24	124	26.53	51	0	0	54
25	103	20.56	34	0	0	79
26	99	21.26	67	0	0	84
27	140	25.02	59	0	0	97
28	125	26.82	39	0	0	97
29	114	24.21	58	0	0	66
30	154	31.1	68	0	0	59
31	140	25.05	58	0	0	97
32	99	21.26	41	0	0	84
33	102	20.56	53	0	0	79
34	141	26.53	38	0	0	85
35	89	15	57	0	0	55
36	146	31.92	70	1	1	87
37	96	23.12	40	0	0	68
38	128	30.85	61	0	1	85

39	124	15.63	60	0	0	54
40	160	31.1	61	0	0	103
41	101	24.75	70	0	0	82
42	125	26.82	32	0	0	97
43	114	24.21	30	0	0	66
44	160	31.1	69	0	0	103
45	126	28.32	45	0	0	89
46	101	45.01	41	0	0	82
47	188	25.81	53	0	0	76
48	128	30.85	38	1	1	85
49	96	23.12	57	0	1	68
50	131	31.92	45	0	1	82
51	89	15	27	0	0	55
52	124	26.53	33	1	0	54
53	102	20.56	50	0	0	79
54	99	21.26	26	0	0	84
55	140	25.02	50	0	0	97
56	125	26.82	55	0	1	66
57	114	24.21	60	0	1	103
58	160	31.1	68	0	0	89
59	126	28	50	0	0	82
60	101	24.75	61	0	0	82
61	128	30.85	45	0	0	85
62	96	23.12	41	0	0	68
63	131	31.92	53	0	0	82
64	89	15	38	0	0	55
65	124	26.53	57	0	0	54

66	102	20.56	45	0	0	79
67	99	21.26	45	0	0	84
68	140	25.02	27	0	1	97
69	125	26.82	33	0	0	97
70	114	24.21	58	0	0	66
71	160	31.1	42	0	0	103
72	126	28.32	45	0	0	189
73	101	14.98	54	0	0	82
74	188	25.81	59	0	0	76
75	179	29.5	48	0	0	97
76	119	33.19	52	0	0	84
77	138	40	49	0	1	87
78	168	24.04	49	0	1	107
79	119	27.52	41	1	0	94
80	129	29.75	34	0	1	84
81	137	24.08	59	0	1	99
82	129	23.12	61	0	1	84
83	179	31.92	70	0	1	97
84	140	21.26	59	0	0	97
85	137	25.81	50	0	0	99
86	168	25.02	49	1	1	107
87	179	29.5	52	0	1	97
88	101	24.75	60	0	0	82
89	160	31.1	61	0	0	103
90	124	15.63	70	1	0	54

SOURCES: Field Survey, 2019.

6.1 DATA ALNAYSIS

The Systolic being the depended variable will be regress on the independent variables: BMI, Age, smoking, drinking. The Diastolic, the bottom number that is use to measure BP will equally be use as a dependent variable against the independent variables. This is to examine the degree of contributions of BMI, Age, smoking and drinking to Systolic and Diastolic as it prone to BP.

Table 1: Dependent Variable: (systolic) against independents

(Drinking, Age, BMI, Smoking)

Model Summary[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.535[a]	.286	.252	22.883

a. Predictors: (Constant), Drinking, Age, BMI, Smoking

b. Dependent Variable: systolic

Model Summary[b]

Model	Change Statistics					
	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.286	8.510	4	85	.000	2.160

b. Dependent Variable: Systolic

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	17825.010	4	4456.253	8.510	.000[a]
	Residual	44507.612	85	523.619		
	Total	62332.622	89			

a. Predictors: (Constant), Drinking, Age, BMI, Smoking

b. Dependent Variable: Systolic

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	46.747	14.128		3.309	.001
	BMI	1.746	.420	.386	4.155	.000*
	Age	.661	.200	.305	3.298	.001*
	Smoking	5.603	8.477	.064	.661	.510
	Drinking	3.044	5.882	.050	.517	.606

a. Dependent Variable: Systolic

*Significant at 1% level.

From the above tables under table 1, which is the regression result of SYSTOLIC against Drinking, Age, BMI, Smoking, it indicates that the R^2 value is 0.29 and the adjusted R^2 is 0.25 meaning that 29% and 25 % variation of SYSTOLIC is explained by the effect of blood pressure, subject to the factors under review .The 'F' value is 8.51 which is a test of the appropriateness of the model and with a 'P' value of 0.000 .It means that Systolic can be used to measure the blood pressure of the body system. The coefficient of the independent variables revealed that they are positive, that is a direct contributing factors of blood pressure. Testing for the statistical significance of this estimate, the BMI and age has a "p" value of 0.000 and 0.001 respectively .It means that they are statistically significant (a strong contributing factors). But the smoking and drinking are not statistically significant but they are statistically contributing factors due to the positive relationship with the systolic.

Table 2: Dependent Variable: (Diastolic) against independents

(Drinking, Age, BMI, Smoking)

Model Summary[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.356[a]	.127	.086	18.162

a. Predictors: (Constant), Drinking, Age, BMI, Smoking

b. Depended variable : Diastolic

Model Summary[b]

Model	Change Statistics					
	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.127	3.084	4	85	.020	1.636

b. Dependent Variable: Diastolic

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	4068.480	4	1017.120	3.084	.020[a]
	Residual	28037.309	85	329.851		
	Total	32105.789	89			

a. Predictors: (Constant), Drinking, Age, BMI, Smoking

b. Dependent Variable: Diastolic

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	54.102	11.213		4.825	.000
	BMI	1.097	.333	.338	3.291	.001*
	Age	-.019	.159	-.012	-.121	.904
	Smoking	-3.372	6.728	-.054	-.501	.618
	Drinking	3.710	4.668	.086	.795	.429

a. Dependent Variable: Diastolic

*Significant at 1% level.

From the above tables under table 2, which is the regression result of DIASTONIC against Drinking, Age, BMI, Smoking, it indicates that the R^2 value is 0.127 and the adjusted R^2 is 0.086 meaning that 12% and 8.6 % variation of DIASTONIC is explained by the effect of blood pressure, subject to the factors under review .The 'F' value is 3.084 which is a test of the appropriateness of the model and with a 'P' value of 0.020 .It means that diastolic can be used to measure the blood pressure of the body system. The coefficient of the independent variables revealed that the BMI and drinking are positive, that is a direct contributing factors of blood pressure. But the age and smoking are negative that is inversely contributing factors of blood pressure. And testing for the statistical significance of this estimate, only the BMI is significant with a "p" value of 0.001. Drinking is a contributing factor due to the positive relationship with the diastolic but not statistically significant. Age and smoking are not significant with the diastolic.

7.0 CONCLUSION

The systolic and diastolic were both used for reading the blood pressure (BP) . From the study and analysis carried out it was observed that BMI is a strong risk factor of HBP among staff of the Polytechnic. This may result from lack of aerobic exercise , good balance diet, eating habit etc. It was also seen that age is another strong factor observed from the systolic reading of (BP) which indicated that the older you are, the more you are prone to HBP. However, smoking and drinking are not statistically significant to systolic and diastolic BP, but contributed positively to systolic. This shows that smoking and drinking among the staff is equally on the increase. The impact of Diastolic in measuring BP is lower than that of Systolic in measuring BP. This was better explained by the R^2 and (Adj) R^2 as showed from both analysis. Hence, the systolic effect is generally given more priority in the measurement of BP. Again, this was also revealed from the instrument used in measuring the BP of some selected staff within the Polytechnic. The first value is always the higher

value from the reading of the instrument used hence, Systolic is often given a higher priority in measuring the BP.

8.0 RECOMMENDATIONS

As a result of the above findings in this research work, the following are recommended:

(i) Regular check –up is advised to every adult as early detection of any ailment is

an advantage

(ii) The staff should engage themselves in regular aerobic exercise. That is, walking or running

for about 20 to 30 minutes most days of the week.

(iii) Stakeholders in health sectors must take it upon themselves to keep the adult folks aware of

the implication of over-weight by providing them with accurate, timely and up to date

information regarding this health conditions.

(iv) They should watch and control their food intake by eating more fruits, vegetables, food that

contain more fiber and vitamin D, eating more fish and avoid much alcohol intake and

smoking habit.

(v) Avoid undue stress and too much work load and one should ensure he lives happily with people around him.

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EFFECT OF CONCENTRATION OF INITIATOR ON THE GRAFT COPOLYMERIZATION OF VINYL ACETATE ON STARCH

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ABSTRACT

The graft copolymerization of vinyl acetate onto starch was carried out at 70^0C in a water bath (Philip harris) using benzoyl peroxide as the initiator. A varying concentration (0.02 - 0.14M) of benzoyl peroxide was used at a constant monomer concentration to determine its effect on the grafting percentage and grafting efficiency. It was observed that the graft yield increased on increasing initiator concentration and reached a maximum graft yield value of 0.06M while a gradual decrease in graft yield occurs at higher initiator concentration.

Keywords: grafting, starch, vinyl acetate, benzoyl peroxide, copolymerization.

Introduction

One trend in modern day is to effect gradual replacement of natural materials with either all synthetic materials or modified natural materials, Bhattacharrya and Misra (2004). Grafting is one polymer modification technique in which a polymer is linked to the backbone of a parent polymer by chemical linkages, (Samaha *et al.,* 2004). Graft copolymerization is a commonly used method for the modification of surfaces of polymers and it is important too in order to modify the physical or chemical properties of polymers. During grafting, the side chains are covalently bonded to the main polymer backbone or substrate to form a copolymer with branched structure. Graft copolymers have many different and useful properties different from those which each has alone. Grafting methods can be classified mainly according to grafting medium and the type of initiation mechanisms, (Kalia and Sabaa, 2013).

Starch is a carbohydrate consisting of large number of glucose unit joined together by glucosidic bonds. In its pure state it is white, tasteless and odourless powder that is insoluble in cold water or alcohol. Starch is a natural raw material (polymer) characterized by low cost and biodegradability. The native form of starch exists in relatively inert granular structure, which are composed of macromolecules arranged in a polycrystalline state. Chemical modification of starch via graft copolymerization constitutes a powerful means of improving the starch properties such as absorbency, ion exchange capabilities, elasticity, thermal resistance and resistance to microbiological attacks. The most common method to synthesize starch graft copolymers is through the formation of active sites such as free radicals or ions at certain position on the backbone polymer molecule, (Starch https://en.wikipedia.org/wiki/starch).

A number of free radicals initiating systems has been used to prepare graft copolymer including benzoyl peroxide and ceric ion. In this work, benzoyl peroxide was used in varying concentrations to initiate the system. (Bhawaningrum, 2012).

Materials and Methods

Starch from cassava was obtained from Jattu market, Etsako West L.G.A Edo State. Vinyl acetate (Sigma-Aldrich Co), benzoyl peroxide (BDH Ltd), acetic acid (BDH Ltd), methanol(BDH Ltd)were used without further purification.

Grafting process

2g of Starch was dispersed in 100ml of deionized water in a 250ml beaker. A known amount of benzoyl peroxide (0.02M, 0.04M, 0.06M, 0.08M, 0.10M, 0.12M, 0.14M) was added to the starch slurry and allowed to interact for 30 minutes in a water bath (Philip haris) at a temperature of 70^0C. The vinyl acetate monomer was added in a drop-wise manner. The polymerization reaction was allowed to progress and stirring slowly for 2 hours. The reaction was terminated by the addition of 2ml of hydroquinone solution (10mg/ml) to the reaction mixture. The mixture was filtered and the residue was air dried and weighed. The ungrafted poly (vinyl acetate) homopolymer was removed by extraction with acetic acid and water, the residue obtained was air dried and weighed, (Egharevba *et al*)

The percentage graft level (Pg) is the weight of the grafted polymer divided by the weight of the starch multiplied by 100 (8).

$$\% \quad Pg = \frac{W_1}{W_0} \times 100$$

Where W_0 is the weight of the starch and W_1 is the weight of the grafted polymer.

The grafting efficiency is the weight of grafted polymer divided by the weight of the grafted polymer and homopolymer multiplied by 100.

$$= \frac{W_1}{W_1 + W_2} \times 100$$

Where W_2 is weight of the homopolymer formed.

Results

TABLE 1: Effect of Benzoyl peroxide concentrations variation on graft level and grafting efficiency

INITIATOR(Benzoyl Peroxide) M	% GRAFT LEVEL	GRAFTING EFFICIENCY %
0.02	115.50	59.38
0.04	121.50	63.61
0.06	126.50	67.28
0.08	125.50	67.10
0.10	124.50	67.29

0.12	118.00	63.95
0.14	112.00	60.54

Percentage graft level (Pg): The highest graft level was achieved at 0.06M concentration of benzoyl peroxide. It was observed that benzoyl peroxide was capable of forming active sites on the base polymer (Starch), and that the number of active sites created on the starch backbone is dependent on the initiator concentration. The percentage graft level increased with increasing initiator concentration to a concentration that further increase resulted in decrease in the percentage graft levels. This is shown in figure 1.

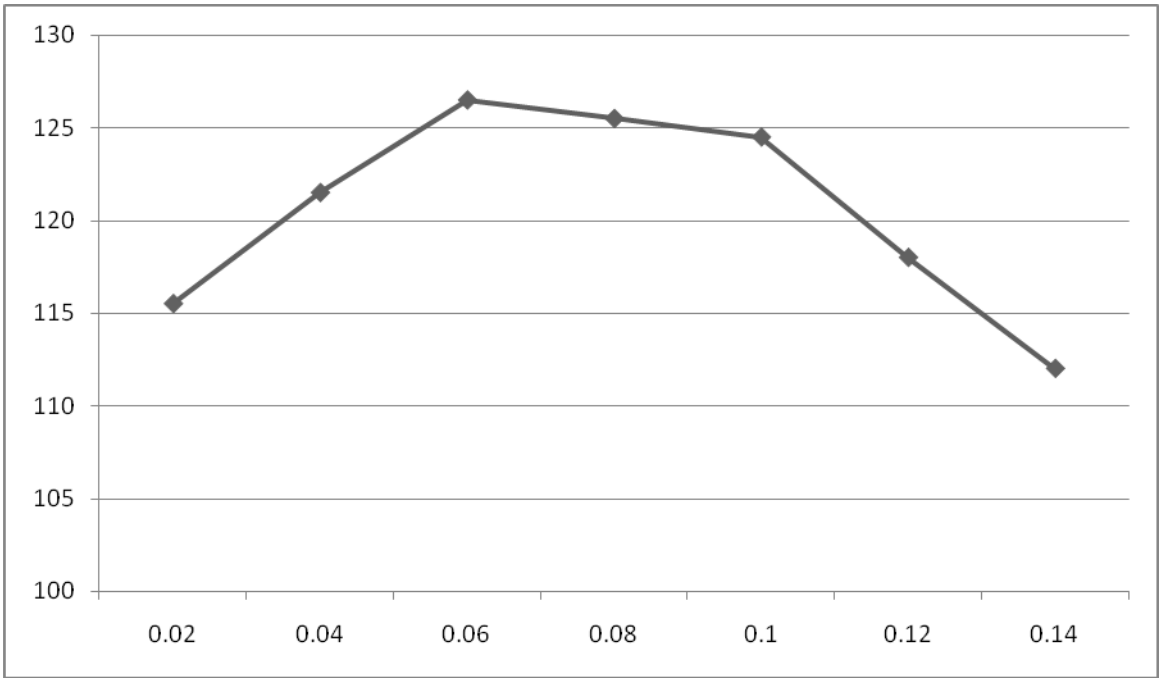

Figure 1: Effect of benzoyl peroxide concentration on % graft level.

Grafting efficiency percentage (Pe): Maximum percentage grafting efficiency (67.29%) was attained at 0.10M benzoyl peroxide concentration. It was observed that initiator concentration had effect on the grafting efficiency. The concentration of initiator has a decisive effect on grafting. With increasing initiator concentration up to 0.10M the graft efficiency increases and thereafter decreases. This is evident in figure 2.

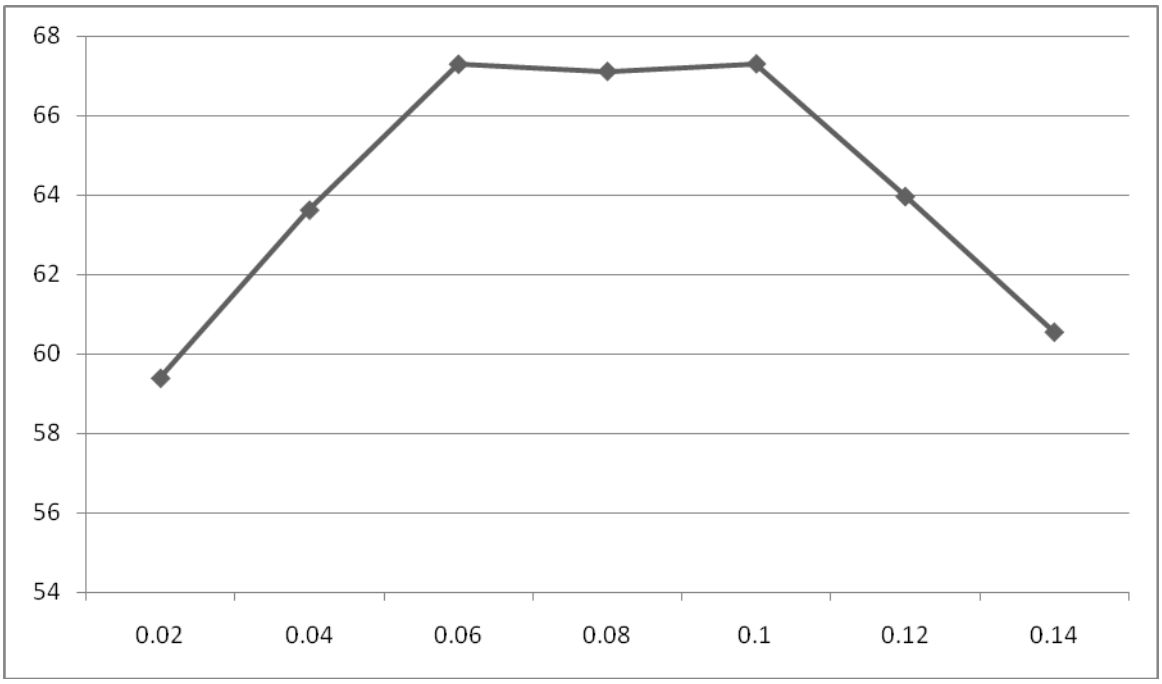

Figure 2: Effect of benzoyl peroxide concentration on efficiency of grafting.

Discussion

As observed by Suzana Djordjevic *et al*, 2012 when they compared various initiators in the graft copolymerization of acrylic acid onto potato starch, we also found out that benzoyl peroxide in the appropriate concentration successfully initiated the graft copolymerization of vinyl acetate on starch. A concentration of 0.06M of benzoyl peroxide gave the highest level of graft and 0.10M of benzoyl peroxide gave a grafting efficiency of 67.29% in the vinyl acetate-starch copolymer.

Conclusion

It's important to modify the physical and or chemical properties of polymers and this has been made possible as seen in this research work. The use of ceric ion as initiator has been common in the grafting of vinyl monomers, in this work we have been able to establish that benzoyl peroxide could initiate grafting of vinyl acetate onto starch. The increase of the graft yield with increasing initiator concentration could be ascribed to the increase of active sites on the starch macromolecules. However, the increase of benzoyl peroxide concentration above 0.1M makes the radical concentration excessive in the medium, causing the rate of termination reactions to increase and allows the homopolymer to become predominant

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EFFECT OF SOLUTE Mg ON DISLOCATION DYNAMICS DURING NANOINDENTATION OF Al-Mg THIN FILMS

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ABSTRACT
The observation of the plastic deformation introduced by conventional nanoindentation has been restricted for a long time to post mortem studies of the deformed material, mostly by atomic force microscopy (AFM) or scanning or transmission electron Microscopy (TEM). This post mortem approach entails some significant limitations to the analysis of the deformation mechanisms. Most importantly, it does not allow for direct observation of the microstructure during indentation and thus lacks the possibility to monitor deformation events and the evolution of dislocation structures as the indentation proceeds. Moreover, the deformed microstructure observed after indentation is generally different from that of the material under load due to recovery during and after loading. But in-situ nanoindentation in TEM allows for direct observation of indentation induced dynamical processes and consequent, does not from the limitations above. Based on this, we have carried out in-situ nanoindentation in TEM on Al and Al-Mg thin films to study the effects of solute Mg on dislocation dynamics. Our study shows that dislocations spread instantly across the entire grain in pure Al specimen, while they advanced slowly in a jerky-type fashion in all observed Al-Mg alloys. This is as a result of solute drag (solute Mg) on dislocation motion.

Key words: *Dislocation dynamics, in-situ nano indentation, solute drag, relaxation processes.*

1.0 INTRODUCTION

In-situ nano-indentation measurement by Minor *et al*, (2004) on polycrystalline aluminum films have provided experimental evidence that grain boundary motion is an important deformation mechanism when indenting thin films with grain sizes of several hundreds of nanometers. This is remarkable observation, since stress-induced grain boundary motion is not commonly observed at room temperature in this range of grain sizes.

Grain boundary motion in metals typically occur at elevated temperatures driven by a free energy gradient across the boundary, which may be presented by the curvature of the boundary or stored deformation energy on either side of the boundary, Doherty, *et al*, (1997). In the presence of an externally applied shear stress, Wining, *et al*, (2001) found that migration of both low-angle and high-angle grain boundaries in pure Al occur at temperature above 200^0C. This type of stress- induced gain boundary motion (known as dynamic grain growth) is considered by many researchers to be the mechanism responsible for the extended

elongations obtained in super plastic deformation of fine-grained materials.

The occurrence of grain boundary motion in room temperature deformation of nanocrystalline FCC (Face Centered Cubic) metals was anticipated recently by molecular dynamics simulations, Van Swygenhoven, *et al*, (2001) and a simple bubble raft model, Van Vlet *et al*, (2003). Experimental observations of such grain boundary motions have subsequently been provided by in-situ straining experiments of nanocrystalline Ni thin films, (Jin et al, 2004). In both the simulations and the experiment, grain boundary motion was observed for grain size below 20nm. In simple deformation modes such as uniform tension or compression, dislocation- based plasticity is still predominant in this regime and grain boundary motion generally does not occur. In the case of nano indentation however, the stress field is highly inhomogeneous and consequently involves large stress gradients, Larson *et al*, (1996). These stress gradients are thought to be the primary factor responsible for the observed grain boundary motion at room temperature.

Since the properties of high purity metals such as pure Al are less relevant for the design of engineering and advanced materials, we have focused on the deformation mechanisms described above. To this end, in-situ nano indentation experiments have been conducted on ultra fine-grained Al – Mg films, with varying Mg contents. TEM observations are interpreted and related to quantitative load-displacement data, obtained both directly from the in-situ indentation experiments and indirectly through conventional ex-situ nano indentation on the same specimens.

2.0 MATERIALS AND METHODS

The Al and Al-Mg films for the present investigation were deposited by thermal evaporation. The substrate was kept at 300^0C to establish a grain size of the order of the layer thickness, which was about 200 to 300nM for all specimens. After evaporation, the substrate heating was switched off, allowing the specimen to cool down to room temperature in approximately one hour.

One pure Al film was prepared by evaporating a high purity (5N) Aluminum source. Deposition of the Al-Mg alloy films was achieved by evaporating alloys with varying Mg content. Since Al and Mg have different melting temperatures and vapor pressure, the Mg content of the deposited film is not necessarily equal to that of the evaporated material. Moreover, the actual evaporation rates depend on the quality of the vacuum and the time profile of the crucible temperature. The composition of the deposited alloy films was therefore determined by energy disperses spectrometry (EDS) in a scanning electron microscope (SEM) at 5 KV. The measured Mg concentration of the four Al-Mg films prepared where 1.1, 1.8, 2.6 and 5.0 wt%. On each of the evaporated films three to four in-situ experiments were carried out with maximum depths ranging from 50 to 150nm, using the indentation stage for the JEOL 20CX. The indentation rate being controlled manually through the piezo voltage was of the order of 5nm/s. In addition, several quantitative insitu indentation experiments were conducted with the prototype holder for the JEOL 3010 microscope on the Al and Al-2.6%Mg films. These displacement-controlled indentations were made to depth of approximately 150nm, with a loading time of 20S.In order to be able to

resolve grain boundary phenomena during each in situ indentation, the specimen was titled to such an orientation that two adjacent grains were both in (different) two-beam conditions.

Conventional nanoindentation measurements were carried out ex situ on the same films away from the wedge. As in the in situ experiments, a pyramidal Berkovich tip was used. Load –controlled indentations were executed to maximum depts., of 50, 100 and 150nm at a targeted strain rate of $0.05s^{-1}$, defined as loading rate divided by load. At this strain rate the indenter velocity during loading was of the order of 2nm/s, which is comparable to the in situ measurements.

3.0 RESULTS

The effect of solute-mg on the propagation of dislocations was particularly visible during the early stages of loading. While in pure Al the dislocations instantly spread across the entire grain (faster than the 30 frames per second video sampling rate), they advanced more slowly and in a jerky type fashion in all observed Al-mg alloys. Fig 4 shows a sequence of images from an indentation in Al-2.6%Mg. The arrows mark the consecutive positions where the leading dislocation line is pinned by solutes. From these images, the mean jump distance between obstacles is estimated to be of the order of 50nm.

Due to the single-tilt axis limitation of the indentation stage, the orientation of the plane relative to the electron beam is unknown; therefore, the measured jump distance is a projection and a lower bound of the actual jump distance. At the low strains for which jerky-type dislocation motion was observed, solute atoms are the predominant barriers to mobile dislocations, has been shown in earlier in situ pulsed nuclear magnetic resonance (NMR) experiments (Schlagowski *et al*, 1988); (De Hosson *et al*, 1983). Consequently, the mean jump distance can be predicted by Mott-Nabarro's model of weakly interacting diffuse forces between Mg solute and dislocations in Al, (Nabaro, 1995). A calculation of the effective obstacle spacing, assuming that the maximum internal stress around a solute atom has a logarithmic concentration dependence, yield a value of 30nm in Al-2.6%Mg. This is in fair agreement with our experimental observation of a mean jump distance of the order of 50nm.

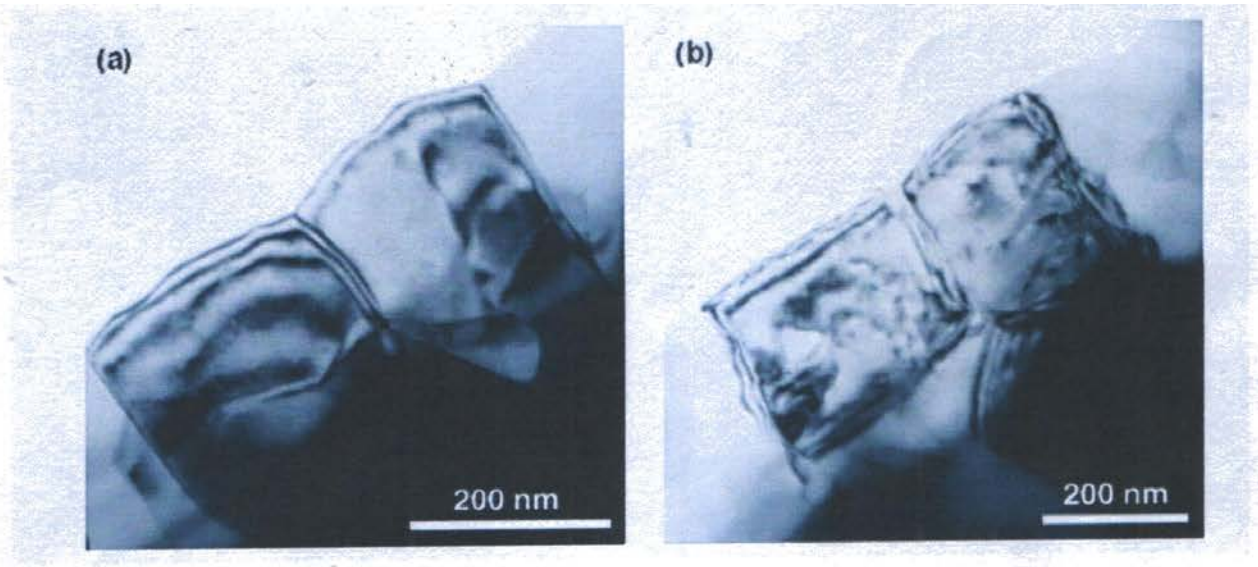

Figure 1: Bright-field images of evaporated Al-Mg layers with (a) 1.1 and (b) 5.0 wt% Mg. The presence of Al-Mg precipitates in (b) is revealed by strain contrast.

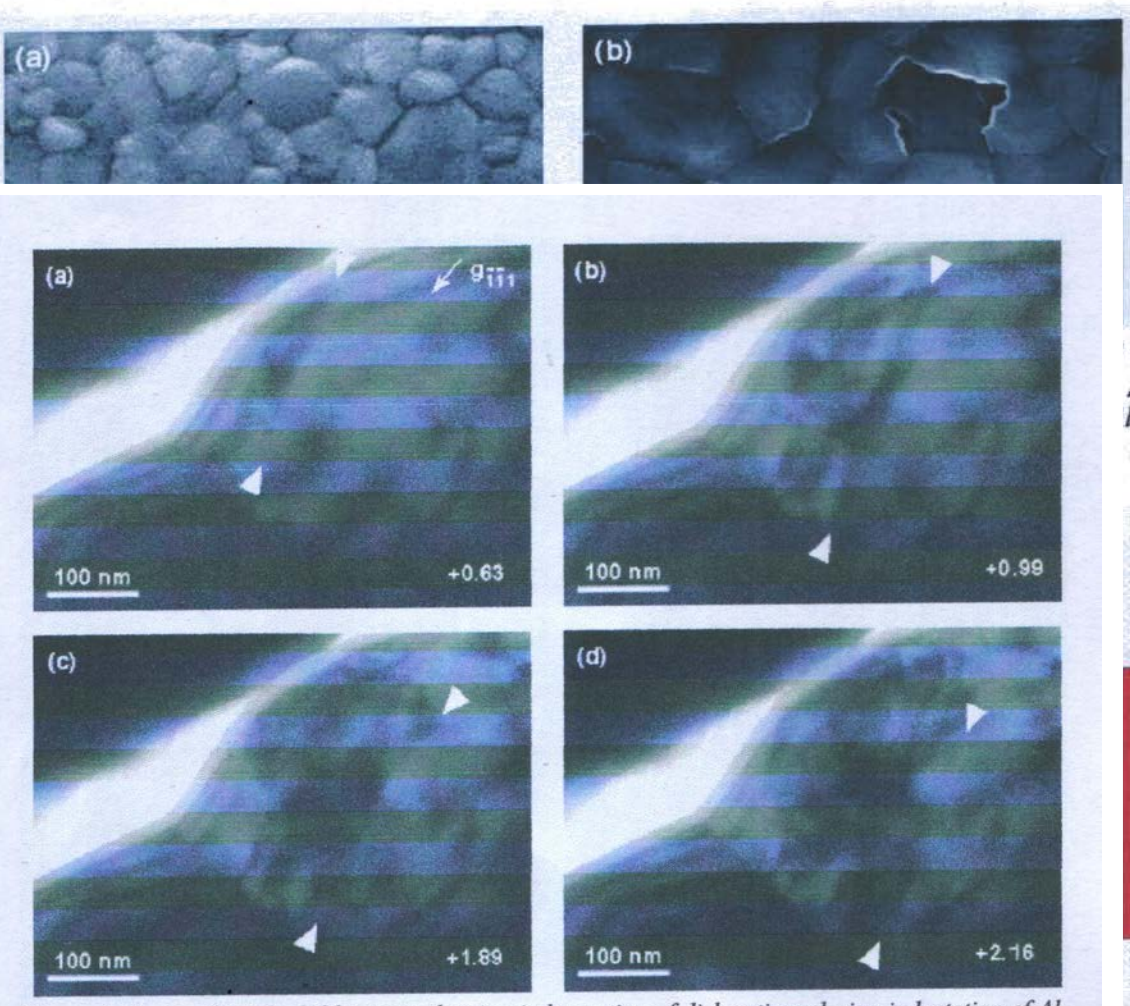

Figure 4: Series of bright-field images showing jerky motion of dislocations during indentation of Al-2.6wt%Mg. The time from the start of the indentation is given in seconds. Note the presence of a native oxide layer on the surface.

gliding dislocation with a random array of obstacles in its slip plane, is given by (Foreman and Makin, 1966; Kocks 1966) as:

$$\lambda = \frac{2\sqrt{2}}{3fv}\pi l \quad \text{----------(1)}$$

Provided that the size of the particles r is negligible in comparison with their center to-center separation, i.e. if $\lambda >> r$. It is reasonable to assume that the minimum size of the semi-coherent precipitates is at least 10nm to produce sufficient strain contrast in figure 1b. As a result, the mean planar separation of the precipitates is calculated to be at least 92nm, i.e larger than the mean separation between the solutes between. In this approach, the obstacles are assumed to be spherical and consequently, we ignore the effect that the precipitation in Al may become discontinuous or continuous depending on the temperature.

However, even in the case of a widmanstatten structure, the effective separation between the needle-shaped precipitates is larger than the effective solute obstacle spacing, De Hosson *et al*, (1988). Therefore, based on the experimental observations in the alloys below and the above solid solubility of magnesium, the strain contrast depicted in figure 1b and the abovementioned theoretical considerations, solute atoms are assigned as the main obstacles to dislocation motion.

5.0 CONCLUSION

The in-situ nano indentation behavior of Al-Mg thin films with grain sizes of several hundreds of nanometers has been studied. We observed that the movement of dislocations through the Al-Mg films proceeded in a jerky fashion due to their interaction with solute Mg atoms (solute drag). The observed jump distance in an Al-2.6% Mg films is of the order of 50nm. This value compares well to the theoretical average distance between obstacles in the presence of diffuse interaction.

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GROUNDWATER POTENTIAL INVESTIGATION IN IGBESA USING ELECTRICAL RESISTIVITY TECHNIQUES

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ABSTRACT

Groundwater potential studies have been carried out in Igbesa area of Ogun State South-western, Nigeria using Vertical Electrical Sounding and 2-D Wenner Resistivity Profiling. This was to identify potential water bearing zones for agricultural or irrigational purpose. Five traverses were established and a total of twenty Vertical Electrical Sounding (VES) data were acquired using the Schlumberger array and five Horizontal Profiling using Wenner array along the five traverses. The VES data was processed with curve matching and subjected to computer iteration techniques using WINRESIST while Horizontal Profiling was processed with DIPRO software. Both methods were integrated and the subsurface layers were delineated into three geo-electric layers: topsoil, sand/clayey sand/ clay, sand/sandy clay and sand. From the results, the topsoil has resistivity values that range from 2 - 3000 Ωm within the depth of about 4m. The first aquifer unit was delineated as the second geoelectric layer within the depth range of about 8.6 – 24.6 m having resistivity and thickness values that range from 117 – 514 Ωm and 7.2 – 22.7 m respectively. This aquifer unit can be exploited for groundwater development. The second aquifer is represented by the third geo-electric layer having resistivity values that range from 107 - 232 Ωm. The 2D Wenner Resistivity Profiling shows same lithology across the profile and penetrated to depth of about 50 m beneath the surface. In conclusion, the study area has a moderate groundwater potential and sand represent the aquifer unit within the study area

Keywords: Groundwater, Igbesa, Lithology, Aquifer, Geophysics, Resistivity.

I. Introduction

The science of geophysics involves application of physics principle to the study of the earth. Geophysical investigation involves taking measurement at or near the surface of the earth that are influenced by the internal distribution of physical properties. Analysis of these measurements gives indication of how the physical properties of the earth's interior vary vertically and internally. Geophysical methods are applied to a range of investigation from the entire earth to the exploration of a localized region of the upper crust. The use of geophysics in groundwater investigation has become a promising approach (Oyedele and Momoh, 2009; Atakpo, 2013).

One of the best resource to man is water which has become a major problem in our society as a result of increase in demand for portable water as well as the declining precipitation in the water shed that is seriously diminishing in the available surface water supply in many areas in Ogun

State. Water is of fundamental importance to all living organisms, plants, animals and also man.

It is of equal importance with the air we breathe in maintaining the vital process necessary to life and growth. Natural water is not available everywhere and as a result of this uneven distribution, villages and towns are restricted to areas where there is existence of supply. As a result of this, many people drink contaminated water from streams, well and rivers which have led to the outbreak of various diseases like cholera and other airborne disease that are hazardous and dangerous to human health.

Groundwater is among the mineral resources of prime importance to the hydro geophysicist. From earliest times and in many parts of the world, the development through civilization has been dependent on upon it. Despite our familiarity with water, its geologic occurrence is still misunderstood for example, it is common belief that groundwater occurs in pore spaces and fractures in rocks. (Lowrie, 1997)

In Nigeria, especially in the rural area, there is an ever increasing reliance on ground water for both domestic and industrial usage. The reliance on ground water is such that it is necessary to ensure that there is significant supply of portable water. The use of geophysics in understanding of the occurrence of groundwater resources, mapping and quality evaluations has not only proved to be very effective but also to be a necessity.

II. Theory

The generalized form of electrode configuration in resistivity survey is as shown below in figure 1.

When the distance between the two current electrodes is finite, the Potential

$$V1 = -A1/r1 \text{ where } A1 = -\frac{Ip}{2\pi} \quad (1)$$

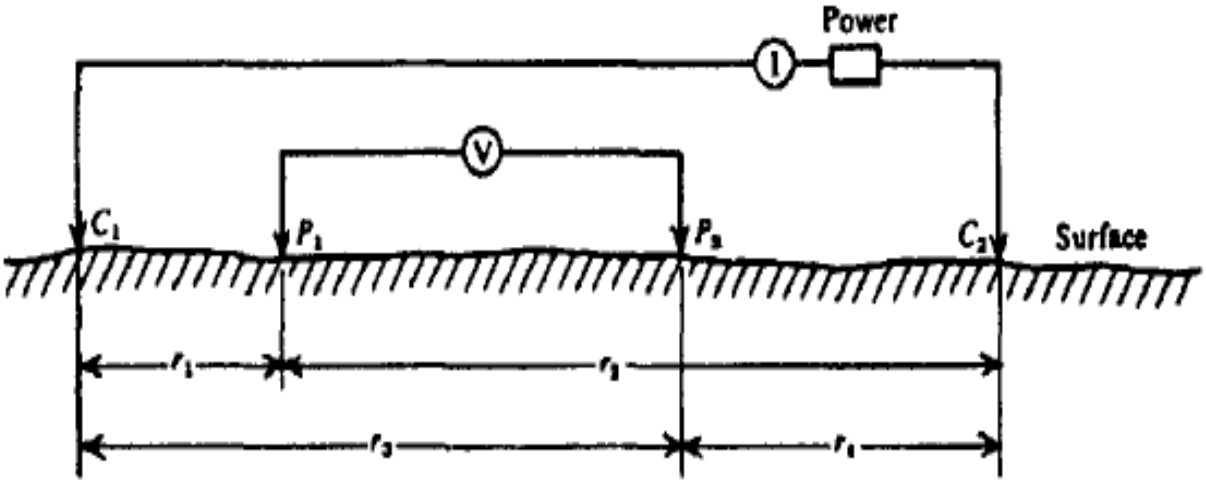

Fig 1: Two Current and Two Potential Electrodes on the Surface of Homogeneous Isotropic Ground of Resistivity ρ(*Telford et al., 1990*)

The potential due to C_2 at P_2 is

2

Thus,

$$V1 + V2 = \frac{I\rho}{2\pi}\left(\frac{1}{r1} - \frac{1}{r2}\right) 3$$

A Apparent Resistivity and Electrode Configuration

The purpose of electrical survey is to determine the subsurface resistivity distribution by making measurements on the ground surface. From these measurements, the true resistivity of the subsurface can be estimated. The ground resistivity is related to various geological parameters such as the mineral and fluid content, porosity and degree of water saturation in the rock. Electrical resistivity surveys have been used for many decades in hydro geological, mining and geotechnical investigations. More recently, it has been used for environmental surveys.

The resistivity measurements are normally made by injecting current into the ground through two electrodes (C_1 and C_2 in Fig 1, and measuring the resulting voltage difference at two potential electrodes (P_1 and P_2). From the current (I) and Voltage (V) values, an apparent resistivity (ρa) value is calculated.

$$\rho a = \frac{KV}{I} \quad 5$$

Where k is the geometric factor which dependent on the arrangement of the four electrodes. The figure above shows the common arrays used in resistivity surveys together with their geometric factors. Resistivity meters normally give a resistance value, $R = \frac{V}{I}$, so in practice the apparent

Resistivity value is calculated by equation 6

P_2, the difference in potential between P_1 and P_2 can be measured which is given by equation (2.17)

$$VV = \frac{I\rho}{2\pi}\left(\frac{1}{r1} - \frac{1}{r2}\right) - \left(\frac{1}{r3} - \frac{1}{r4}\right) 4$$

$$\rho a = KR$$

6

The calculated resistivity value is not the true resistivity of the subsurface, but an apparent value which is the resistivity of a homogeneous ground which will give the same resistance value for the same electrode arrangement. The relationship between the apparent resistivity and the true resistivity is a complex relationship. To determine the true subsurface resistivity, an inversion of the measured apparent resistivity values using a computer program software package will be used.

- **Vertical Electrical Sounding (VES)**

VES method is also called depth sounding (DP). It measures internal variation in the ground apparent resistivity which is measured with respect to a fixed center of array. The current and the potential electrodes are maintained at the same relative spacing and the whole spread is progressively expanded about a central point. The principle of VES is based on the fact that the wider current electrode separation enables the delineation of deeper layers. It gives a 1-D measurement of the subsurface. Increase of the spread length of the current electrode yields a high depth of penetration.

- **Constant Separation Traversing (Wenner) CST**

This method measure the internal variation in ground with apparent resistivity being

measured using an electrode array with fixed spacing. The whole array is moved after each measurement. It gives a 2-D measurement of the subsurface.

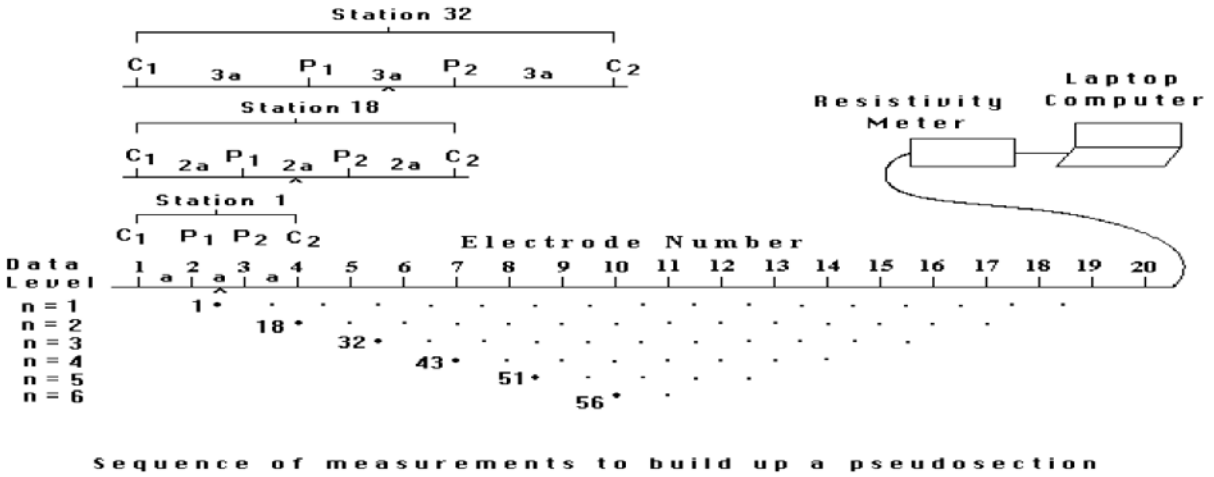

Fig 2: 2-D Measurement Using Wenner Arrangement Configuration. (Loke, 1999)

B Factors Influencing Electrical Resistivity

Certain factors tends to affect the values of resistivity, some of these factors are highlighted below:

- **Rock types**: The resistivity of rock varies with the rock type and the geological processes that give rise to them. The rock texture also play a significant role in the determination of the resistivity especially when the rock type is large in size and less compacted. The resistivity decreases due to increase in porosity while a small size and more compacted type give rise to an increase in resistivity.
- **Pressure**: An increase in pressure will lead to an increase in the resistivity of the rock type, also decreasing the porosity of the rock type due to an increase in pressure increases the resistivity in return.
- **Porosity**: This affects resistivity in terms of the pore space when there is high porosity; it results in low resistivity and vice versa. It depends on the fluid type present in the material.
- **Temperature**: The electrical conduction of aqueous electrolytes increases with increasing temperature, since viscosity of the water decreases as the mobility of the ions increases.

  Practically, all rocks and minerals are semiconductors whose conductivities increases with increasing temperature according to the equation

$$\delta = \delta_0 exp^{\frac{-E}{KT}} \quad (2.20)$$

  Where T=absolute temperature

  K=Boltzmann constant=1.38×10^{-23} $mol^{-1}k^{-1}$

E= Activation energy (energygap) for the material.

- **Water saturation**: The resistivity of rocks decreases with increase in water saturation. The conductivity of the groundwater (concentration and types of dissolved minerals and salt it contains) in accordance with an empirical formula called ARCHIE'S LAW for the resistivity of the rock is

$$\delta = a\emptyset^{-m}S_w^{-n}\rho_w \quad (2.20)$$

Where δ = resistivity, ρ_w = resistivity of water, S_w= water saturation, $\emptyset$= porosity
n,a,m= empirical constants

III Location and Physiography

1 Geology of the Study Area

The study area falls within the eastern Dahomey (or Benin) Basin of southwestern Nigeria which stretches along the continental margin of the Gulf of Guinea. The area is generally a gently sloping low-lying area. The rocks are Late Cretaceous to Early Tertiary in age (Jones and Hockey, 1964; Omatsola and Adegoke, 1981; Billman, 1992; Olabode, 2006). The stratigraphy of the basin has been grouped into Abeokuta Group, Imo Group, Oshoshun, Ilaro and Benin Formations. The Cretaceous Abeokuta Group consists of Ise, Afowo and Araromi Formations, and mainly composed of poorly sorted ferruginized grit, siltstone and mudstone with shale-clay layers. Overlying the Abeokuta Group is the Imo Group which is subdivided into the limestone-dominated Ewekoro Formation and the shale-dominated Akinbo Formation. The Akinbo Formation is overlain by the OshoshunFomation and then Ilaro Formation which is predominantly a sequence of coarse sandy estuarine, deltaic and continental beds; the Ilaro Formation displays rapid lateral facies changes. Overlying the Ilaro Formation is the Benin Formation which is predominantly coastal plain sands and Tertiary alluvium deposits. The local geology is predominantly coastal plain sands which are underlain by a sequence of coarse sandy estuarine, deltaic and continental beds largely characterized by rapid changes in facies.

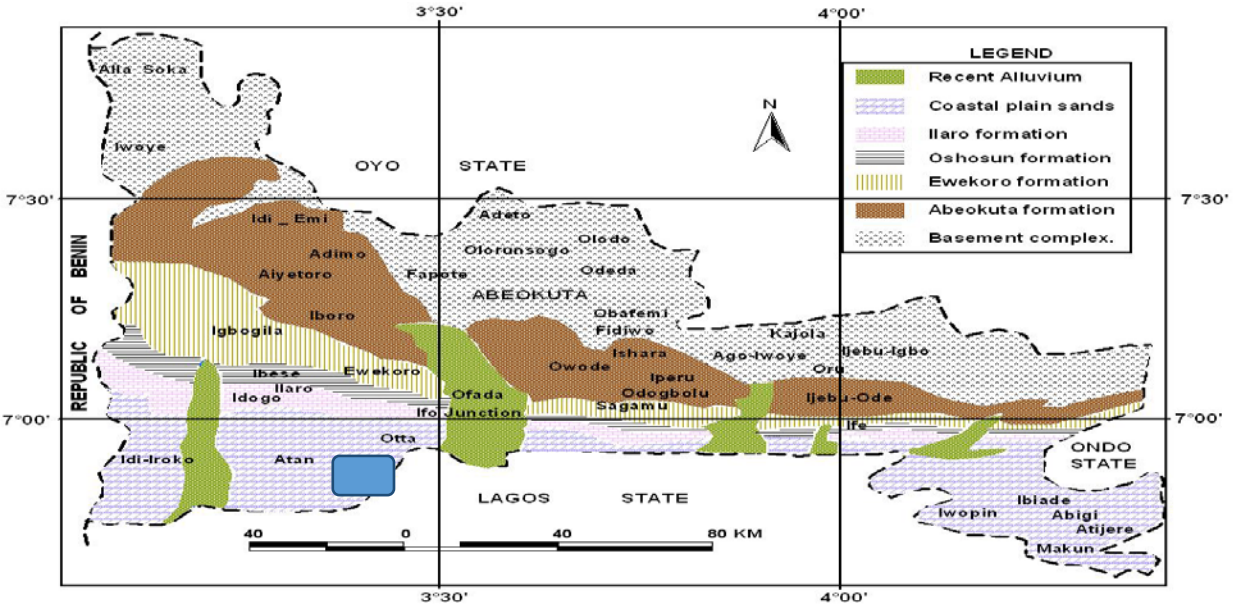

Fig 3: Geological map of Ogun State showing the Study Area (*Olurin et al., 2012*)

2 Location of the Study Area

The study area; Ogun state, is one of the fast developing states in Nigeria. It lies in the south western part of the country within latitudes 6^0N and 8^0N and Longitudes 3^0E and 5^0E. The state is bounded in the west by the Republic of Benin and on the east by Ondo state. To the north is Oyo state while Lagos state and the Atlantic Ocean are to the south. The state covers about 16,762 square kilometer which is approximately 1.81 percent of Nigeria's land mass (Akanni, 2000; Solanke, 2014).

IV. Materials and method

Geo-electrical investigation was carried out on the survey area with a total of five traverses representing the spread length of the constant separation traversing (CST). Total of twenty Vertical electrical sounding (VES) were subsequently carried out on each traverse with each traverse having equal amount of VES point.

VES data acquired from the survey area was processed and analyzed by graphs plotting of apparent resistivity against electrode half spacing on a logarithmic scale. Then the curves obtained were interpreted using master curve and auxiliary curve to obtain resistivity and thickness of each layer delineated. The results were then used as starting model for computer iteration process using winRESIST.

Fig 4: Base Map of the Study Area

For the CST, the field data acquired was imputed into Res2D where the forward and inverse modeling was obtained.

From the results of the computer iteration, the geo-electric sections were then drawn using the drawing tools of the Microsoft Word software. Based on the interpretation of the data acquired from resistivity survey carried out in the study area, the following information was obtained:

- Lithologies of each layers
- Thickness of layers and depth to aquifer
- Groundwater potential zones

V. Result and Conclusion

The Groundwater investigation in Igbesa area in Ogun State, South-western, Nigeria was carried out using Vertical Electrical Sounding and 2-D Electrical Resistivity Profiling to identify potential water bearing zones capable of sustainable industrial development and population growth of the study area.

The interpreted results of the VES and Wenner data are presented as geo-electric sections and 2D resistivity imaging. Four geo-electric layers were delineated which comprises of the topsoil, sand/clayey sand/ clay, sand and clayey sand/sand. From the VES results, the topsoil has resistivity values range from 9 - 610 Ωm while the thickness values range from 0.8 - 2.6 m. The second geo-electric layer was delineated within the depth range of 7.5 – 38.6 m beneath the surface having resistivity values that range from 27 - 750 Ωm and thickness values that range from 5.7 – 37.3 m. This layer constitutes clay/clayey sand/sandy clay and sand. The sand unit delineated as the second geoelectric layer with resistivity and thickness values that range from 117 – 514 Ωm represent the aquifer unit for groundwater development. The third geo-electric layer constitute clay, clayey sand, sandy clay and sand having resistivity values that range from 22 - 2737 Ωm. The sand unit delineated within the third geoelectric layer with resistivity and thickness values that range from 107 – 232 Ωm represent the second aquifer unit for groundwater development.

The 2D Wenner Resistivity Profiling shows same lithology across the profile and penetrated to depth of about 50 m beneath the surface.

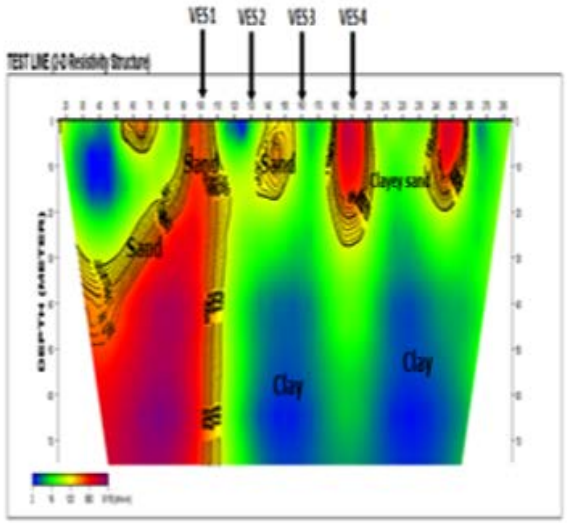

Fig 5a: 2D Resistivity Section along Traverse One

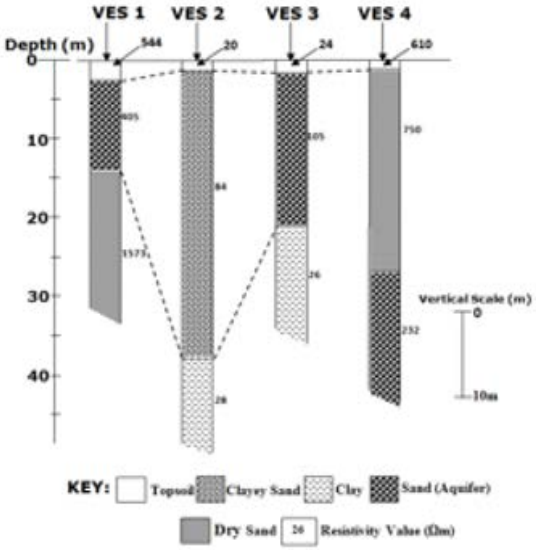

Fig 5b: Geo-electric Section Relating VES 1, 2, 3, and 4

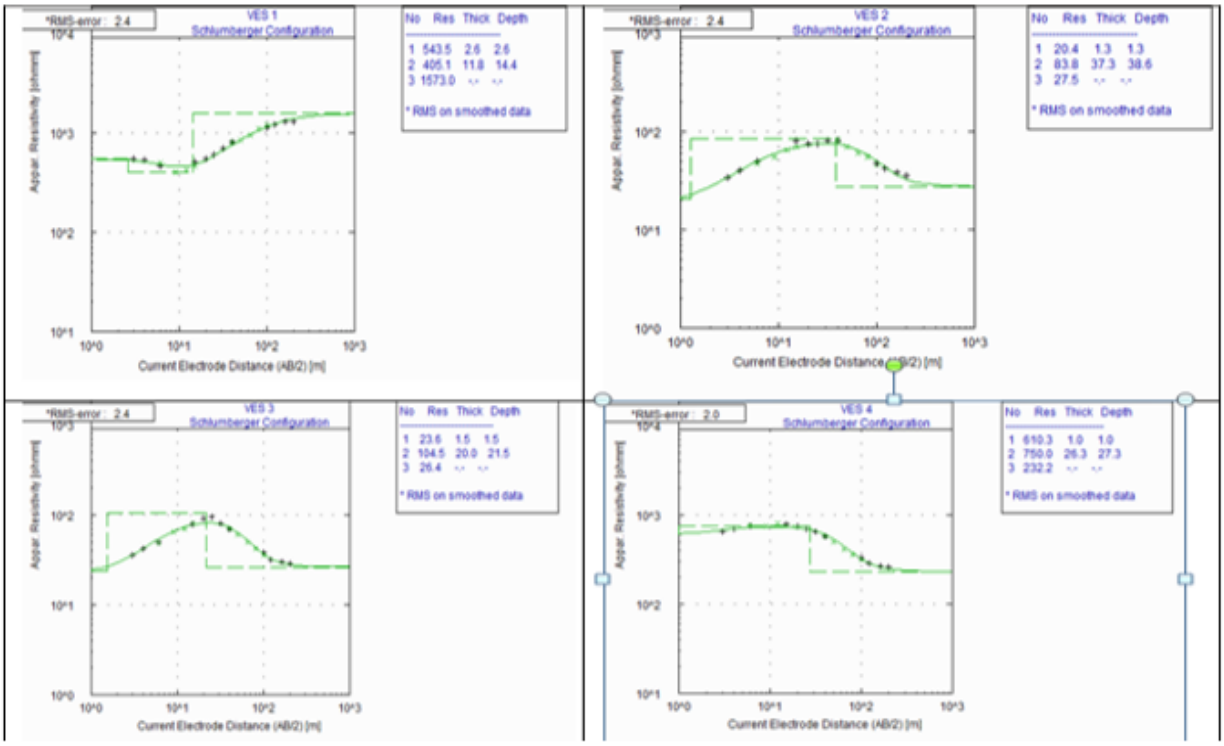

Fig 5c: WINRESIST Result for VES1, 2, 3 and 4

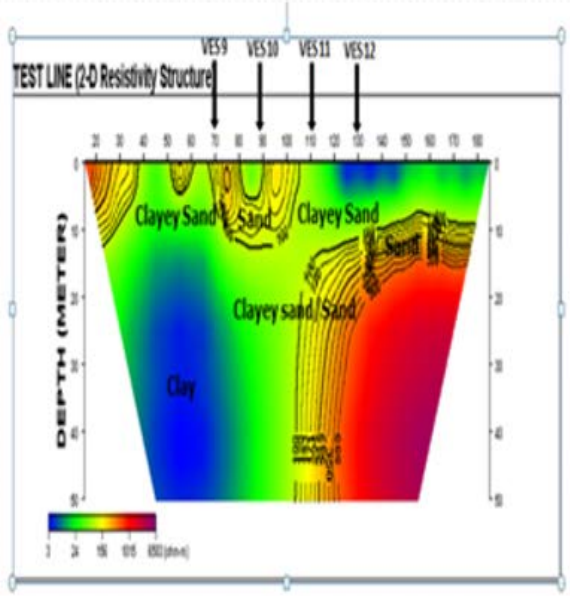

Fig 7a: 2-D Resistivity Section along Traverse Three

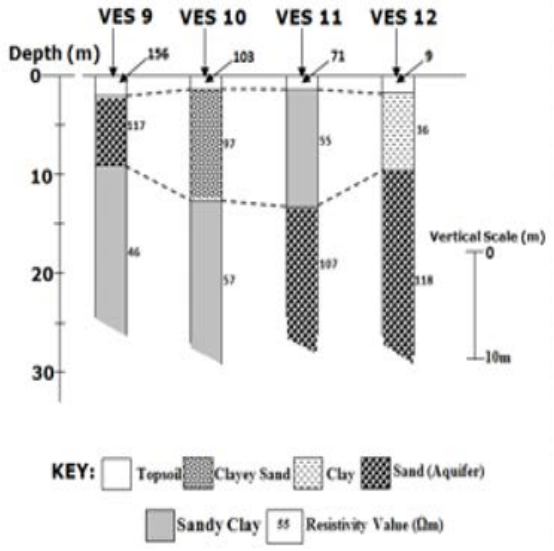

Fig 7b: Geo-electric Section Relating VES 9, 10, 11, and 12

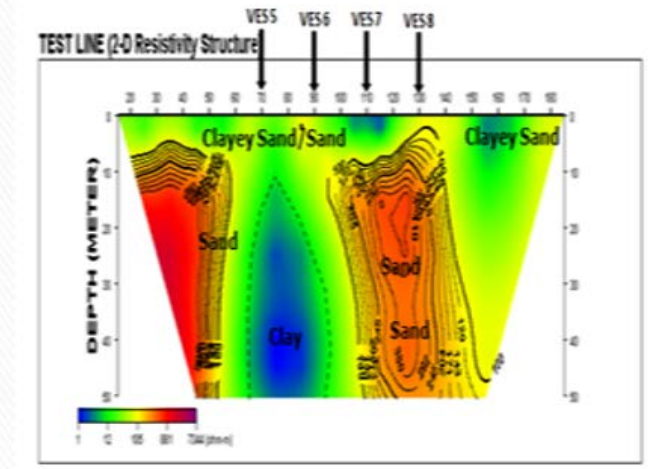

Fig 6a: 2D Resistivity Section along Traverse Two

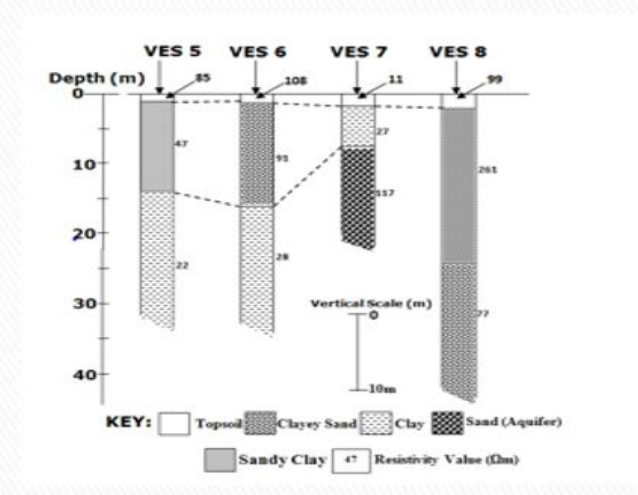

Fig 6b: Geo-electric Section Relating VES 5, 6, 7, and 8

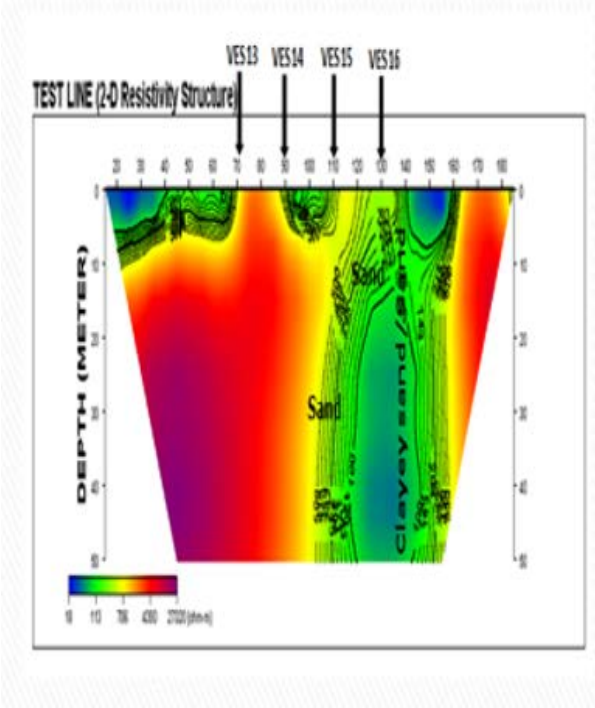

Fig 8a: 2-D Resistivity Section along Traverse Four

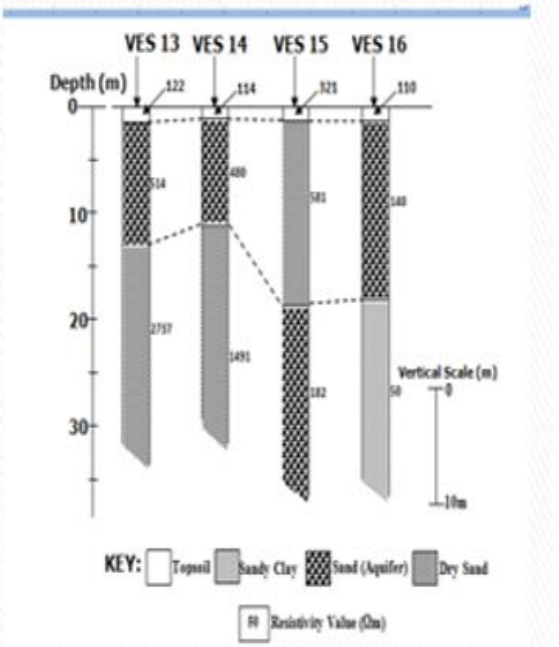

Fig 8b: Geo-electric Section Relating VES 13, 14, 15 and 16

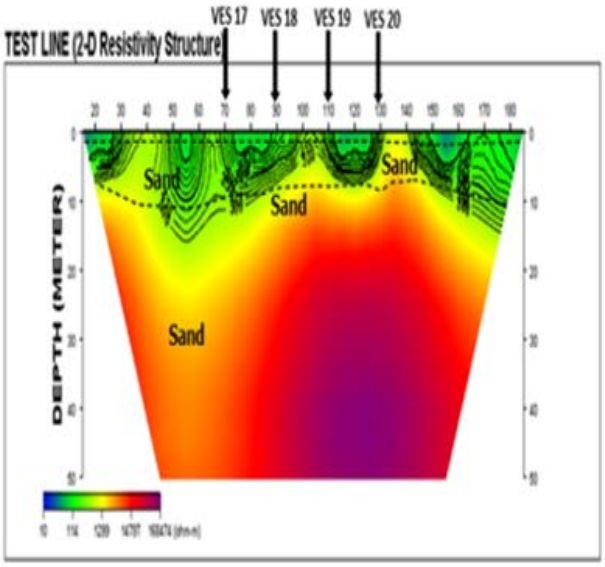

Fig 9a: 2-D Resistivity Section along Traverse Five

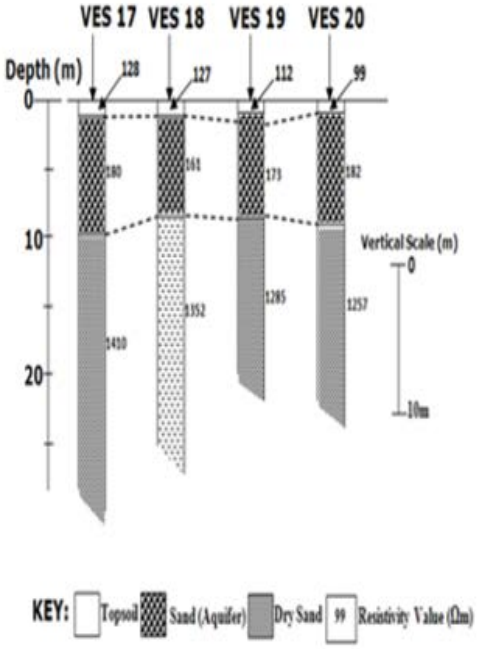

Fig 9b: Geo-electric Section Relating VES 17, 18, 19 and 20

VI. Recommendation

The study area has a moderate groundwater potential and sand represent the aquifer unit within the study area.It is therefore recommended that boreholes in the study area should be sunk within the second and third geo-electric layers for a good groundwater supply. However, aquifer units (delineated as the second geoelectric layer) were delineated at shallow depth (8.6 – 24.6 m) and are probably prone to pollution. It is also recommended that chemical analysis should be carried out to determine the safe limit of the groundwater.

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THE ANALYSIS OF RETURN LOSS IN A SINGLEMODE OPTICAL FIBER USING THE OPTICAL TIME DOMAIN REFLECTOMETER (OTDR) AT A WAVELENGTH OF 1550nm

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ABSTRACT

This paper was aimed at analysing return loss in single mode optical fiber at a wavelength of 1550nm using one of the testing method known as the optical time domain reflectometer (OTDR) software. Return loss in fibre optics takes place at discontinuities of refractive index, especially at an air-glass interface. Return loss is caused by discontinuities and impedance matching, dirty connectors, broken optical cable and poorly maintained connectors. The effect of return loss in a fiber optic span from undesirable feedback into the laser cavity which can also lead to degradation and multipath interference. The result of my findings shows that return loss increases as the peak of the trace increases. The increase in the peak is due to the amount of reflection. The higher the reflection, the higher the trace peak. It was observed that some traces have two peaks. Some of them are flat, while others are normal peak. The flat peak indicates that the receiver was overloaded.

KEYWORDS: optical fibre, OTDR, return loss, Refractive index, connector

INTRODUCTION

Optical fiber is the data carrier of choice compared to copper wire. Fiber optic networks have exponentially higher capacity experience no crosstalk, and can be installed in areas with high electromagnetic interference such as along utility and power lines (Aida, 2013).

Fiber optic networks span multiple length scales. Intercity and transoceanic fiber optic telecommunications networks span thousands of kilometers. In aircrafts and ships, telecommunications systems have link lengths up to 500m. Data center networks have lengths in meters. Fibre optic components have very short lengths on the centimeter and smaller scale. Across all these applications, data needs to be sent with great fidelity from the source to the receiver. Any loss or reflection events along the way will contribute to a degradation of the signal (Aida, 2013)

In optics (particularly in fiber optics) a loss that takes place at discontinuities of refractive index, especially at an air-glass interface such as a fibre end face. At those interfaces, a fraction of the optical signal is reflected back toward the source. This reflection phenomenon is also called “Fresnel reflection loss,” or simply “Fresnel loss”(FOA, 2011).

Fiber optic transmission systems use lasers to transmit signals over optical fiber, and a high optical return loss (ORL) can cause the laser to stop transmitting correctly. The measurement of ORL is becoming more important in the characterization of optical networks as the use of wavelength-division

multiplexing increases. These systems use lasers that have a lower tolerance for ORL, and introduce elements into the network that are located in close proximity to the laser (Trevor, 2009).

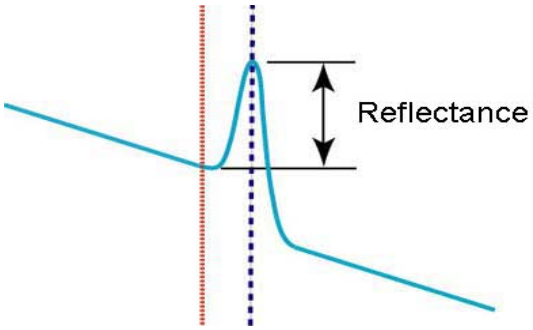
OPTICAL RETURN LOSS OR REFLECTANCE LOSS

Reflectance or optical return loss (which has also been called "back reflection") of a connection is the amount of light that is reflected back up the fibre toward the source by light reflections off the interface of the polished end surface of the mated connectors and air. It can also be defined as the signal attenuated by impedance variation in the structure of a cable or associated connection parts (Stephen *et al.,* 2001). It is also called fresnel reflection and is caused by the light going through the change in index of refraction at the interface between the fibre (n= 1.5) and air (n=1). Reflectance is primarily a problem with connectors but may also affect mechanical splices which contain an index matching gel to prevent reflectance (FOA, 2011)

CAUSES OF RETURN LOSS IN FIBER OPTICS

- Dirty connector

There are some very simple faults within an optical network that can cause high return loss. A dirty connector is one such source. Even a tiny dust particle on a 5 micron single-mode core can end up blocking the optical signal, resulting in signal loss (FOA, 2011).



- Broken optical fibre

A break in the optical fiber can also cause high return loss. In some instances, it is possible for the optical fiber to have a break in it, but still be able to guide light through. In this case, a measurement of insertion loss across this fibre will result in a low insertion loss.

- Poorly mated connector

If a connector is not fully seated, the resulting air gap between connector end faces would result in high return loss from that point. In this case, the insertion loss (IL) may be low and the signal fidelity could still be good (FOA, 2011).

- Discontinuity and Impedance mismatches

Discontinuity can occur were cable is bent too much, kinked or otherwise damaged. While impedance takes place in coaxial cable, connectors and other passive components (Stephen *et al.,* 2001).

RETURN LOSS TESTING BY OTDR

The OTDR measures the amount of light that is returned from both backscatter in the fiber and reflected from a connector or splice. The amount of light reflected is determined by the differences in the index of refraction of the two fibre joined, a function of the composition of the glass in the fiber.

Figure 1. A sharp peak (FOA, 2011)

In an OTDR, the peak that identifies a reflective event is measured and reflectance calculated. Higher peaks indicate higher reflectance. In order to measure reflectance, the peak must not saturate the OTDR receiver, indicated by a flat-topped reflectance peak (below).

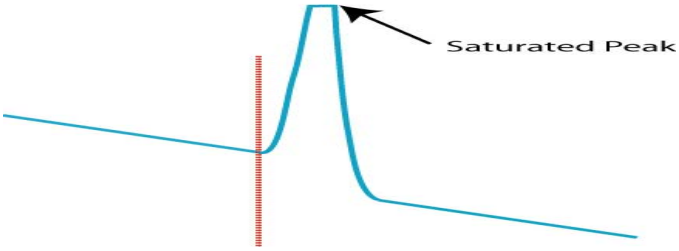


Figure 2. A saturated peak (FOA, 2011)

METHODOLOGY

This project was carried out on a 32 core fiber optic transmission link using the single mode fiber cable at a wavelength of 1550nm to determine return loss in different fiber. The instrument used is the optical time domain reflectometer (OTDR) using trace measurement (TRM) software.

OPTICAL TIME DOMAIN REFLECTOMETER (OTDR)

An optical time-domain reflectometer (OTDR) is an optoelectronic instrument used to characterize an optical fiber. An optical domain reflectometer (OTDR) is the optical equivalent of an electronic time domain reflectometer (Gifford *et al.*, 2007). It injects a series of optical pulses into the fiber under test. It also extracts, from the same end of the fiber, light that is scattered (Rayleigh backscatter) or reflected back from points along the fiber. The strength of the return pulses is measured and integrated as a function of time, and plotted as a function of fiber length.

Figure 3. An OTDR (Laferriere *et al*, 2011)

RESULT AND DISCUSSION

The traces gotten were analyzed using the trace measurement software which terminates at the fiber optic backbone (fob). A 32 cores cable with a wavelength of 1550nm was used for 18 fibers with a pulse width of 20000ns, a point spacing of I 6m and a range of 261363.80m. The return loss

for each fiber occurred at different distances. At each trace the return loss was determined.

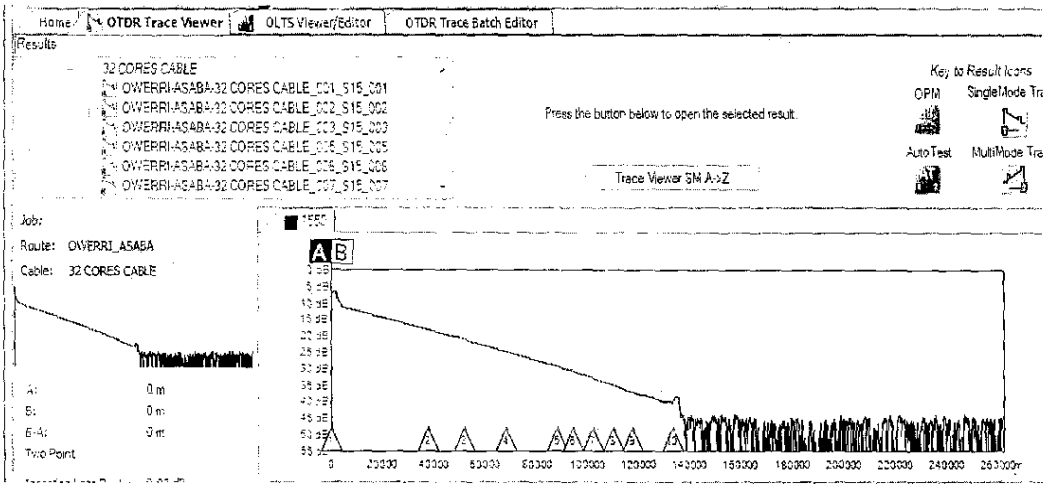


Figure 4. Trace of Link with one Peak (source: OTDR software)

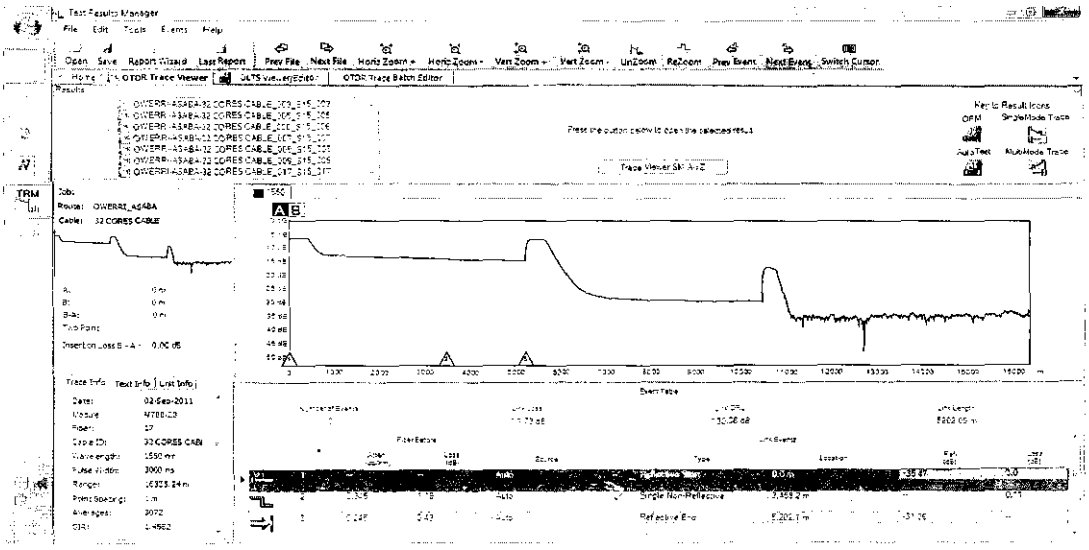


Figure 5. Trace of Link with Two Peaks (source: OTDR software)

RESULT

Table 1.Shows the result obtained after analyzing with the OTDR

Link	No Of Peaks	Nature of 2nd peak	Distance (M)	Optical Return Loss (Db)
1	1	-	2074.3	1.50
2	1	-	2074.3	8.78
3	1	-	2904.0	9.07
4	1	-	2489.2	8.19
5	1	-	2904.0	7.90
6	2	Sharp Peak	2489.2	8.42
7	1	-	2489.2	10.08
8	1	-	2489.2	11.09
9	2	Overloaded Flat Peak	259.2	12.40
10	2	Overloaded Flat Peak	285.2	12.70
11	1	-	2489.2	9.33
12	1	-	2489.2	8.98
13	1	-	2489.2	10.19
14	1	-	2489.2	6.77
15	1	-	2489.2	10.80
16	1	-	2904.0	10.17
17	1	-	155.6	14.49
18	1	-	1659.4	0.87

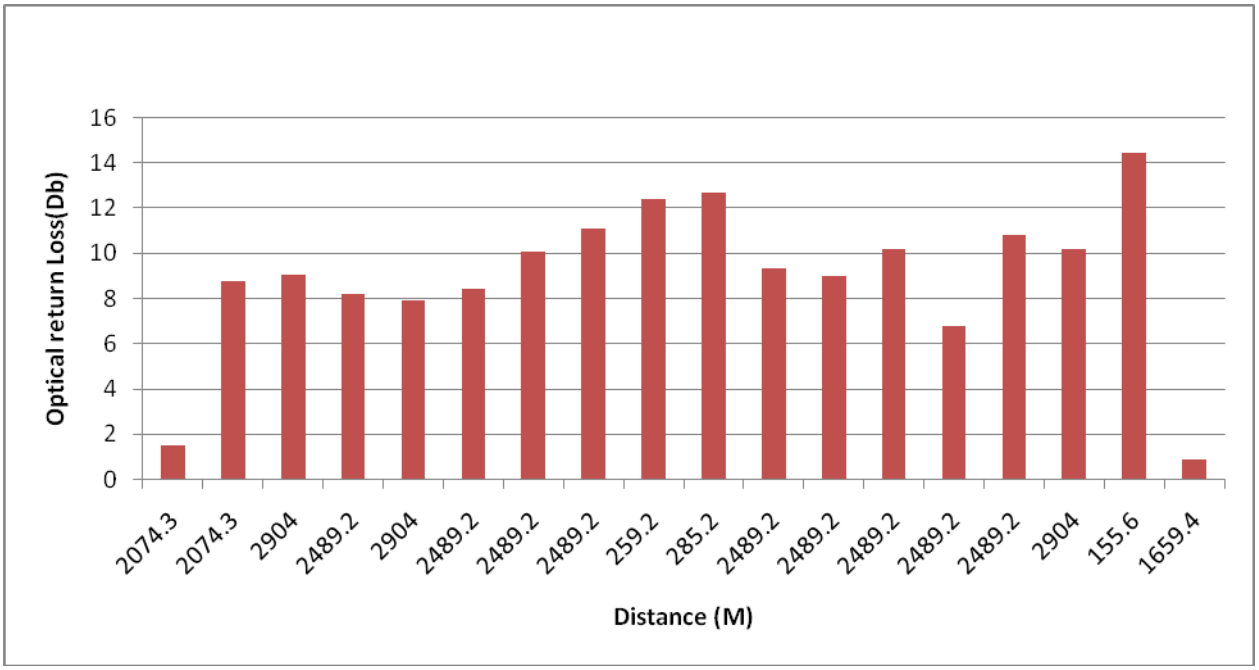


Figure 6: Bar chart showing distance against optical return loss for 18 links

DISCUSSION

From figure 6, link 18 shows cable with the lowest return loss, while link 17 shows the cable with the highest return loss. These results show that return loss increases as the peak on the trace increases. The increase in the peak is due to the amount of reflection. The higher the reflection, the higher the trace peak. In table 1 above, it was also observed that some traces have two peaks, these are found in link 6, 9 and 10. Link 6, has both peaks sharp. Link 9 and 10, have one peak which is normal, while the second peak is flat and saturated. This is shown in Figure 5. The flat peak shows that the receiver was overloaded. Flat top reflections peak saturates the OTDR and thus reflection could not be accurately measured.

As observed from both traces in figure 4 and 5, the far end shows noise level, otherwise known as 'ghost'. This results from short cables with highly reflective connectors caused by reflected light from the far end connector reflecting back and forth in the fiber until it is attenuated to the noise level.

CONCLUSION

Conclusively, there are three ways to measure reflectance. One method uses a source and power meter with some accessories or an instrument called an optical continuous-wave reflectometer (OCWR), another method uses an optical time domain refiectometer (OTDR), while the other uses optical frequency domain reflectometer (OFDR). To yield accurate result, connect the device under test (DUT) at the end beyond the instrument dead zone. Dead zone length represents the distance over which the OTDR cannot make measurement because reflections in this length 'blind' or saturate the OTDR. Thus, reflections that occur in the dead zone cannot be detected or appear hi an OTDR as a vague anomaly instead of as discrete pulse. Reflections caused by material scattering may have a different effect to reflections caused by a point event. A point reflection

will cause a sudden impulse of reflected light, whereas backscattered light is a very low level distributed reflection. Therefore in some critical applications, connector reflections of -60 db might be specified in a link with -32 db inherent backscatter, to reduce the effect of sudden impulse reflections.

RECOMMENDATION

I. Manufacturers of lasers and designers of fiber-optic systems must carefully measure return loss to ensure it is small enough to not disturb a transmitter's laser or lasers.

2. Spaces should not exist between two physical contact connectors along an optical path, to prevent reflection from occurring.

3. Fusion splicing method should be used when joining fibers as this tends to produce negligible reflections (0.1dB).

4. The limit for the installed system and the transmitters should be different. The cable system specification may be in the region of -30db, to prevent excessive receiver noise, while the transmitter specification maybe in the region of -50db, to prevent spurious operation of the laser.

5. Index matching fluid should be added when splicing to reduce reflection.

6. A low reflection detector arrangement should he used at the receiver.

7. The installation of isolators to control reflection

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COMPARATIVE STUDIES ON THE ANTIOXIDANT POTENTIALS OF NON-POLAR EXTRACTS OF LEAF AND BARK OF *AZADIRACHTA INDICA*

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ABSTRACT
The frequent use of Neem (*Azadirachta indica*) in Africa especially in Nigeria suggests its therapeutical potentials. The objective of this research work is to compare the antioxidant potentials of n-hexane (non-polar solvent) extracts of leaf and bark of *Azadirachta indica* in an *in vitro* model. The leaf and bark of the plant were prepared by cold maceration using n-hexane extraction. The filterate was collected and concentrated using rotary evaporator. The extracts (0-5µg/ml) were subjected to these antioxidant tests; 1,1-diphenyl-2picrylhydrazyl (DPPH) radical scavenging ability, Ferric Reducing Antioxidant Power (FRAP) and Thiobarbituric Acid Reactive Species (TBARS). Neem leaf and bark extracts showed prominent dose-dependent antioxidant activity. However, the leaf extract tend to exhibit higher antioxidant potential than the bark extract at $p< 0.05$. Consequently, this may be one the attributes why people prefer the use of the leaf more than the bark for several purposes.

KEYWORDS: Antioxidant, *Azadirachta indica*, non-polar, leaf and bark extracts

INTRODUCTION

Medicinal plants such as Neem showing antioxidant property are used to prevent oxidative damage caused by free radicals (Maxwell, 1995). Reactive oxygen species (ROS) are consisting of free radicals (O_2, HO) and non free radicals (H_2O_2). Free radical are molecules which contain unpaired electron in the outer orbital and are highly reactive in the body by oxidizing (removing an electron from) other atoms, or sometimes reducing (donating their electron to) other atoms. The major source of reactive oxygen species are mitochondria, produced by electron transport chain in aerobic respiration as byproducts. The production of free radicals makes important physiological functions in the body. One of these functions is the production of superoxide and nitric oxide by neutrophils and macrophages which aids in phagocytosis process and help these cells in destroying bacteria. The superoxide radicals in phagocytic cells can be thought of as nonselective antibiotics, killing any infecting bacteria (as well as the neutrophils) and perhaps also injuring surrounding tissue cells, as these radicals contribute to the inflammation reaction, these free radicals also promote cellular proliferation (mitotic division) of fibroblasts, so that scar tissue can form and stimulate proliferation of lymphocytes in the process of clone production (Dana, 1986; Lakshmi *et al*., 2012). Free radicals start the chain reaction that damage the cell get involved in immune suppression, cell membrane disintegration, membrane protein damage and DNA mutation, which can further initiate the development of many diseases like cancer, liver injury, cardiovascular diseases, inflammation, diabetes and atherosclerosis from oxidation reaction. The most reactive free radical is the hydroxyl radical which is known to initiate lipid peroxidation and

cause fragmentation of DNA leading to mutations (Lakshmi *et al*., 2012; Shinde *et al*., 2012). Although the body possesses such defense mechanisms as enzymes and antioxidant nutrients, which arrest the damaging properties by removing, free radical intermediates and inhibits other oxidation reactions. Oxidative stress is linked to altered redox regulation of cellular signaling pathways and the formation of many types of cells stimulation.

MATERIALS AND METHODS

Chemicals and Reagents

1,1-diphenyl-2picrylhydrazyl (DPPH), 2,4,6-tris (2-pyridyl)-S- triazine (TPTZ), sodium trioxocarbonate (iv) (Na_2CO_3), Folin reagent, n-hexane, distilled water, aluminum chloride ($AlCl_3$), acetate buffer (0.2M, pH of 3.6), ferric chloride ($FeCl_3$), and hydrochloric acid (HCl) were obtained from Sigma-Aldrich (St. Louis, MO USA). All other chemicals and solvents used were of analytical grade.

Preparation of tissue homogenate

Tissues (Brain) was quickly removed, placed on ice and homogenized in cold 50mM Tris-HCl pH 7.4. The homogenate was centrifuged at 4000rpm for 10 min to yield the low-speed supernatant fraction that was used for biochemical assays.

Plant Collection and sample preparation

The fresh leaves and barks of *Azadirachta indica* were collected from neem tree from Auchi Polytechnic, Auchi, Etsako West Local Government Area, Edo State, Nigeria. The leaves and barks were air dried and pulverized into coarse powder. After which, extractions were done by maceration for 72 hours using n-hexane (1:6, w/v), at room temperature and filtered (filter paper Whatman No. 2) under vacuum. The filtrate was then evaporated and lyophilized to obtain a dry extract.

METHODS

Free Radical Scavenging Ability (DPPH)

The free radical scavenging ability of the cerebral tissue against DPPH (1, 1-diphenyl-2-picrylhydrazyl) free radicals was evaluated. Tissue homogenates were mixed with 600µL, 0.3mM methanolic solution containing DPPH radicals, the mixtures was left in the dark for 30 min and the absorbance of the resulting golden yellow was measured at 517nm (Brand-Williams *et al*., 1995).

Ferric Reducing Antioxidant Power (FRAP)

The reducing property of the extracts was determined by assessing the ability of the extracts to reduce $FeCl_3$ solution as described by Oyaizu (1986). A 2.5 ml aliquot was mixed with 2.5 ml of 200 mM sodium phosphate buffer (pH 6.6) and 2.5 ml of 1% potassium ferricyanide. The mixture was incubated at 50^{o}C for 20 min and then 2.5 ml of 10% trichloroacetic acid was added. This mixture was centrifuged at 801 × g for 10 min. 5 ml of the supernatant was mixed with an equal volume of water and 1 ml of 0.1% ferric chloride. The absorbance was measured at 700 nm and ferric reducing power was subsequently calculated using ascorbic acid equivalent.

Thiobarbituric Acid Reactive Substances (TBARS) Assay

Thiobarbituric acid reactive substances (TBARS) in tissue homogenate were assayed by method of Okhawa *et al*., (1979). The colour was developed by adding 300µl 8.1% SDS to homogenate, followed by sequential addition of 500µl acetic acid/HCl (pH 3.4) and 500µl 0.8% TBA. This mixture was incubated at 95ºC

for 1 hour forming a purple color product which was measured at 532nm and the absorbance was compared to that of a standard curve obtained using malondialdhyde (MDA).

STATISTICAL ANALYSIS

All values obtained were expressed as mean ± SEM of three independent experiments carried out in different days using Duncan's New Multiple Range Tests where appropriate with significant difference from control at $p < 0.05$.

RESULTS

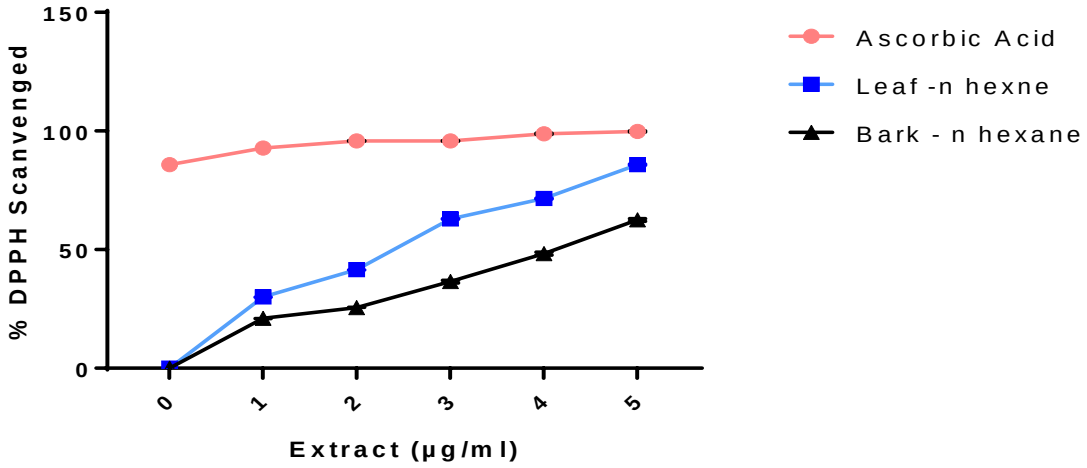

Figure 1: DPPH radical scavenged of extracts leaf and bark n-hexane extracts of *Azadirachta indica*. Data represent mean ± SD of three independent experiments.

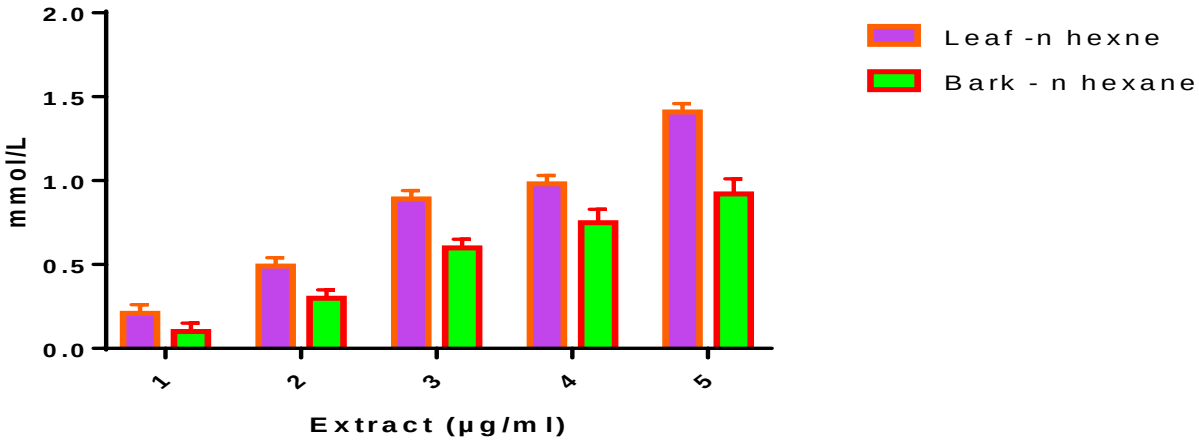

Figure 2: Ferric reducing antioxidant abilities of extracts leaf and bark n-hexane extracts of *Azadirachta indica*. Data represent mean ± SD of three independent experiments.

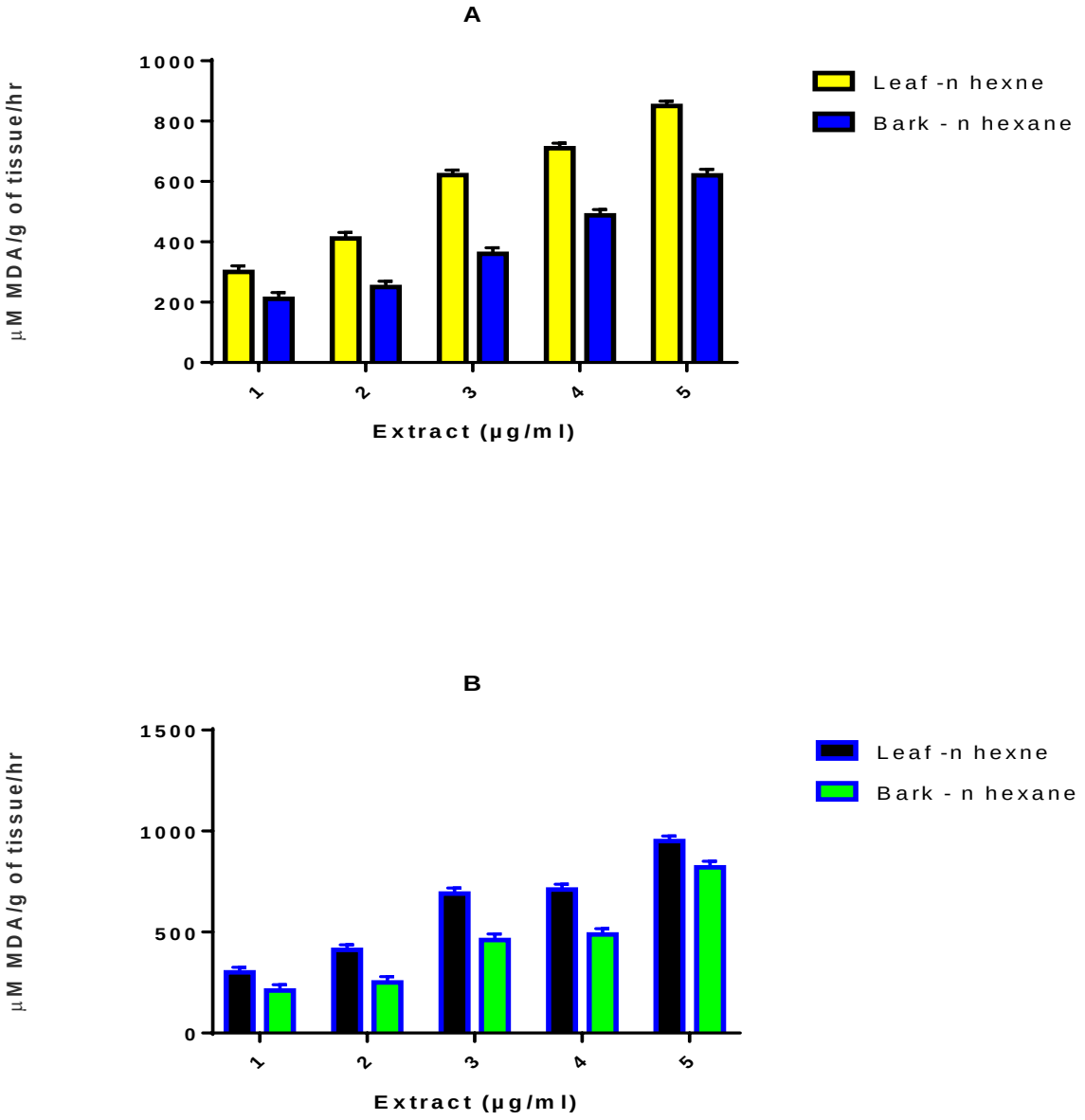

Figure 3: The effect of leaf and bark n-hexane extracts of *Azadirachta indica* on brain tissue induced lipid peroxidation by Fe^{2+} (panel A) and SNP (panel B). Data represent mean ± SD of three independent experiments.

DISCUSSION

The antioxidant potentials of non-polar extracts (1 – 5 µg/ml) of leaf and bark of *Azadirachta indica* in an *in vitro* model was evaluated in this research work. For instance, the extent to which DPPH radicals could be scavenged, reduction of ferric ions to ferrous ions and inhibition of lipid peroxidation induced by iron.

DPPH radical is one of the free radicals commonly used for prelude radical scavenging abilities of plant extracts. This is because DPPH radical is stable and can decolorize in the presence of antioxidants (Biswas *et al*., 2002; Liu *et al*., 2011). The scavenging abilities of antioxidants are either by the transfer of electron or

hydrogen atom DPPH radical, thereby neutralizing its free radical property (Pan *et al*., 2008). The result as presented in Figure 1 shows that the leaf extract exhibited much higher DPPH radical scavenging abilities that the bark extract, even when compared with ascorbic acid in the current study.

More so, in the Ferric reducing antioxidant power, FRAP assay similar trend was observed. FRAP is another conventional method used in evaluating the antioxidant capacity of plant extracts. The principles of FRAP assay is based on the antioxidant strength in reducing ferric tripyridyltriazine complex to its ferrous form. The intensity of the blue colour formation is proportional to the concentration of the ferrous form and the antioxidant capacity of the extract. The leaf and bark extracts of the plant exhibited antioxidant capacity in this assay. This implies are usually electron donors as they reduce the oxidized intermediate to the stable form in order to eliminate the oxidation chain reaction (Nwanjo *et al.,* 2006; Muller *et al.,* 2007). However, the result shows the extracts significantly reducing antioxidant power for the leaf extract more than the bark extract ($P<0.05$).

In same manner, lipid peroxidation assay was done. Lipid peroxidation is painstaking as the main molecular mechanisms involved in the oxidative damage to cells and its components, which lead to cell death). It is a multifaceted process well-known to occur in both plants and animals, that involves the formation and propagation of lipid radicals, the uptake of oxygen, a rearrangement of the double bonds in unsaturated lipids and the eventual destruction of membrane lipids, with the production of a variety of breakdown products, like alcohols, ketones, alkanes, aldehydes and ethers (Dianzani and Barrera, 2008; Marisa *et al*., 2012). Reactive Oxygen Species (ROS) enhances lipid peroxidation of cell membrane's phospholipids (Vazzana *et al*., 2013). It is catalyzed by iron resulting in the formation of peroxyl radicals (ROO•). Once formed, peroxyl radicals can be rearranged via a cyclisation reaction to endoperoxides (precursors of malondialdehyde) with the final product of the peroxidation process being malondialdehyde (MDA). In addition, Lipid peroxidation products are formed with the abstraction of a hydrogen atom from an unsaturated fatty acid. The lipid peroxidation process influences membrane fluidity as well as the integrity of biomolecules associated with the membrane (membrane bound proteins or cholesterol). These highly oxidizable lipids may then, in turn, attack nearby proteins causing the formation of an excess of protein carbonyls. A major development over the past two decades has been the realization that free radical mediated peroxidation of membrane lipids and oxidative damage of DNA are associated with a variety of chronic health problems, such as cancer, atherosclerosis, neurodegenerative diseases, and aging. Therefore, inhibition of oxidative damage by supplementation of antioxidants becomes an attractive therapeutic strategy to reduce the risk of these diseases. To measure lipid peroxides, the amount of MDA is determined calorimetrically after reaction with thiobarbituric acid (Dana, 1986). The ability of leaf and bark extracts of *Azadirachta indica* to prevent the deleterious effect of iron mediated lipid peroxidation in the cerebral tissue homogenates was investigated.

However, the result showed that the leaf extracts was able to prevent Fe^{2+}-induced lipid peroxidation in wistar rat brain more than the bark extracts. This is because there was inhibition of the formation of thiobarbituric acid reactive species and this inhibition is very much significant, as revealed by Figure 3, panels A and B.

Literature data have shown that neem leaf and bark are radical scavengers because of their polyphenol contents which are excellent nucleophiles (Maxwell, 1995; Shinde *et al*., 2012). This may also give them the attribute to quench lipid per oxidation, acting as chain break antioxidants (Lakshmi *et al*., 2012). Furthermore, bioflavonoids have been shown to possess pharmacokinetic properties similar to those of tocopherol (Vitamin E) and dietary phenolic acids may also have physiological antioxidant properties, quenching reactive oxygen species (ROS), thereby potentially modifying pathogenic mechanisms relevant to cardiovascular disease (Malaguti *et al*., 2014).

CONCLUSION

In conclusion, it was observed that non-polar extracts of neem leaf is richer in antioxidant than the non-polar extracts of neem bark. Although further studies should be carried out on the plant seed or root using polar and other non-polar solvent for both *in vitro* and *in vivo* models and possibly isolate, identify and characterize the active component so as to maximize the medicinal potential of the plant.

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EVALUATION OF NUTRIENT AND ANTI-NUTRIENT OF SOME TRADITIONAL GREEN LEAFY VEGETABLES IN EDO NORTH, NIGERIA

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ABSTRACT

Traditional green leafy vegetables are a major component of diets of rural and urban households in Nigeria. Many of them grow wild and are used as food and medicine especially in the rural areas. This study was carried out to determine the mineral content, proximate, phytochemical and ant-nutrient in Ujuju leave (*Myrianthus arboreus)*, bitter leave (*vernonia amygdalina*), pumpkin leave (*Telfairia occidentalis*), green vegetable (*Brassica oleracea*), Scent leave (*Ocimum gratissimum*), bitter herb (*Gongronema ratifolia*), cassava leave (*Manihot esculenta krantz*), Okazi leave (*Gnetum africanum*). The result for the proximate showed that the edible leafy vegetables contained a lot of carbohydrate (50.10% - 55.18%). The ash and fat were generally low with Ujuju leave having the least value of ash (2.75 ± 0.01) and Okazi leave having the least value of fat (3.27 ± 0.01). From the phytochemical result, all leaves were high in tannins, alkaloids and flavonoid (++). The Saponins, phenolic, steroids and glycosides were relatively low with some of the leaves lacking phenolic or steroids or both. In the anti-nutritional factors, all the leaves were high in flavonoid (2.65 ± 0.01 – 3.30 ± 0.05) and low in Saponins (0.38 ± 0.01 – 0.64 ± 0.01). The tannins (1.06 ± 0.01 - 1.15±0.01), alkaloids (1.18 ± 0.01-1.28 ± 0.01), phytate (1.20 ± 0.01-1.35 ± 0.01), oxalate (1.25 ± 0.01- 1.43± 0.01) and polyphenol (1.09 ± 0.03 - 1.24 ± 0.01) were relatively low. The vegetables contain significant quantities of carbohydrate, fibre, protein, tannins, alkaloids and flavonoid which have health promoting benefits.

(key words: Vegetables, phytochemical, antinutrient, proximate)

INTRODUCTION

Vegetables are those herbaceous plants whose part or parts are eaten as supporting food or main dishes and they may be aromatic, bitter or tasteless (Edema, 1987). Indigenous green leafy vegetables are a major component of diets of rural and urban household in Nigeria (Akwaowo et al., 2007). They add variety to the menu and are valuable sources of nutrients especially in rural areas where they contribute substantially to proteins, minerals, vitamins, fibres and other nutrients which are usually in short supply in daily diets. The nutrient content of different types of vegetables varies considerably and they are not major sources of carbohydrates compared to the starchy foods which form the bulk of food eaten, but contain vitamins, essential amino acids, as well as minerals and antioxidants (Fasina *et al*., 2006). According to Okafor (2004) vegetables are the cheapest and most

available sources of important proteins, vitamins, minerals and essential amino acids. Vegetables are included in meals mainly for their nutritional and medicinal properties. The medicinal value of these plants lies in some chemical substances that produce a definite physiological action on the human body. Some plant foods have nutritional and medicinal properties (Yan *et ai*., 2003) because of the interaction between their nutrient and phytochemical constituents. There are some used and inexpensive leafy vegetables grown in Nigeria whose chemical and anti-nutritive potentials are yet to be adequately studied and utilized. The objective of this study is to determine the proximate composition, phytochemical composition, anti-nutrients and mineral content of some Traditional Green Leafy Vegetable in Edo North, Nigeria.

MATERIALS AND METHODS

Sample collection

Ujuju leave (*Myrianthus arboreus*), bitter leave (*Vernonia amygdalina*), pumpkin leave (*Telfairia occidentalis*), Green vegetable (*Brassica oleracea*), scent leave (Ocimum gratissimum), bitter herb (*Gongronema ratifolia*), cassava leave (*Manihot esculenta* krantz) and Okazi leave (*Gnetum africanum*) were collected. The samples were dried in a shade to remove moisture.

Reagents

Distilled water, Ammonium buffer, EDTA, Hydroxylamine, NaOH, Arychrome BLACK T-indicator, KCn, Molybdenum salt, H_2So_4, $FeCl_3$, $KMnO_4$, Antimonium Potassium titrate and P-developer. All chemicals used were Analar grades.

The digestion was subjected to Flame photometer (410 Sheerwood) and UV Spectrometer for colour (UV 2100 Unicorn) in triplicate.

Fat content determination

The method described by Nielsen (1994) was adopted and used. 0.5g of crushed chips was placed in a test tube, 5ml of petroleum ether were added and stopped. It was shaken and centrifuged for 5 minutes to allow the solid particles settle to the bottom. The liquid was decanted into a pre-weighed flask. Another 5ml of the petroleum ether were added to the solid in the test tube and the procedure was repeated. The flask was then warmed to drive off the ether. The flask and the solid were then weighed. The percent fat in the sample was calculated using the formula: % Fat = wt of solid fatx100 Wt of sample.

Crude fibre content determination

The crude fibre content was determined according to the method as described by Pearson, (1976), 2g of ground sample was weighed into a 1 liter conical flask. 200ml 0f 5% Conc. (H_2SO_4) Sulphuric acid was Added. It was digested over a sand bath for 30 minutes. It was diluted in distilled water and filtered using vacuum pump. It was washed with hot distilled water and tested neutrality with blue litmus paper. 200ml of 5% NaOH (Sodium Hydroxide) solution was added, and digested a sand bath for 30 minutes; dilute with distilled water and filter. Few drops of 5% HCl was added and washed using a vacuum pump. It was tested for neutrality with red Litmus acetone.

Protein content determination

This determination is a modified Kjeldahl Method. In Bremmer (1965) instead of titrating the digested sample with NaOH in a Kjeldahl apparatus, an aliquot of the digested sample, plus some colour developing reagents were used to develop

colours which were read in a spectrophotometer at 630nm. Protein is obtained by multiplying percentage Nitrogen by 6.25 i.e. Protein % = N% x 6.25

Phytate determination

Method of Young and Greaves (1990) was used. 8g of finely ground sample was soaked in 20% Hcl and allowed to stand for 3hours. After 3 hours it was filtered through layers of filter paper and 50ml pipette from the filtrate into a 400ml beaker and 10ml of 3% ammonium thiocynate solution indicator added. 10ml of distilled water was added to obtain the proper acidity. The solution was titrated with a standard ferric chloride solution containing about 0.00185g/ml until a brownish yellow colour persisted for five minutes. The user equivalent was obtained and from the amount, phytin phosphorus was found by multiplying by conversion factors. This was converted by multiplying by the factor 3.55 to obtain the phytic acid content.

$$\text{Phytic Acid} = \frac{\text{factors} \times \text{titre}}{1{,}000 \times \text{weight of sample}} \times \frac{100}{1}$$

Tannin determination

The tannin content of the seed flour was determined by Van-burden and Robinson (1981). 500g of the sample was weighed into a 500ml plastic bottle. 500ml of distilled water was added and shaken for 1 hour by a mechanical shaker. This was filtered into a 500ml volumetric flask and made up to mark. Then 5ml of the filtrate was pipette out into a test tube and 0.008m potassium Ferro cyanide. The absorbance was measured at 420nm within 10minutes.

Oxalate determination

The oxalate content of the seed flourwere determined by Day and Underwood (1986).1 gram of the sample was weighed into a 100ml conical flask. 75ml of 0.5m H_2So_4 was added and the solution was carefully stirred intermittently with magnetic stirrer for about one hour and then filtered using Whatman No 1 filter paper. 25ml of the sample filtrate (extract) was collected and filtered hot (80-90^{0}C) against 0.1N$KMnO_4$ solution to the point faint pink colour that persisted for at least 30 seconds. The oxalic acid content was estimated according to the relationship;

Oxalic acid (mg/g) = titre × 0.9004mg/g

Saponin determination

Method of Obadoni and Ochuko (2001) was used. The samples were grinded and 20g of each were put into a conical flask and 100ml of 20% aqueous ethanol were added. The samples were heated over a hot water bath for 4hours with continuous stirring at about 55^{0}c. The mixture was filtered and the residue re-extracted with another 200ml 20% ethanol. The combined extracts were reduced to about 40ml over water bath at about 90^{0}C. The concentrate was recovered while the ether layer was discovered. The purification process was repeated. 6ml of n-butanol was added, the combined extracts were washed twice with 10 ml of 50% aqueous sodium chloride. The remaining solution was heated in a water bath after evaporation, the samples were dried in the oven to a constant weight, and the saponincontent was calculated as percentage.

$$\text{Saponin \%} = \frac{\text{wt of sample of washing and drying}}{\text{Wt of sample used}} \times \frac{100}{1}$$

PHYTOCHEMICAL ASSAY

The method of Trease and Evans (2002) was used to identify the following

phytochemicals in the crickets and feeds i.e. alkaloids, Saponins, tannins, anthroquinones, flavonoids, steroid or triterpenoids and glycosides. Specific tests for different phytochemicals was carried out also using the various methods by Pearson (1976).

Test for Alkaloids: 1cm^3 of 1% HCL was added to 3cm^3 of the extracts in a test tube. The mixture was heated for 20 minutes. It is then cooled and filtered. The filtrate will used for the following test: (i) 2 drops of Mayer's reagent was added to 1cm^3 of the extracts. No reddish coloured precipitate observed in each feeds tested, indicated the absence of alkaloids in the extracts. (ii) Drops of wanger's reagent was added to 1cm^3 of the extracts. A reddish brown precipitate observed in each feeds, indicated the absence of alkaloids in the extracts.

Test for glycosides: 0.1g of the feed sample was boiled with 10ml of water in a beaker for 20mins, and then filtered. From the filtrate, 2ml was mixed with Fehling solution (A & B) and then heated for 1min. another sample from the filtrate was added to 5ml dilute H_2SO_4 and boiled for 3-5mins and sodium bicarbonate added, then 2ml Fehling solution (A & B) was added and mixed, boiled for 1min. results indicated the presence of carbohydrate, reducing sugar (glycosides).

Test for Saponins: (i) Frothing test: 2cm^3 of the extracts in a test tube is vigorously shaken for 2 minutes. Frothing observed in each extract tested indicates the presence of Saponins. (ii) Emulsion test: 5 drops of olive oil was added to 3cm^3 of the feed in a test tube and the mixture vigorously shaken. A stable emulsion formed in each extract tested indicates the presence of Saponins.

Test for steroids: 0.5g of the powder sample was extracted with methanol and then filtered. The filtrate was evaporated to dryness. And the residue dissolved in 2ml chloroform. Sulphuric acid was carefully added to form a lower layer. A pink-red color observed at the interphase of both liquids indicates the presence of steroid.

Test for Flavonoids: 1cm^3 of 10% NAOH is added to 3cm^3 of the extracts. A yellow coloration observed in each feed tested indicates the presence of flavonoids.

STATISTICAL ANALYSIS

Significance of difference was tested by analysis of variance and the Tukey–Kramer test using the GraphPad InStat version 2.04a (GraphPad Software Inc, San Diego, California, USA).

RESULTS

The results of the proximate analysis, phytochemical screening and anti-nutritional factors of eight Nigerian traditional green leafy vegetables are shown in tables 1, 2 and 3.

TABLE 1: PROXIMATE ANALYSIS OF EIGHT GREEN VEGETABLES

S/N	% PROTEIN	% FAT	% ASH	% FIBRE	% M.C.	% CHO
Ujuju leaves	18.36 ± 0.01	4.58 ± 0.01	2.75 ± 0.01	13.67 ± 0.01	10.56 ± 0.03	50.10 ± 0.02
Bitter leave	14.48 ± 0.01	4.79 ± 0.01	4.06 ± 0.01	12.26 ± 0.01	10.44 ± 0.01	53.99 ± 0.01

Pumpkin leave	15.84± 0.01	3.86± 0.02	3.85 ± 0.01	13.08 ± 0.01	10.76 ± 0.01	52.62± 0.04
Green leave	16.68 ± 0.01	4.18 ± 0.01	3.27 ± 0.03	12.54 ± 0.01	10.37 ± 0.01	52.98 ± 0.03
Scent leave	14.73± 1.49	3.68 ± 0.01	3.13 ± 0.01	12.79 ± 0.01	10.96 ± 0.01	54.72 ± 1.48
Bitter herb	14.76 ± 0.01	4.34 ± 0.01	3.29 ± 0.01	13.07 ± 0.01	10.06 ± 0.01	54.49 ± 0.00
Cassava leave	16.65 ± 0.01	3.76 ± 0.02	3.17 ± 0.01	12.29 ± 0.01	10.18 ± 0.01	53.97 ± 0.03
Okazi leave	15.58 ± 0.01	3.27 ± 0.01	3.25 ± 0.01	12.38 ± 0.01	10.36 ± 0.01	55.18 ± 0.01

Results are mean ± SD of three independent determinations. Values in a column with different letters are significantly different ($P < 0.05$)

TABLE 2: PHYTOCHEMICAL SCREENING OF EIGHT GREEN LEAFY VEGETABLES

S/N	Saponins	tannins	Alkaloids	Flavonoid	Phenolic	Steroids	Glycosides
“ujuju” leave	+	++	++	++	+	+	+
Bitter leave	+	++	++	++	-	-	+
Pumpkin leave	+	++	++	++	-	-	+
Green leave	+	++	++	++	+	-	+
Scent leave	+	++	++	++	-	+	+
Bitter herb	+	++	++	++	+	+	+
Cassava leave	+	++	++	++	+	+	+
“okazi” leave	+	++	++	++	+	+	+

TABLE 3: ANTI-NUTRITIONAL FACTORS OF EIGHT LEAFY VEGETABLES

Mg/ 100g	Saponins	Tannins	Alkaloids	Phytate	Oxalate	Flavonoids	Polyphenol
"ujuju" leave	0.64 ± 0.01	1.15 ± 0.01	1.24 ± 0.01	1.35 ± 0.01	1.37 ± 0.01	3.30 ± 0.05	1.13 ± 0.01
Bitter leave	0.75 ± 0.01	1.08 ± 0.01	1.28 ± 0.01	1.28 ± 0.01	1.43 ± 0.01	3.27 ± 0.01	1.18 ± 0.01
Pumpkin leave	0.58 ± 0.01	1.10 ± 0.01	1.19 ± 0.01	1.34 ± 0.01	1.37 ± 0.02	3.26 ± 0.01	1.24 ± 0.01
Green leave	0.45 ± 0.01	1.07 ± 0.01	1.18 ± 0.01	1.26 ± 0.01	1.28 ± 0.01	3.18 ± 0.01	1.18 ± 0.01
Scent leave	0.39 ± 0.01	1.13 ± 0.01	1.26 ± 0.01	1.28 ± 0.01	1.34 ± 0.01	2.98 ± 0.01	1.09 ± 0.03
Bitter herb	0.38 ± 0.01	1.09 ± 0.01	1.24 ± 0.01	1.20 ± 0.01	1.27 ± 0.01	2.85 ± 0.01	1.09 ± 0.05
Cassava leave	0.43 ± 0.01	1.06 ± 0.01	1.26 ± 0.01	1.23 ± 0.01	1.25 ± 0.01	2.65 ± 0.01	1.16 ± 0.01
Okazi leave	0.49 ± 0.01	1.12 ± 0.01	1.19 ± 0.01	1.27 ± 0.01	1.36 ± 0.01	2.76 ± 0.01	1.11 ± 0.01

Results are mean ± SD of three independent determinations. Values in a column with different letters are significantly different ($P < 0.05$)

DISCUSSION

The proximate analysis (table1) shows that all leaves were high in carbohydrate with Okazi leave having the highest percentage of carbohydrate. Ujuju leave had the lowest value of carbohydrate. However, the highest value of fibre was in Ujuju leave and the lowest value was in bitter leave. Fibre cleanses the digestive tract, by removing potential carcinogens from the body and prevents the absorption of excess cholesterol. Fibre also adds bulk to the food and prevents the intake of excess starchy food and may therefore guard against metabolic conditions such as hyper-cholesterolemia and diabetes mellitus. The presence of mucilage in some vegetables makes their soup more tasty and palatable (Smith, 1985). Excessive intake of fiber can reduce the transit time through the intestines to such a degree that other nutrients cannot be absorbed. This is because calcium, iron, zinc and magnesium share the same transport system and reduced absorption of other minerals. The value of protein obtained was moderate. The highest value of protein was found in Ujuju leave and bitter leave had the lowest value of protein. Fat and ash had low values. This is in line with the literature review which classified vegetables as a poor source of the nutrient especially for fresh samples (Okafor, 2004). Among the proximate components, fat and ash are the lowest in the edible green leafy vegetables. The moisture content of the edible green leafy vegetables were moderate with scent leave having the highest value and cassava leave having the lowest value. Leafy green contain water which keeps us hydrated and contributes to beautiful skin and hair.

Traditional edible green leafy vegetables have proven a nutritive value in terms of having more protein, minerals, carbohydrate and vitamins than some exotic vegetables (Sotelo *et al*., 2007). Leafy vegetables are said to be an invaluable substitute for meat and therefore form important part of daily

diets of rural communities in particular, especially in the study area. Qualitative analyses of the phytochemical components in the edible leafy vegetables studied are presented in table 2. The medicinal properties of these components have been documented by a number of researchers (Sotelo *et al*., 2007). It is noteworthy that alkaloids were recorded in the eight leafy vegetables studied that they all have nutritive and medicinal values; they all contained Saponins, tannins, flavonoid and glycosides; five contained phenolic and five contained steroid. In this locality, hypertensives are usually placed on diet containing large quantities of *Vernonia amygdalina* (bitter leaf) which is high in carbohydrate, alkaloid, Saponins, tannins, flavonoid and glycosides. From the result obtained, higher values were gotten for tannins, alkaloid and flavonoid in bitter leave. Ayitey-Smith (1989) had earlier recorded that bitter leaf contains an alkaloid, vernomine, which is capable of reducing headaches associated with hypertension. The therapeutic relevance of bitter leaf has also been reported by Odugbemi (2006) and Okoli *et al*. (2007). The other leaves like "ujuju", pumpkin leaf, green vegetable, scent leave, bitter herb, cassava leave and "okazi" leaf are also important sources of alkaloid with medicinal properties and are used in the management of cold, chronic catarrh, persistent headaches and migraine (Sotelo *et al*., 2007). They can also be used in the treatment of diarrhea by local inhabitants which have been documented by Onwuka (1983) among the Yorubas of Western Nigeria. The medicinal importance of tannins and Saponins which are components of traditional herbal preparations used in managing various common ailments has been reported by Onwuka (1983). The antibacterial properties of tannins have been documented by Banso and Adeyemo (2007). The leaves eaten in soup are thought to assist conception in women in this locality and this has been reported in Ghana. Phytochemical investigation of this plant has yielded more than twenty different compounds; mainly amide alkaloids (Onwuka, 1983) and some of these alkaloids have been found to possess antimicrobial activities against organisms such as Klebsiella pneumonia, Mycobacterium smegmatis and Candida albicans (Okafor, 2004). The result of phytochemicals has showed that flavonoids and alkaloids is an indication of the medicinal potential of the leaves. Anti-nutrients (table 3) are natural or synthetic compounds that interfere with the absorption of nutrients. Phytate which is an anti-nutrient that interferes with the absorption of minerals from the dietis highest in ujuju leaf and lowest in bitter herb. Phytic acid has a strong binding affinity to minerals such as calcium, magnesium, iron, copper and zinc. This results in precipitation, making the minerals unavailable for absorption in the intestines. Oxalate was present in all edible leafy vegetables studied. Oxalates bind to calcium and prevent its absorption in the human body. Excessive intake of required nutrients can also result in them having an anti-nutrient action. Some proteins can also be anti-nutrients such as the trypsin inhibitors and lectins found in legumes. These enzyme inhibitors interfere with digestion (Hill, 1960). The value of flavonoids in all edible leafy vegetables studied was higher than other anti-nutrient present. Flavonoid is a widespread form of anti-nutrients which are a group of polyphenolic compounds that include tannins. These compounds chelate metals such as iron and zinc and reduce the absorption of these nutrients, but they also inhibit digestive enzymes and may also precipitate proteins (yan *et al*., 2003). The least value of anti-nutrients found in the edible leafy vegetable was Saponins.

Saponins are a class of chemical compounds, one of many secondary metabolites found in natural sources with Saponins found in particular abundance in various plant species. More specifically, they are amphipathic glycosides grouped in terms of phenomenology, by the soap-like foaming they produce when shaken in aqueous solutions and in terms of structure, by their composition of one or more hydrophilic glycoside moieties combined with a lipophilic triterpene derivative. Bitter leave recorded the highest level of soap-like foaming while bitter herb recorded the lowest level of Saponins. However, the levels of anti-nutrients are reduced in modern crops, probably as an outcome of the process of domestication. Many traditional methods of food preparation such as fermentation, cooking and malting increase the nutritive quality of edible leafy vegetables through reducing certain anti-nutrients such as phytic acid, polyphenols and oxalic acid.

CONCLUSION

This study has demonstrated that edible green leafy vegetables contain appreciable quantities of nutrients with health-promoting benefits. The result of the study has shed some light on the substances that are responsible for the medicinal properties of the vegetable. They help protect the body from nutrition related disease. vegetables are potent antibiotics, anti-hypertensives and blood building agents and also Improves fertility in females when eaten in soups.

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THE EFFECT OF AUCHI METROPOLITAN WASTE DUMPSITE ON CADMIUM CONCENTRATION IN SOIL AND LEAVES OF VERNONIA AMYGDALINA GROWING IN IT'S VICINITY

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ABSTRACT

This study investigated the effect of Auchi Metropolitan Waste Dumpsite on Cadmium concentration in Soil and *Vernonia amygdalina* (commonly known as bitter leaf) growing in it vicinity. Soil and plant samples were collected from the dumpsite and at a distance of 200, 400 and 600 meters away from the dumpsite based on the availability of the plant. The samples collected from the dumpsite represented 'Sample 1' while the samples collected at 200, 400 and 600 meters away from the dumpsite represented 'Sample 2, Sample 3 and Sample 4' respectively. The soil and plant leaves were analyzed for cadmium concentration. The results of the analysis showed that the Cadmium concentration in soil was highest in sample 1 (12.60 mg/kg) when compared to sample 2 (10.28 mg/kg), sample 3 (9.56 mg/kg) and sample 4 (8.40 mg/kg). However, the cadmium concentration in all the soil samples (sample 1, sample 2, sample 3 and sample 4) exceeded the permissible limit (3 mg/kg) recommended by Food and Agricultural Organization/World Health Organization (FAO/WHO). The Cadmium concentration in plant leaf was also highest in sample 1 (1.88 mg/kg) when compared to sample 2 (1.48 mg/kg), sample 3 (1.10 mg/kg) and sample 4 (0.64 mg/kg). However, the cadmium concentration in all the plant leaf samples (sample 1, sample 2, sample 3 and sample 4) exceeded the permissible limit (0.02 mg/kg) recommended by World Health Organization (WHO). The metropolitan waste dumpsite increased the concentration of Cadmium in the soil and plant leaf.

Keywords: Auchi, Metropolitan waste dumpsite, Cadmium concentration, Soil, *Vernonia amygdalina*, Permissible limit.

INTRODUCTION

Cadmium (Cd) is a heavy metal that is of great concern in the environment, because of its toxicity to animals and humans. Metals such as Cadmium found in waste dumps exist in various forms either as the pure metal or alloyed with various other metals. The disposal of materials contaminated with heavy metals, such as occurs with garbage dumps and with polluters dumping waste on the side of a road can create patchy point of contamination, which are of concern and pose dangers to people in contact with the contaminated soils. It has been shown that considerable amounts of toxic metals arising from human activities are accumulated in soil (Agirtas *et al*., 1999). With rains, they are percolated into the soil and are eventually translocated into plants and into man through consumption of these plants (Ogunsola *et al*., 1993). They thus enter the food chain as a result of their uptake by edible plants (Kilicel, 1999). Toxic heavy metals such as cadmium can also be taken directly by man and other animals through inhalation of dusty soil. Heavy metals impairing the quality of our environment come from various sources that can be categorized into urban-industrial aerosols, liquid and solid wastes from animal and man, mining industry and agricultural chemicals (Gerard, 1996). Heavy metal pollutants such as cadmium and lead

(Nyangababo and Hamya, 1986; Alloway, 1993) from additives used in gasoline and lubricating oils are also deposited on highway soils and vegetation. Urban areas known for high level of industrial activities generate more pollutants and therefore subject to the menace of resultant indiscriminate disposal of both domestic and industrial wastes. A typical example of such urban centres is Auchi located in Etsako west local government area of Edo state, Nigeria. There are reports that suburbs of such urban centres are loaded with toxic heavy metals and certain trace elements resulting from poor waste management programme (Obute *et al*., 2001). Population explosion and urbanization have increased the quantities and types of solid wastes produced (Ogbonna *et al*., 2007). Most towns in Nigeria including Auchi are characterized by heaps of garbage and rubbish on street corners and junctions, open place and in drainages, resulting from open dumping of waste. Both the quantity and quality of solid waste generated in Nigeria vary very widely from day to day and according to the season of the year and still increasing mainly due to improper waste management (Ademola, 1993; Osibanjo, 1995; Adeniji and Ogu, 1998; Ideriah *et al*., 2005). Ideriah *et al* (2005) reported that concentrations of heavy metals in soil around waste dumps are influenced by types of wastes, topography, run-off and level of scavenging. Solid waste dumped along roadsides are usually left over a long time to decompose naturally (by microorganisms), eaten by animals, picked by scavengers or washed away by the floods into the larger creek and rivers thus affecting the surface water quality (Ogbonna *et al*., 2007). In addition to the degradation of the physical environment, this condition impacts the natural environment aesthetically and health wise (Ogbonna *et al*., 2007). They harbour flies, fleas, mosquitoes, rats and other disease vectors, which could cause several diseases such as Lassa fever, malaria, filariasis and yellow fever (Ekugo, 1998).

Vernonia amygdalina (commonly known as bitter leaf) is a shrub or small tree of 2 m - 5 m with petiolate leaf of about 6 mm diameter and elliptic shape. The leaves are green with a characteristic odour and a bitter taste. They are used as vegetable and stimulate the digestive system, as well as reduce fever. *Vernonia amygdalina* is also used to make beer in Nigeria.

It is the aim of this study to determine the effect of Auchi metropolitan waste dumpsite on cadmium concentration in soil and *Vernonia amygdalina* growing in it's vicinity.

MATERIALS AND METHODS

Dumpsite Location and Description

Auchi metropolitan waste dumpsite is located in the forest area along new Igarra road, Auchi. It spreads over an area of approximately 1,000,000 square metres and the waste fill height vary from 2metres to 4metres. The waste dumped at this site include kitchen waste, plastic, glass, metals, clothes, batteries, tyres and hospital wastes. The site is an open dump.

Sample Collection and Preparation

Soil and Plant samples were collected from the dumpsite and at a distance of 200, 400 and 600 metres away from the dumpsite based on availability of the plant. Each soil sample weighed 200 grams. The test plant was *Vernonia amygdalina* (commonly known as bitter leaf). The plants were uprooted and washed in distilled water to remove soil particles from the root. The soil and plant samples were put in black polythene bags, tied and labeled with masking tape and marker. The samples collected from the dumpsite were labeled as 'Sample 1', while the samples collected at 200, 400 and 600 metres away from the dumpsite were labeled as 'Sample 2, Sample 3 and Sample 4' respectively. The Samples were taken to the laboratory at chemistry division of the Nigerian Institute for Oil Palm Research (NIFOR) to analyze the cadmium concentration of the soil and plant leaves.

Sample Treatment and Analysis

The plant samples were separated into leaves, stems, and roots. The Soil and plant leaves were oven-dried at 100^0c for 48 hours and ground to fine powder. 2 grams of each

soil sample and 1gram of each plant sample was acid digested using nitric acid. Samples were kept on hot plate. After removing from hot plate, each sample was filtered into 100 mililiters graduated cylinder up to 35 mililitres so that 35 mililitres of each sample was prepared. The samples were subjected to Atomic absorption spectrophotometer (Perkin Elmer) to analyze the cadmium concentration of soil and plant leaves.

RESULTS AND DISCUSSION

Table 1 shows the result for cadmium concentration in soil samples and Food and Agricultural Organization/World Health Organization (FAO/WHO) permissible limit in soil. The cadmium concentration in soil decreased with distance away from the dumpsite. The cadmium concentration in soil was highest in sample 1 (Dumpsite soil) (12.60 mg/kg) when compared to sample 2 (soil collected at a distance of 200 meters away from the dumpsite) (10.28 mg/kg), sample 3 (soil collected at a distance of 400 meters away from the dumpsite) (9.56 mg/kg), and sample 4 (soil collected at a distance of 600 meters away from the dumpsite) (8.40 mg/kg). However, the cadmium concentration in all the soil samples (sample 1, sample 2, sample 3 and sample 4) exceeded the permissible limit (3.00mg/kg) recommended by FAO/WHO (2001).

Table 2 shows the result for cadmium concentration in plant samples and World Health Organization (WHO) permissible limit in plant. The cadmium concentration in plant decreased with distance away from the dumpsite. The cadmium concentration in plant was highest in sample 1 (Dumpsite plant) (1.88 mg/kg) when compared to sample 2 (plant collected at a distance of 200 meters away from the dumpsite) (1.48 mg/kg), sample 3 (plant collected at a distance of 400 meters away from the dumpsite) (1.10 mg/kg) and sample 4 (plant collected at a distance of 600 meters away from the dumpsite) (0.64 mg/kg). However, the cadmium concentration in all the plant samples (sample 1, sample 2, sample 3 and sample 4) exceeded the permissible limit (0.02mg/kg) recommended by WHO (1996).

The metropolitan waste dumpsite increased the concentration of cadmium in the soil and plants. Excess level of Cadmium intake (cadmium poisoning) may cause flue-like symptoms including chills, fever and muscle ache sometimes referred to as ‘the Cadmium blues’. More severe exposures can cause tracheobronchitis, pneumonitis and pulmonary edema (Robards and Worsfold, 1991). Symptoms of inflammation may start hours after the exposure and include cough, dryness and irritation of the nose and throat, headache, dizziness, weakness, fever, chills and chest pain. Complications of Cadmium poisoning include: cough, anemia and kidney failure (possibly leading to death). Cadmium exposure increases one’s chances of developing cancer (Christine, 1997).

CONCLUSION AND RECOMMENDATION

This study shows that Auchi metropolitan waste dumpsite increased the concentration of Cadmium in the soil and *Vernonia amygdalina* (commonly known as bitter leaf) growing in it vicinity, since the farther the soil and plants from the dumpsite, the lesser the concentration of Cadmium in the samples. Plants such as *Vernonia amygdalina* growing in the vicinity of a metropolitan waste dumpsite are prone to contamination by Cadmium, since the concentration in plant samples exceeded the permissible limit recommended by World Health Organization (WHO). We therefore recommend that Metropolitan waste dumpsite should be sited in locations that are far away from farmlands, so that the release of heavy metals such as cadmium to such soil will be minimized. This will reduce the contamination of plants growing on such soil.

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Table 1: Cadmium Concentration in Soil Samples

Samples	**Concentration (mg/kg)**
Sample 1	12.60
Sample 2	10.28
Sample 3	9.56
Sample 4	8.40
FAO/WHO Permissible Limit	3.00

Table 2: Cadmium Concentration in Plant Samples

Samples	**Concentration (mg/kg)**
Sample 1	1.88
Sample 2	1.48
Sample 3	1.10
Sample 4	0.64
WHO Permissible Limit	0.02

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THE EFFECT OF IBIENAFE METROPOLITAN WASTE DUMPSITE ON LEAD CONCENTRATION IN SOIL AND LEAVES OF NEWBOULDIA LAEVIS GROWING IN IT'S VICINITY

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ABSTRACT

This study investigated the effect of Ibienafe Metropolitan Waste Dumpsite on Lead concentration in Soil and *Newbouldia laevis* (commonly known as fence plant) growing in it vicinity. Soil and plant samples were collected from the dumpsite and at a distance of 200, 400 and 600 meters away from the dumpsite based on the availability of the plant. The samples collected from the dumpsite represented 'Sample 1' while the samples collected at 200, 400 and 600 meters away from the dumpsite represented 'Sample 2, Sample 3 and Sample 4' respectively. The soil and plant leaves were analyzed for Lead concentration. The results of the analysis showed that the Lead concentration in soil was highest in sample 1 (63.00 mg/kg) when compared to sample 2 (21.90 mg/kg), sample 3 (17.00 mg/kg) and sample 4 (10.80 mg/kg). However, the Lead concentration in Sample 1 (dumpsite soil) exceeded the permissible limit (50 mg/kg) recommended by Food and Agricultural Organization/World Health Organization (FAO/WHO). The Lead concentration in plant leaf was also highest in sample 1 (1.90 mg/kg) when compared to sample 2 (1.40 mg/kg), sample 3 (0.90 mg/kg) and sample 4 (0.65 mg/kg). However, the lead concentration in all the plant leaf samples (sample 1, sample 2, sample 3 and sample 4) exceeded the permissible limit (0.43 mg/kg) recommended by Food and Agricultural Organization/World Health Organization (FAO/WHO). The result of this study shows that the metropolitan waste dumpsite increased the concentration of Lead in the soil and plant leaf.

Keywords: Ibienafe, Metropolitan waste dumpsite, Lead concentration, Soil, *Newbouldia laevis*, Permissible limit.

INTRODUCTION

Lead (pb) is one of the most widespread heavy metal contaminant in soils. It is highly toxic to living organisms even at low concentration. Lead has no biological function but can cause morphological, physiological and biochemical dysfunction in plants. It is a heavy metal of anthropogenic origin (Hassan *et al.*, 2009). Lead is a pollutant that accumulates in soils, sediments and water and it is extremely persistent in the environment. Nearly all human activities generate waste and the way in which this is stored, collected and disposed of, can pose risks to the environment and to public health (Zhu *et al*., 2008). The earth is very good at recycling waste, but when the amount of wastes generated is far more than the earth can cope with, it poses a big threat to lives, a phenomenon called pollution. Pollution occurs at different levels and affects all lives ranging from plants, animals to man (Zhu *et al*., 2008). The decay of these solid wastes releases substances that can affect the soil nutrients content, increase the concentration of heavy

metals in the soil, altering the natural balance of nutrients available for plant growth and development, thereby affecting species diversity and agricultural productions. Heavy metals are natural components of the earth's crust. They can neither be degraded nor destroyed. To a small extent they enter our bodies via food, drinking water and air (Lenntech, 2014). Heavy metals can enter a water supply by industrial and consumer wastes, or even from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers and groundwater (Lenntech, 2014). Heavy metals are dangerous because they tend to bioaccumulate, which means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment (Tahar and Keltoum, 2011). Heavy metals have received the attention of researchers all over the world, mainly due to their harmful effects on plants and other living organisms (Tahar and Keltoum, 2011). Heavy metal content of soils is a critical measurement for assessing the risks of refuse dumpsites. Since these contaminants affect the environmental qualities in and around such open dumpsites, monitoring of soil qualities especially heavy metal content in dumpsite becomes necessary which can facilitate to recommend suitable remedial measures (Biswas *et al*., 2010). The presence of toxic heavy metals in municipal solid waste composts (MSWC) raises serious concerns about the adverse environmental impact as a result of excessive application to agricultural lands (Nicholson *et al*., 2003; Nouri *et al*., 2006; Ayari *et al*., 2008; Mahvi, 2008). Heavy metals originate mostly in non source-separated municipal solid wastes from a variety of sources: batteries, electronic appliances, newspapers, paint chips, foils, motor oils, and plastics that can all introduce metal contaminants into their compostable organic fractions (Hamdi *et al*., 2003). High and excessive accumulation of heavy metals in soil and other media may eventually contaminate both human and animal food chain (Williams *et al*., 1987; He *et al*., 1992; Chukwuji *et al*., 2005).

Newbouldia laevis (commonly known as fence plant) belongs to the family 'Bignoniaceae'. The tree has wide distribution across West and Central Africa. It is often planted as a boundary marker. It also has various medicinal uses. The bark is used in the treatment of Constipation, Piles, Fracture, Menstrual pains and Body pains. The Leaves are used to treat typhoid (Blench, 2015).

It is the aim of this study to determine the effect of Ibienafe metropolitan waste dumpsite on lead concentration in soil and *Newbouldia laevis* growing in it vicinity.

MATERIALS AND METHODS

Dumpsite Location and Description

Ibienafe metropolitan waste dumpsite is located in the forest area of Agbulumi quarters, Ibienafe, South-Ibie, Etsako-West local government area of Edo State. It spreads over an area of approximately 810,000 square metres and the waste fill height vary from 3metres to 5metres. The waste dumped at this site include glass, tyres, batteries, metals, plastic, hospital wastes and kitchen waste. The site is an open dump.

Sample Collection and Preparation

Soil and Plant samples were collected from the dumpsite and at a distance of 200, 400 and 600 metres away from the dumpsite based on availability of the plant. Each soil sample weighed 200 grams. The test plant was *Newbouldia laevis* (commonly known as fence plant). The plants were uprooted and washed in distilled water to remove soil particles from the root. The soil and plant samples were put in black polythene bags, tied and labeled with masking tape and marker. The samples collected from the dumpsite were labeled as 'Sample 1', while the samples collected at 200, 400 and 600 metres away from the dumpsite were labeled as 'Sample 2, Sample 3 and Sample 4' respectively. The Samples were taken to the laboratory at chemistry division of the Nigerian Institute for Oil Palm Research (NIFOR) to analyze the lead concentration of the soil and plant leaves.

Sample Treatment and Analysis

The plant samples were separated into leaves, stems, and roots. The Soil and plant leaves were oven-dried at 100^0c for 48 hours

and ground to fine powder. 2 grams of each soil sample and 1gram of each plant sample was acid digested using nitric acid. Samples were kept on hot plate. After removing from hot plate, each sample was filtered into 100 mililiters graduated cylinder up to 35 mililitres so that 35 mililitres of each sample was prepared. The samples were subjected to Atomic absorption spectrophotometer (Perkin Elmer) to analyze the lead concentration of soil and plant leaves.

RESULTS AND DISCUSSION

Table 1 shows the result of lead concentration in soil samples and the Food and Agricultural Organization/World Health Organization (FAO/WHO) permissible lead limit in soil. The lead concentration in soil decreased with distance away from the dumpsite. The lead concentration in soil was highest in sample 1 (Dumpsite soil) (63.00 mg/kg) when compared to sample 2 (soil collected at a distance of 200 meters away from the dumpsite) (21.90 mg/kg), sample 3 (soil collected at a distance of 400 meters away from the dumpsite) (17.00 mg/kg), and sample 4 (soil collected at a distance of 600 meters away from the dumpsite) (10.80 mg/kg). However, the lead concentration in sample 1 (dumpsite sample) exceeded the permissible limit for lead in soil (50.00mg/kg) recommended by FAO/WHO (2001).

Table 2 shows the result for lead concentration in plant samples and Food and Agricultural Organization/World Health Organization (FAO/WHO) permissible limit in plant. The lead concentration in plant decreased with distance away from the dumpsite. The lead concentration in plant was highest in sample 1 (Dumpsite plant) (1.90 mg/kg) when compared to sample 2 (plant collected at a distance of 200 meters away from the dumpsite) (1.40 mg/kg), sample 3 (plant collected at a distance of 400 meters away from the dumpsite) (0.90 mg/kg) and sample 4 (plant collected at a distance of 600 meters away from the dumpsite) (0.65 mg/kg). However, the lead concentration in all the plant samples (sample 1, sample 2, sample 3 and sample 4) exceeded the permissible limit for lead in plants (0.43mg/kg) recommended by FAO/WHO (2001).

The metropolitan waste dumpsite increased the concentration of lead in the soil and plants. According to Butcher (2009), excessive level of Lead intake (Lead poisoning) can cause the following in children: developmental delay, learning difficulties, irritability, loss of appetite, weight loss, sluggishness and fatigue, abdominal pain, vomiting, hearing loss and seizures. Babies exposed to Lead before birth might be born prematurely, have lower birth weight and slowed growth. Although children are primarily at risk, lead poisoning is also dangerous for adults. Signs and symptoms in adults might include high blood pressure, joint and muscle pain, difficulties with memory or concentration, headache, abdominal pain, mood disorders, reduced sperm count and abnormal sperm, miscarriage and still birth or premature birth in pregnant women.

CONCLUSION AND RECOMMENDATION

This study shows that Ibienafe metropolitan waste dumpsite increased the concentration of lead in the soil and *Newbouldia laevis* (commonly known as fence plant) growing in it vicinity, since the farther the soil and plants from the dumpsite, the lesser the concentration of lead in the samples. Plants such as *Newbouldia laevis* growing in the vicinity of a metropolitan waste dumpsite are prone to contamination by lead, since the concentration in plant samples exceeded the permissible limit recommended by FAO/WHO. It is therefore recommended that Municipal solid waste should be sorted into biodegradable and non-biodegradable waste. The decomposable waste that improves nutrient of the soil should be separated from the non-decomposable waste. Soil containing non-biodegradable waste should not be used for agricultural cultivation of crops, while soil containing biodegradable waste should be used for agricultural cultivation of crops.

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Table 1: Lead Concentration in Soil Samples

Samples	**Concentration (mg/kg)**
Sample 1	63.00
Sample 2	21.90
Sample 3	17.00
Sample 4	10.80
FAO/WHO Permissible Limit	50.00

Table 2: Lead Concentration in Plant Samples

Samples	**Concentration (mg/kg)**
Sample 1	1.90
Sample 2	1.40
Sample 3	0.90
Sample 4	0.65
FAO/WHO Permissible Limit	0.43

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CHEMICAL EVALUATION AND EFFECT OF GERMINATION OF SOME NIGERIAN-GROWN GRAIN LEGUMES

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Abstract

Grain legumes are under-exploited as possible sources of phytase for the poultry industry. The current study was conducted to assess the effect of germination on phytase activities, phytate and total phosphorus content in samples of Nigerian-grown grain legumes. The legumes screened were African yambean (AYB, Sphenostylis stenocarpa), lima bean (Phaseolus lunatus), pigeon pea (Cajanus cajan), cowpea (Vigna unguiculata) and groundnut (Arachis hypogea). Phytase activity was low in AYB, lima bean and pigeon pea but high in cowpea and groundnut. Phytate content ranged between 3.01 g kg−1 and 8.95 g kg−1 while total phosphorus content ranged between 2.63 g kg−1 and 5.93 g kg−1. The grain legumes with higher phytase activity recorded the lowest phytate and phosphorus content. During germination there was an initial 4-fold to 35-fold increase in phytase activity after 6–7 days of germination followed by a decrease until 10 days ($P < 0.05$). The increase in phytase activity during germination was accompanied by a significant reduction in phytate ($P < 0.05$) and a small but significant increase in total phosphorus.The increase in phytase activity and the accompanying decrease in phytate content could have a positive implication for the nutrition of poultry and ruminants and for the environment.

Keywords: legumes; phytase; phytate; phosphorus; germination

INTRODUCTION

Legumes make an important contribution to the human diet in many countries, since they contain high proportion of protein, carbohydrate, dietary fibre, vitamins and non-nutrients (Katina *et al*., 2005) A less widely recognised class of nutrients is minerals, which have major nutritional significance for human and animals. Phosphorus is an essential mineral in the growth and development of poultry. It plays an important role in metabolism, being a part of many important organic compounds involved in metabolic processes, such as phosphates used for energy, and the synthesis of DNA and RNA (Hatten *et al*., 2001). Phosphorus excretion in poultry manure can lead to water pollution when the manure is used as a fertilizer (Sharpley, 1999). The need to maintain sufficient dietary phosphorus levels while reducing phosphorus excretion in poultry manure has led to an increase in the application of phytase to poultry feed. The phytases(myo-inositol hexakisphosphate phosphohydrolases, EC.3.1.3.8, EC.3.1.3.26 and EC.3.1.3.72) are a subfamily of the high□molecular-weight histidine acid phosphatases. They catalyse the phosphate monoester hydrolysis of phytic acid, which results in the stepwise formation of myo-inositol pentakis-, tetrakis- , tris-, bis-, and monophosphates, as well as the liberation of inorganic phosphate (Sathe and Reddy, 2002). The use of phytase reduces phosphorus excretion in poultry manure by allowing the birds to utilise more of the phytate

phosphorus(Sharpley, 1999). Phytate phosphorus has the ability to complex with cations such as calcium, magnesium, zinc, copper and nitrogen and certain gastrointestinal proteases, thus reducing the availability of these cations and of amino acids (Aletor, 1993). The use of phytase may free these cations and proteases bound in phytate phosphorus complexes and improvemany production parameters and body structure characteristics in broilers and laying hens, such as body weight, bone ash content, feed consumption, egg weight, and egg shell quality (Zyla et al., 1999). The phytases used for this purpose are usually of microbial origin and the technology involved in the extraction, purification and thermo-stabilisation of the enzymes is still beyond the reach of developing countries, especially those in Africa. High native phytase activities are present in cereals and by-products (500–10 000 U kg−1), whereas lower activities have been reported for legume seeds (0–300 U kg−1) (Viveros et al., 2000). However, no studies have been carried out on the level of phytase activity in legumes grown in Nigeria. The current study was conducted to assess distribution of phytase activities and the contents of phytate and total phosphorus in samples of different Nigerian grown grain legumes and the influence of sprouting on these parameters

MATERIALS AND METHODS

Samples

Seed samples harvested in 2008 were purchasedfrom localfarmers in Edo State in mid-western Nigeria. The legumes screened were cowpea (Vigna unguiculata), pigeon pea (Cajanus cajan), lima bean (Phaseolus lunatus), African yambean (Sphenostylis stenocarpa) and groundnut (Arachis hypogea).

Surface sterilisation and germination

For surface sterilisation, seeds were soaked in 0.5% NaOCl for 3 min and then in 0.75% H2O2 for 2 min. After soaking, seeds were thoroughly rinsed with sterile water. The pretreated seeds were strained through two layers of gauze before spreading on plastic trays overlaid with wet tissue papers. The seeds were then allowed to germinate in disinfected dark cupboards at 24–28 ◦ C for 0–10 days. The seeds were rinsed once a day with sterile water during the period of germination. After harvesting, the seeds to be used for the determination of phytate and total phosphorus were oven-dried at 60 ◦ C for about 18 h, allowed to cool and then milled. Portions of freshly harvested and the dried, milled samples were used for moisture determination.

Enzyme preparation

The preparation of the crude enzyme was basically as described by Senna et al. (2006) Fresh samples of ungerminated and germinated seeds were homogenised in 0.1 mol L−1 sodium acetate buffer (pH 5.0). The homogenate was centrifuged at 12 000×g for 5 min. The pellets were discarded and supernatants were used for enzyme assays, described as total homogenate. All procedures were carried out at 4 ◦C.

Enzyme activity

Was determined at 4 ◦C. The assay mixture consisted of 350 µL of 0.1 mol L−1 sodium acetate buffer, pH 5.0 and 100 µL of 2 mmol L−1 sodium phytate. This mixture was pre□incubated for 10 min at 40 ◦ C and the enzymatic reactions were started by adding 50 µL of the crude enzyme to the pre-incubated assay mixtures. After incubation at 40 ◦ C for 30 min, the liberated phosphate was measured by using the ammonium molybdate method.11 Added to the assay mixture were 1.5 mL of a freshly prepared solution of acetone/2.5 mol L−1 H2SO4/10 mmol L−1 ammonium molybdate (2 : 1:1 v/v) and 100 µL of 1.0 mol L−1 citric acid. Any cloudiness was removed by centrifugation prior to measurement of the absorbance at 355 nm. To calculate the enzyme activity, a calibration curve was produced over the range of 5–600 nmol of phosphate (ε = 8.7 cm2 µmol−1). Activity (units) was expressed as 1 µmol of phosphate liberated perminute. Blanks were run by adding the ammonium molybdate solution prior to adding the enzyme to the assay mixture.

Phytate extraction and determination

Phytate extraction and determination was essentially according to the method of Wheeler and Ferrel (1971) with slight modifications. Instead of extraction using 3% TCA, 1.2 mol L−1 HCl containing 10% Na2SO4 was used because of excessive foaming with TCA.13

Determination of total phosphorus

The method of Jacobs14 was applied for the determination of total phosphorus. This involved digestion of seeds (5 g) with 30 mL conc. HNO3 and 20 mL conc. H2SO4.

Statistics

Significance of difference was tested by analysis of variance and the Tukey–Kramer test using the GraphPad InStat version 2.04a (GraphPad Software Inc, San Diego, California, USA,).

RESULTS

Table 1. Phytase activity, total phytate and total phosphorus content of selected Nigerian-grown grain legumes

Component	African yambean	Lima beans	Pigeon pea	Cowpea	Groundnut
Phytase (U kg−1)	19.5 ± 0.0a	19.7 ± 0.0a	20.1 ± 0.0a	139.1 ± 1.1b	171.3 ± 1.4c
Phytate (g kg−1)	6.65 ± 0.19a	8.95 ± 1.20b	5.89 ± 0.92c	4.58 ± 0.61d	3.01 ± 0.59e
Phosphorus (g kg−1)	4.19 ± 0.97a	5.93 ± 1.01b	3.92 ± 0.23a	3.33 ± 0.17c	2.63 ± 0.15d

Results are mean ± SD of three independent determinations. Values in a row with different superscript letters are significantly different ($P < 0.05$)

Table 2. Phytase activity (U kg−1 of dry matter) during germination of legume seeds

Days	African yambean	Lima beans	Pigeon pea	Cowpea	Groundnut
0	19.5 ± 0.0a	19.7 ± 0.0a	20.1 ± 0.0a	139.1 ± 1.1b	171.3 ± 1.4c
1	20.2 ± 1.1a	23.3 ± 1.4a	70.4 ± 5.1b	348.7 ± 3.3b	188.2 ± 3.0a
2	38.8 ± 3.2a	84.3 ± 2.3ab	173.1 ± 12.2c	444.2 ± 3.9c	191.7 ± 8.2a
3	80.8 ± 3.4b	123.1 ± 5.1b	288.9 ± 4.9d	449.6 ± 6.8c	322.1 ± 6.4b
4	181.2 ± 2.4c	151.4 ± 4.2c	323.2 ± 4.7d	484.3 ± 9.3c	518.9 ± 12.2c
5	411.6 ± 6.3d	164.3 ± 2.5c	589.9 ± 3.2e	559.7 ± 2.9d	666.7 ± 8.6d
6	463.4 ± 8.9d	159.5 ± 5.5c	711.8 ± 9.3f	654.3 ± 5.8e	556.9 ± 9.5c
7	390.3 ± 2.2d	84.2 ± 0.8ab	645.6 ± 4.3ef	739.2 ± 4.1f	531.2 ± 10.1c
8	412.9 ± 9.1d	41.1 ± 0.9a	666.7 ± 3.9ef	633.3 ± 82.2e	456.7 ± 4.4e
9	344.4 ± 10.2e	46.4 ± 0.9a	493.7 ± 4.6g	546.7 ± 9.5d	451.9 ± 7.8e

10	309.2 ± 10.3e	46.1 ± 0.8a	488.8 ± 3.3g	492.6 ± 3.1c	445.0 ± 5.1e

Results are mean ± SD of three independent determinations. Values in a column with different letters are significantly different ($P < 0.05$).

Table 3. Phytate content (g kg−1 of dry matter) during germination of legume seeds

Days	African yambean	Lima beans	Pigeon pea	Cowpea	Groundnut
0	6.65 ± 0.19a	8.95 ± 1.20a	5.89 ± 0.92a	4.58 ± 0.61a	3.91 ± 0.59a
1	6.37 ± 0.53b	8.55 ± 0.80a	5.67 ± 0.81a	4.14 ± 0.54a	3.86 ± 0.44a
2	6.24 ± 0.17b	7.96 ± 0.12b	4.55 ± 0.90b	3.56 ± 0.76b	3.59 ± 0.42a
3	5.44 ± 0.33c	6.77 ± 0.62c	3.67 ± 0.97c	3.22 ± 0.48b	2.12 ± 0.39b
4	4.13 ± 0.36d	6.17 ± 0.39d	3.08 ± 1.12d	2.33 ± 0.43c	2.04 ± 0.30c
5	3.75 ± 0.42e	4.95 ± 0.19e	2.46 ± 0.72e	2.05 ± 0.21c	1.98 ± 0.11c
6	3.12 ± 0.34f	3.88 ± 0.19e	1.99 ± 0.87f	1.11 ± 0.09d	1.02 ± 0.14d
7	2.19 ± 0.09g	3.11 ± 0.29f	1.09 ± 0.06g	0.97 ± 0.12d	1.02 ± 0.02d
8	2.01 ± 0.03g	2.45 ± 0.24g	1.06 ± 0.03g	1.13 ± 0.34d	0.99 ± 0.05d
9	1.87 ± 0.04h	2.03 ± 0.09h	1.01 ± 0.01g	1.03 ± 0.28d	0.99 ± 0.03d
10	1.83 ± 0.12h	1.99 ± 0.06h	0.99 ± 0.01g	1.01 ± 0.25d	0.96 ± 0.01

Results are mean ± SD of three independent determinations. Values in a column with different letters are significantly different ($P < 0.05$).

Table 4. Total phosphorus content (g kg−1 of dry matter) of germinating legumes seeds

Days	African yambean	Lima beans	Pigeon pea	Cowpea	Groundnut
0	4.19 ± 0.97a	5.93 ± 1.01a	3.92 ± 0.23a	3.33 ± 0.17a	2.63 ± 0.15a
1	4.25 ± 0.21a	5.89 ± 0.76a	3.90 ± 0.51a	3.31 ± 0.19a	2.61 ± 0.12a
2	4.28 ± 0.51a	5.97 ± 0.29ab	3.97 ± 0.55ab	3.36 ± 0.41ab	2.72 ± 0.06b
3	4.27 ± 0.15a	6.01 ± 0.97b	3.99 ± 0.11ab	3.42 ± 0.29b	2.71 ± 0.09b
4	4.34 ± 0.87b	6.00 ± 1.00ab	4.07 ± 0.67b	3.23 ± 0.78c	2.74 ± 0.03b

5	4.37 ± 0.22b	6.06 ± 0.56b	4.02 ± 0.10b	3.31 ± 0.67a	2.72 ± 0.04b
6	4.37 ± 0.45b	6.10 ± 0.71bc	4.09 ± 0.49b	3.46 ± 0.54b	2.76 ± 0.05b
7	4.38 ± 0.11b	6.09 ± 0.62bc	4.17 ± 0.61c	3.67 ± 0.53c	2.76 ± 0.05b
8	4.48 ± 0.16fc	6.14 ± 1.11c	4.19 ± 0.88c	3.76 ± 0.89d	2.82 ± 0.17c
9	4.49 ± 0.87c	6.25 ± 0.34d	4.18 ± 0.91c	3.72 ± 0.73d	2.81 ± 0.11c
10	4.51 ± 0.91c	6.27 ± 0.67d	4.21 ± 0.73c	3.61 ± 0.76c	2.82 ± 0.08c

Results are mean ± SD of three independent determinations. Values in a column with different letters are significantly different ($P < 0.05$)

DISCUSSION

Distribution of phytase activity, phytate and total phosphorus in legume seeds The distribution of phytase activity, total phytate and total phosphosrus in the legumes assayed are shown in Table 1.With the exception of the phytase activity in the seeds of African yambean (AYB), Lima beans and pigeon pea, significant differences were observed in the samples screened for all parameters assayed ($P < 0.05$). The phytase activity in seeds of AYB, Lima beans and pigeon pea was found to be low. Only cowpea seeds and groundnut exhibited higher phytase activity. The legume seeds with higher phytase activity recorded the lowest phytate and phosphorus content. One factor that could contribute to low phytase activity is inhibition by inorganic phosphate (Sung et al., 2005). This may explain why samples with higher phosphorus content recorded very low phytase activity. There is scarcity of information on the phytase activity of legumes grown in Nigeria. The phytase activity for the legume seeds reported in the present study (20.0–170 U kg−1) is slightly lower than that reported for field beans, peas and lupins (200–300 U kg−1) by Steiner et al. 9 Larger variations in phytase activity (0–200 U kg−1) has been reported for different species as well as for the same species of legumes (Eeckahout et al., 1994) Such variations may be due to differences in cultivars, location of farm and harvest year.9 Lima bean seeds recorded the highest phytate content (8.95 g kg−1) while groundnut had the lowest (3.01 g kg−1). Azeke et al. (2007) reported phytate contents of between 3 g kg−1 and 7 g kg−1 for seeds of three varieties of AYB, which is similar to the values presented in this study. The phytate content of pigeon pea seeds reported here (5.89 g kg−1) is lower than that reported by Oloyo (2004) (8.11 g kg−1) but higher than that reported by Sangronis and Machado19 (0.73 g kg−1) probably due to differences in cultivars and assay methods. The range of phytate content reportedfor legume seeds in this studyfalls within the range (1–13 g kg−1) reported for many similar and different legumes by Kumar et al. (2010). Phytate is formed during maturation of plant seeds21 and so differences in phytate contents of seeds may be due to differences in degree of maturation during harvest. The phosphorus contents of legume seeds screened in this study ranged between 2.63 g kg−1 and 5.93 g kg−1. These values are in the range of previously reported literature data (Oloyo, 2004;

Shen et al., 2005). For example, Oloyo (2004) reported 2.90 mg g−1 phosphorus for pigeon pea, which is only slightly lower than that presented in here. Steiner et al. (2007) reported a narrower range of 4.1–5.7 g kg−1 for field beans, peasandlupins. Ithasbeenfound thatabout 75–90% of total phos□phorus is bound as phytate phosphorus in cereals and legumes (Steiner et al., 2007).

Effect of germination on phytase activity

Germination resulted in significant increases ($P < 0.05$) in phytase activity of all samples screened (Table 2). Germination may have resulted in the synthesis of phytase enzyme in addition to other proteins15 or dormant phytase zymogen may have been activated during germination. For AYB and pigeon pea seeds, phytase activities were highest on the 6th day of germination (23-fold and 35-fold increase respectively). However, for Lima beans, cowpea and groundnut, phytase activity was highest the 5th (eight-fold), 7th (five-fold) and 5th (four-fold) day of germination, respectively. After this increase, phytase activity declined significantly ($P < 0.05$) probably due to the degradation of the enzyme by active protease23 or due to inhibition by accumulating phosphate (Sung et al., 2005). A similar trend was reported for germinating lentil,24 barley15 and soybean (Prazeres, et al., 2004). A time lag of 1–2 days was observed in some of the samples before any significant increase in phytase activity was recorded. The exceptions were pigeon pea and cowpea. A similar time lag was also reported by Konietzny et al. (1995) for germinating spelt, Greiner (2002) for lupine seeds and Sung et al. (2005) for barley. It is likely that during germination the expression of phytase delayed relatively even when other proteins are being synthesised. The implication of the low phytase activity in some of the legume seeds screened is that the contribution of native phytases originating from such legume seeds in terms of improving the availability of plant phosphorus for pigs and poultry will be of minor importance. The only option will be subjecting the seeds to processes such as germination which have the potential to increase phytase activity. The higher phytase activity in the sprouted legumes means they will have the potential to contribute substantially to the gastrointestinal hydrolysis of phytate in non□ruminant animals.

Effect of germination on phytate content

Germination for 10 days resulted in a significant reduction ($P < 0.05$) in the phytate contents of all legume seeds screened (Table 3). The reductions ranged between 72% and 83% for all samples. Mubarak (2005) reported a 30% reduction in phytate for mung bean seeds (Phaseolus aureus) after germinating for 3 days. Between 18% and 45% reduction was observed in this study after 3 days of germination. Non-significant changes ($P > 0.05$) in phytate contents were observed within the first 24 h of germination, which also coincided with the initial lag phase observed for phytase activity (Table 2). The highest reductions in phytate contents were observed between the first 6–7 days of germination after which reductions were largely non-significant ($P > 0.05$, Table 3). This also coincides with the reduced phytase activity observed for the same period. The reduction in phytate contents during germination is due to the action of phytase enzyme. During the germination of cereals and legumes, phytate is degraded by intrinsic phytase.20 Many researchers (khattak et al., 2007: Egli et al., 2002) have reported little intrinsic phytate□degrading activity in non-germinated legume grains. Greiner et al. (2001) reported an increase in phytate-degrading activity, with a concomitant decline in phytate content during germination of legumes. Moreover, when the malted cereals were ground and soaked under optimal conditions, a complete degradation of phy□tate was observed (Larsson et al., 2002) exceptfor oats which, under these conditions, had a low phytase activity (Larsson et al., 2002). The daily intake of phytatefor humans on vegetarian diets, on an average, is 2000–2600 mg while for in□habitants of rural areas in developing countries, on mixed diets, it is 150–1400 mg (Larsson et al., 2002). Usually, legume-based food (cooked) items con□tain higher amounts phytate than do cereal-based food items (kumar et al., 2010).

Effect of germination on phosphorus content

Phosphorus contents of screened legume seeds increased marginally (5–8%) after germination for 10 days ($P < 0.05$, Table 4). These increases are probably due to loss of dry mat□ter due to seed metabolism. It appears that the effect of sprouting on legume phosphorus contents differs from one legume species to the other. Mubarak (2005) reported about 4% increase in total phos□phorus of mung bean after germinating for 3 days while Hahm et al. (2009) reported a 6% increase in phosphorus after germinating sesame seedsfor 3 days. They attributed the increase to phosphate translocation, which plays a significant role in sesame metabolism during germination. Three days germination of seed samples in the present study resulted in a 1–3% increase in phosphorus. Oloyo18 reported a 10% phosphorus increase in seeds of Nigerian-grown pigeon pea after germinating for 5 days compared to 3% recorded in the present study. Al-Numair et al. (2009) reported phosphorus in□creases of 6%, 8% and 10%, respectively, for three cultivars of th same white beans (Phaseolus vulgaris) after germinating for 4 days. They also reported phosphorus increases of 1% and 8% for two cultivars of faba beans (Vicia faba) after germinating for the same period. This was attributed to improvement in mineral extractabil□ity caused by germination. This is a possibility since increase in phytase activity during germination can result in increased phosphorus availability. In addition to reasons already adduced phosphorus uptake from the growth medium could be partly responsible for the increase in phosphorus during germination. It is clear that germination increases phosphorus contents of grain legumes to varying degrees. How much of this phosphorus is available to ruminants is not clear. However, phosphorus at suitable concentrations is needed for proper skeletal growth of animals (Pandey et al., 2001) any process such as phytase supplementation, fermentation or germination that would increase its availability would be beneficial to both the animals and the environment.

CONCLUSION

Based on the results of this study, low phytase activity was found in seeds of African yambeans, lima beans and pigeon pea. Higher activities were found in cowpea and groundnut. Germination was effective in increasing the phytase activity of all samples screened. Increase in phytase activity was accompanied by a significant decrease in the content of the antinutrient, phytate and slight increase phosphorus. The increase in phytase activity and the accompanying decrease in phytate content are expected to improve phosphorus availability and utilisation, which would reduce phosphorus pollution. It is recommended that different cultivars of samples of these legumes and from different land areas be screened for same parameters in order to find cultivars with higher phytase activity.

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APPLICATION OF VERTICAL ELECTRICAL SOUNDING (VES) IN INVESTIGATING SUBSURFACE LITHOLOGY FOR WATER-BEARING LAYER IN THE TEACHERS' ESTATE, WATER BOARD AREA OF AUCHI, EDO STATE, SOUTHERN NIGERIA

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ABSTRACT

This research work was carried out at the Teachers' Estate, Water board area of Auchi Town in Etsako West LGA of Edo State. The site was geophysically surveyed with five (5) vertical electrical soundings (VES) using 'AEMC digital terrameter' which has a high soil resistivity. The ground tester data generated in the form of apparent resistivity was plotted against assumed depth (d). The VES results reveal that aquifer may encountered at the depth of 75 to 80 meters, 123 to 128 meters, and 145 meters. The subsurface is underlain by laterite, ferruginous sandstone, sand, clayey sand and intrusive rock. The aim of this work therefore, is to establish the stratigraphic units of the subsurface geology of the Teachers' Estate in the water board area of Auchi town, for aquifer characterization.

Keywords: Vertical electrical sounding (VES), resistivity, subsurface, lithology, and terrameter.

INTRODUCTION

Groundwater is water occupying the entire void within the geologic stratum, and its host by a water-bearing rock called aquifer. Aquifers are located in the subsurface of the earth (David, 1959). Cautious evaluation of existing boreholes in Auchi community shows that the water obtained from the boreholes may not be at their maximum yield as a result of not carefully exploring all the aquiferous layers within the borehole lithology of the existing borehole sites.

Most near-surface exploration before borehole drilling is done by geophysical technique which is an indirect method of determining the subsurface rock formations to a reasonable depth of the earth's interior from the earth's surface. Over the years, the use of surface geophysical methods for prospecting for groundwater using electrical resistivity method dates from the late 1920s (Dobrin, 1988).

Clipton and Foster (1995) reported that the advantages of VES techniques of electrical resistivity method over other geophysical methods cannot be over emphasized.

In a separate work carried out by (Ezomo and Ifedili, 2005, 2007), they emphasized that VES method has the ability to give detailed information in subsurface geology

as are not usually obtained by other methods in prospecting for groundwater.

Surface geophysical survey as an instrument in groundwater exploration according to Ezomo and Ifedili, (2007, 2010), is relatively cost saving. This underscores the imperativeness of the research; which of course is not only relatively cheaper in comparison with drilling a borehole or not identifying all the potential aquifers during borehole drilling and development.

Alile *et al*., (2012) investigated the geoelectrical layers of groundwater resources using the resistivity sounding method in Obaretin, Iyanomon and Orhionmwonbor all in Ikpoba Okha local Government Area of Edo State, Nigeria. The major lithologic layers penetrated are laterite, clay, sand (sandstone) and sandy clay from basic depth interval. The depth to water table in the study area has a maximum drill depth within the range of 60 m to 100 m.

Aigbogun *et al*., (2018) carried out geophysical investigation to ascertain groundwater potential in Egbeta, using one-dimensional (1-D) Vertical Electrical Sounding (VES) technique. The result from this study reveals three VES curves: AAK, HAKQ and HAAK, with the AAK being dominant. The aquifer depth in the area is in the range of 59.8 m to 159.5 m and the resistivity value at this location dropped from 11201.7 Ωm to 607.2 Ωm.

Babaiwa *et al.*, (2020) used the vertical electrical sounding (VES) method for aquifer characterization in Auchi Polytechnic, Auchi. Their results revealed that five (5) to seven (7) layers were delineated which correspond to the topsoil, sandy clay, clayey sand, dry sandstone and saturated sandstone. The depth to aquifer ranges between 95.0 to 169.6 m with resistivity values ranging from 324.3 to 1524.7 Ωm.

Babaiwa *et al.*, (2021) carried out a study using the vertical electrical sounding (VES) to characterize the soil erosion potential in Oredide village, Auchi in Etsako West LGA of Edo State and identified four (4) to five (5) geoelectric layers corresponding to topsoil, lateritic sand, sand and sandstone. The topsoil varies in resistivity from 632.7 – 87383.7 Ωm, lateritic sand from 3820.1 – 83094.2 Ωm, sand from 585.2 – 11969.6 Ωm and sandstone varying in resistivity from 17852 – 35732.4 Ωm. The maximum depth investigated was 57.4m.

Layade *et al.,* (2017) carried out geophysical investigation for groundwater at Gbongudu area, Akobo Ojurin, Ibadan, Southwestern, Nigeria. The Vertical Electrical Sounding using the Schlumberger configuration was employed. The VES results revealed a maximum of five geo-electric layers, viz: topsoil/lateritic sand, shale/clay, weathered layer, fractured basement and fresh basement respectively. Geoelectric sounding results were critically analyzed and interpreted. The yields of wells dug in most of these locations may be insufficient, even for domestic use because of its relatively small thicknesses. However, at a depth of 9.1 m a fracture zone occurs in the area with resistivity value of 17.8 Ωm suggesting the presence of groundwater.

Significantly, or perhaps to a reasonable degree the result of this study will serve as a guide; especially to any individual (s) who may wish to drill and develop a borehole around the Auchi area.

MATERIALS AND METHODOLOGY

The Digital Ground Resistance Tester Model 6470-B is a portable measuring instrument designed to measure soil resistivity (two methods – wenner and schlumberger). This direct reading tester measures from 0.01 to 99.99 KΩ and is auto-ranging, automatically seeking out the optimum measurement range and test current (AEMC, instrument; www.aemc.com). The said instrument is rugged, portable, and user friendly and has been put in use in many site investigations in Auchi. The Schlumberger electrode array was employed for all the soundings. Measurement commenced immediately, an electrical current (I) was passed into the ground through two earth connections (electrodes, H [Z] and E[X]) and the voltage (potential difference (V) is measured across a second pair of electrodes (S[Y] and ES [Xv] as prescribed in the operation manual (www.aemc.com, p38) and (McDowell *et al.*, 2002). However, after field data acquisition, the apparent resistivities were calculated and subsequently plotted against d.

The model 6470-B works with an optically biased USB interface cable required for connecting the instrument to the computer. The cable (cat. No. 2135.41) is equipped with a USB type A on the one end, and an optical connector on the other end. The optical connector end of the cable was connected to the serial port on the front panel of the model 6470-B, and the USB type A end of the cable to an available USB port on the computer.

Location of the study area

Auchi town which lies within latitude 7^0 04' N and longitude 6^0 15' E is noted for undulating terrain; this could be responsible for geologic challenge in relation to borehole drilling and development.

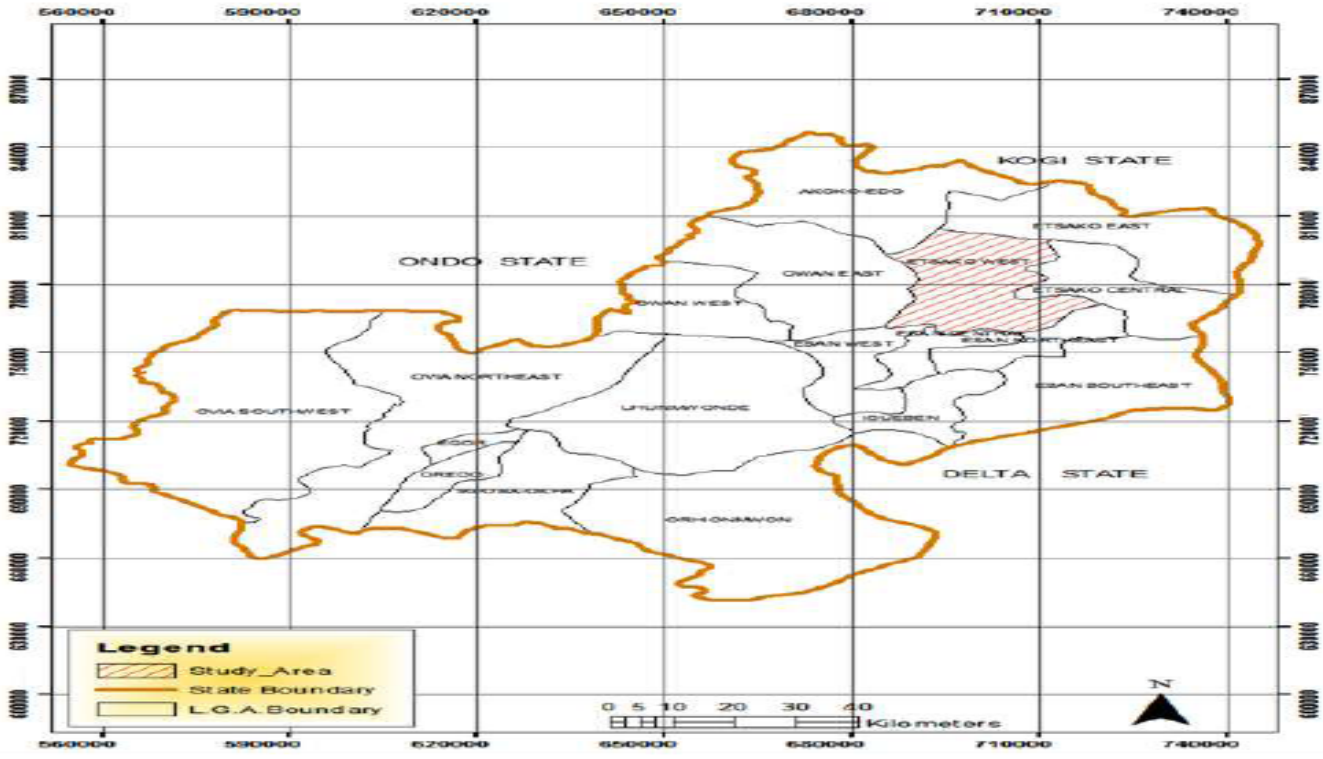

Figure 1. Edo State showing Etsako West LGA (Source: Produced from Arcmap10.1, 2013).

RESULTS AND DISCUSSION

Presented in Table 1 are the results of the VES interpretation.

Table 1: Geo-electric profile and inferred lithology of Teachers' Estate Water Board Area, Auchi).

Depth (m)	Apparent Resistivity (kilo-ohm-m)	Inferred Lithology	Remark
2	4749.65	Top soil (ferruginous)	
3	5940		
6	3505.55		
10	3009.6	Ferruginous sand	
15	2634.71		
20	2864.5		
30	6447	Ferrruginated sandstone	
40	3066.95	Ferruginous sand	
45	1845.42	Clayey/silty sand	
50	2906.85		
55	2661.34	Saturated ferruginous sand	
60	2149.57		
65	4780.01		
70	1231.94	Clay	
75	2828.45	Saturated sand	Probable aquiferous
80	2815.99		Formation
85	9763.74	Sandstone	
90	14001		
98	51009.63		
103	52013.19		
108	308289.58	Compact rock formation	
113	183797.04		
118	64327.73		
123	36136.1		
128	36136.1		
138	7780.73	Wet rock formation	
145	3964.67	Saturated sand	Probable aquifer
150	19092.65	Wet rock formation	
155	13591.15	Wet rock formation	

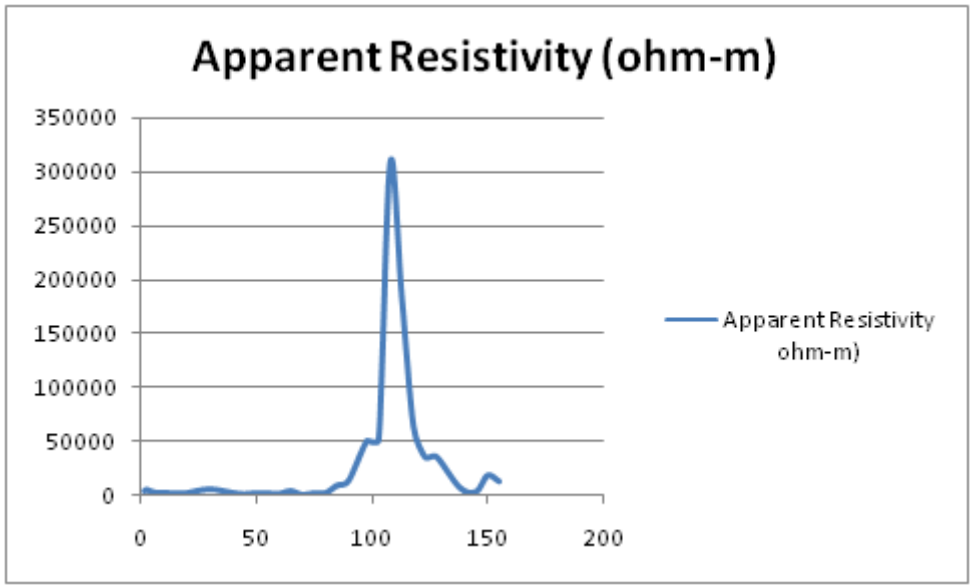

Fig. 2: Depth versus Apparent resistivity at the Teachers' Estate, Water board Area.

DISCUSSION

From 2 meters through to 20 meters is probably ferruginous sand which may be underlaid by ferruginated sandstone at a depth between 30 meters to about 40 meters depth. At a depth of 45 meters, there is resistivity contrast an indication of probable clayey/silty sand. However, we may strike a saturated ferruginous between the depths of 50 meters to 65 meters. Further, at a depth of 70 meters we may encounter clayey formation as the resistivity dropped in value. However, at a depth of 75 meters and most likely to 80 meters we are likely to strike another aquiferous formation that may be underlaid by sandstone at a depth of 85 meters. Although, a sharp resistivity contrast revealing a significant geophysical anomaly between a depth of 90 meters which spans to about 113 meters an indication of a compact formation, unlike the resistivity revealed at a depth of 118 meters showing that it may be the downward part of the compact formation at the depth range of 123 meters through to 128 meters has been soaked by a underground water probably from the formation that may be aquiferous as revealed at the depth of 138 meters to 145 meters. While at the depth of between 150 meters and 155 meters we noticed a high resistivity suspected to be sedimentary kaolin. We may encounter aquifers at the depth of 75 to 80 meters, 123 to 128 meters, and 145 meters. The lithology of the study area is laterite, ferruginous sandstone, sand, clayey sand, and intrusive rock.

CONCLUSION

The geophysical survey carried out in the study area reveals that the depths at which aquiferous formation may be delineated are 75 m, 80 m, 123 m, 128 m, and 145 m. The subsurface lithology corresponds to laterite, ferruginous sandstone, sand, clayey sand, and intrusive rock.

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APPENDIX

The apparent resistivity (ρ_s) was calculated using the formula contained in the owner's manual $\rho_S = \frac{\pi}{A}\left[d^2 - \left(\frac{A}{2}\right)^2\right] R_{S-ES}$, after measurement of the resistance of the auxiliary electrodes (H(Z), S(Y), ES(Xv) and E(X);

where, π is mathematical constant,

A is distance between the two potential electrodes,

d is assumed half-geometry between the two current electrodes and

R_{S-ES} is the measured resistance in ohms.

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TOURISM PROMOTION; AS A TOOL FOR NATIONAL DEVELOPMENT AND SELF-SUFFICIENCY.

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ABSTRACT

Diversification of the Nigerian economy has become a song on the lips of the Nigerian Public affairs Analysts and commentators, yet the Nigerian Government has paid a deafening silence on this most crucial topic. The main focus of Government has remained mainly mono economic (i.e, oil dependent). The government has made little or no investment in other sectors that has great potential in boosting its revenue base. This paper makes an appraisal on the tourism sector by highlighting what is obtainable in other parts of the world and thus giving some suggestions/recommendations on the way foreward.

Keywords: *Tourism, Hospitality, Economy, National Development.*

1.0 INTRODUCTION

Tourism is a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business/professional purposes. These people are called visitors (which may be either tourists or excursionists; residents or non-residents) and tourism has to do with their activities, some of which imply tourism expenditure (United Nations World Tourism Organization, 2008).

Using this definition, we can see that tourism is not just the movement of people for a number of purposes (whether business or pleasure), but the overall agglomeration of activities, services, and involved sectors that make up the unique tourist experience.

It is common to confuse the terms tourism, travel, and hospitality or to define them as the same thing. While tourism is the all-encompassing umbrella term for the activities and industry that create the tourist experience, the UNWTO (2020) defines travel as the activity of moving between different locations often for any purpose but more so for leisure and recreation (Hall & Page,

2006). On the other hand, hospitality can be defined as "the business of helping people to feel welcome and relaxed and to enjoy themselves" (Discover Hospitality, 2015). Simply put, the hospitality industry is the combination of the accommodation and food and beverage groupings, collectively making up the largest segment of the industry (Go2HR, 2020). Hospitality has been further described as: "cordial reception, kindness in welcoming guest or strangers. The act or practice of entertainment of strangers or guests without reward or with kind and generous liberality. Openness (of mind), liberality, welcome to new or various views." (English Dictionary, 2006).

Tourism is a complex system that is built up of industry sectors including accommodation, recreation and entertainment, food and beverage services, transportation, and travel services. It encompasses domestic, inbound, and outbound travel for business, leisure, or other purposes. And because of this large scope, tourism development requires participation from all walks of life, including private business, governmental agencies, educational institutions, communities, and citizens. Recognizing the diverse nature of the industry and the significant contributions tourism makes toward economic and social value for national development is of utmost importannce. There remains a great deal of work to better educate members of the tourism industry, other sectors, and the public about the ways tourism contributes to our national life. This paper aims to bring this information to the fore.

1.1 Tourist and Excursionist

Building on the definition of tourism, a commonly accepted description of a tourist is "someone who travels at least 80 km from his or her home for at least 24 hours, for business or leisure or other reasons" (LinkBC, 2008). The United Nations World Tourism Organization (1995) helps us break down this definition further by stating tourists can be:

1. Domestic (residents of a given country travelling only within that country)
2. Inbound (non-residents travelling in a given country)
3. Outbound (residents of one country travelling in another country)

Excursionists on the other hand are considered same-day visitors (UNWTO, 2020). Sometimes referred to as "day trippers." Understandably, not every visitor stays in a destination overnight. It is common for travelers to spend a few hours or less to do sightseeing, visit attractions, dine at a local restaurant, then leave at the end of the day.

The scope of tourism, therefore, is broad and encompasses a number of activities and sectors.

1.2 Impacts of Tourism

Tourism can generate positive or negative impacts under three main categories: economic, social, and environmental. These impacts are analyzed using data gathered by businesses, governments, and industry organizations.

1.2.1 Economic Impacts

According to the 2019 edition of the UNWTO International Tourism Highlights report, international tourist arrivals reached 1.4 billion, a 5% increase in 2018. UNWTO Secretary-General Zurab Pololikashvili stated that the sheer growth of the industry was driven by a strong global economy, surge of the travel-ready middle class from emerging economies, technological

advances, and more affordable travel costs among others (UNWTO, 2019). At the same time, the UNWTO (2019) reported export earnings from tourism, or the sum of international tourism receipts and passenger transport, reached a staggering USD 1.7 trillion. This demonstrates that the industry is a major economic engine of growth and development.

Europe has traditionally been the region with the highest tourism dollar spending with USD 570 billion, followed by Asia and the Pacific (USD 435 billion), the Americas (USD 334 billion), Middle East (USD 73 billion), and Africa (USD 38 billion). Asia has shown to have the strongest growths in both arrivals (+7%) and spending (+7%). Africa equally shared a +7% growth in arrivals, suggesting a new interest in travelling to the continent.

What are the trends that are motivating people to travel? The six consumer travel trends, according to the UNWTO (2019) include:

- Travel "to change" or focusing on more authentic travel, transformation, and living like a local.
- Travel "to show" or capturing "instagramable" moments, experiences, and visiting selfie-worthy destinations.
- Pursuit of a healthy life or engaging into active travel that involves walking, wellness, and sports tourism.
- Rise of the "access" economy.
- Solo travel and multigenerational travel as a result of single households and an aging population.
- Rising awareness on travel with sustainable advocacies, thoughtful consideration about climate change impacts, and plastic-free travel.

1.2.2 Social Impacts

Because tourism experiences also involve human interaction, certain impacts may occur. Generally, social impacts in tourism are related to guest-to-host or host-to-guest influences and changes. Studies of these encounters often relate to the Social Exchange Theory, which describe how tourists and hosts' behaviours change as a result of the perceived benefits and threats they create during interaction (Nunkoo, 2015).

Positive social impacts in tourism include learning about different cultures, increasing tolerance and inclusion through LGBTQ+ travel, increasing amenities (e.g., parks, recreation facilities), investment in arts and culture, celebration of Indigenous peoples, and community pride. When developed conscientiously, tourism can, and does, contribute to a positive quality of life for residents and a deeper learning and appreciation for tourists.

Unfortunately, tourism also has its shortcomings and is culpable for some detrimental impacts. However, as identified by the United Nations Environment Programme (UNEP, 2003), negative social impacts of tourism can include:

- Change or loss of indigenous identity and values
- Culture clashes
- Physical causes of social stress (increased demand for resources)
- Ethical issues (such as an increase in sex tourism or the exploitation of child workers)

1.2.3 Environmental Impacts

Tourism relies on, and greatly impacts, the natural environment in which it operates. In many cases, the environment is an essential resource that outdoor recreation

and ecotourism cannot exist without. Even though many areas of the world are conserved in the form of parks and protected areas, tourism development can still have severe negative impacts from misuse, overuse, and neglect. According to UNEP (2003b), these can include:

- Depletion of natural resources (water, forests, etc.)
- Pollution (air pollution, noise, sewage, waste and littering)
- Physical impacts (construction activities, marina development, trampling, loss of biodiversity)

The environmental impacts of tourism knows no boundaries and can reach outside local areas and have detrimental effects on the global ecosystem. One example is increased emissions from necessary tourism elements such as transportation. Air travel for instance, is a major contributor to climate change.

An overview of the negative and positive impacts:

Whether positive or negative, tourism is a force for change around the world that is capable of transforming the environment from micro- to macro-scales at a staggering rate.

2.0 DIFFERENT SCENARIOS OF TOURISM REVENUE BASE/IMPACTS

2.1 CANADA: Canada's tourism industry was impacted by world events such as the Great Depression, the World Wars, socio-political turmoil, and global outbreak of disease.

Global events such as 9/11, the SARS outbreak, the wars in Afghanistan and Iraq, and the economic recession of 2008 took their toll on tourism receipts but have successfully seen short-term rebounds. However, nothing has been more impactful to the tourism industry as the corona virus of 2019 (COVID-19), which was first found in China in late 2019 and eventually declared as a pandemic by March 2020 as it spread globally. Tourism was placed in a standstill as global travel restrictions were imposed to prevent the spread of infection. Aggravated with a nose dive of consumer confidence in travel, many tourism businesses and operators big and small were forced to close. The UNWTO predicted a **60% to 70% drop in tourist numbers**, as well as a loss of a staggering **USD 910 billion to USD 1.2 trillion in export revenues, and up to 120 million jobs put at risk** (UNWTO, 2020). According to the UNWTO (2020), COVID-19 created the worst crisis in the history of global tourism since records began in 1950.

2.1.1 Tourism in Canada Prior to COVID-19

In 2018, tourism created $102 billion in total economic activity and 1.8 million jobs according to the Tourism Industry Association of Canada (2018). Up to 2019, Canadian tourism reached its 3rd consecutive year of breaking records by welcoming 22.1 million inbound visitors (TIAC, 2020). Tourism is a major player in the workforce, where 1 in 11 jobs in the country is directly involved with travellers, as stated by TIAC (2018).

The United States is Canada's biggest tourism market, more than all international travellers combined due to their immediate proximity, open borders, and ease of travel. They make up 68% of all inbound visitors to Canada in 2018. American travellers are also big spenders at $663 per trip and typically seek natural attractions, historical sites, and food and drink when they enter the country (TIAC, 2018).

Aside from the United States, Canada continues to see strong visitation from the United Kingdom, France, Mexico,

Brazil, and China. In 2018, we welcomed 6.9 million travellers (excluding the US), more than doubling since 2011 (Statistics Canada, 2019). Canadians travelling domestically accounted for 78% of tourism revenues in the country, though spend less at $244 per trip (TIAC, 2018).

2.2 TOURISM IN BRITISH COLUMBIA (BC): Tourism in BC remains big business. In 2018, the industry generated $20.5 billion in revenue.

The provincial industry is made up of over 19,329 businesses, the majority of which are SMEs (small to medium enterprises), and together they employ approximately 161,500 people (Destination BC, 2018). It may surprise you to learn that in British Columbia, tourism provides the highest Gross Domestic Product, (GDP) or the total revenues produced in a period of time, in 2018—more than mining, oil and gas, agriculture, and forestry (Destination BC, 2018).

2.3 New York Tourism: New York State's tourism economy expanded in 2016 with 2.7% growth in traveler spending, reaching a new high of nearly $65 billion—22% above the state's pre-recession peak set in 2008. Key data illustrate the industry's performance:

■ Room demand expanded 3.8% in 2016.

■ Passenger counts at all NYS airports increased 5.1% in 2016, though associated ticket revenue declined by nearly 9%. Direct tourism employment grew 1.7% to reach a new high in 2016 while associated personal income expanded 5.5%. On both of these measures, tourism outpaced the general economy. (2016 Calendar Year; The Economic Impact of Tourism in New York State)

Travel & tourism is a substantial and growing component of the New York State economy. Direct spending of $64.8 billion generated nearly $105 billion in total business sales including indirect and induced impacts. Over 780,000 jobs were sustained by tourism activity in 2016 with total income of $34.6 billion. 8.3% (1-in-12) of all New York state employment is sustained by tourism, either directly or indirectly. New York State tourism generated $8.2 billion in state and local taxes in 2016, saving each NYS household an average of $1,133 in taxes. Tourism is vital to the NYS labor market .The unemployment rate in New York State was 4.8% in 2016. If the jobs sustained by travelers were eliminated, the unemployment rate would rise to 13.2%.

3.0 TOURISM IN NIGERIA

This centers largely on events, due to the country's ample amount of ethnic groups, but also includes rain forests, savannah, waterfalls, and other natural attractions. The World Travel and Tourism Council estimated revenue related to tourism and travel in Nigeria will exceed $1 billion USD in 2007, and will account for approximately 6% of the gross domestic product. (Tourism Council, 2007). The industry suffers from the country's poor electricity, roads, and water quality. (World Travel, 2007)

3.1 EXAMPLES OF SOME TOURIST ATTRACTIONS AND LOCATIONS IN NIGERIA

- **ABUJA**

Abuja is home to several parks and green areas with the largest one being Millennium Park. Millennium Park was designed by architect Manfredi Nicoletti and was officially opened by the United Kingdom's Elizabeth II in December 2003. Another open area park is located in

Lifecamp Gwarimpa; near the residence of the Minister of the Federal Capital Territory. The park is located on a slightly raised hilltop which contains sport facilities like Basketball and Badminton courts another park is the city park, it is located in wuse 2 and is home to numerous outdoor and indoor attractions such as a 4D cinema, astro-turf, lawn tennis court, paintball arena and a variety of restaurants.

- **LAGOS**

Subsequent to the re-modernization project achieved by the previous administration of Governor Raji Babatunde Fashola, Lagos is gradually becoming a major tourist destination, being one of the largest cities in Africa and in the world. Lagos is currently taking steps to become a global city. Currently, Lagos is primarily known as a business-oriented and a fast-paced community. (*Managing Metropolitan Lagos, 2012).*

Lagos has become an important location for African and "black" cultural identity.[5] Many festivals are held in Lagos; festivals vary in offerings each year and may be held in different months. Some of the festivals are Festac Food Fair held in Festac Town Annually by Festaconline, Eyo Festival, Lagos Black Heritage Carnival, Lagos Carnival, Eko International Film Festival, Lagos Seafood Festac Festival, LAGOS PHOTO Festival, Felabration (as a tribute to Fela Anikulapo Highlife/Afrobeat collections and innovations) and the Lagos Jazz Series, which is a unique franchise for high-quality live music in all genres with a focus on jazz. Established in 2010, the popular event takes place over a 3–5 day period at selected high quality outdoor venues. The music is as varied as the audience itself and features a diverse mix of musical genres from rhythm and blues to soul, Afrobeat, hip hop, bebop, and traditional jazz. The festivals provide entertainment of dance and song to add excitement to travelers during a stay in Lagos.

Lagos has a number of sandy beaches by the Atlantic Ocean, including Elegushi Beach and Alpha Beach. Lagos also has a number of private beach resorts including Inagbe Grand Beach Resort and several others in the outskirts. (Experience, 2020)

Lagos has a variety of hotels ranging from three star to five star hotels, with a mixture of local hotels such as Eko Hotels and Suites, Federal Palace Hotel and franchises of multinational chains such as Intercontinental Hotel, Sheraton and Four Points by Hilton. Other places of interest include the Tafawa Balewa Square, Festac town, The Nike Art Gallery, Freedom Park, Lagos and the Cathedral Church of Christ, Lagos.

- **OBUDU MOUNTAIN RESORT**

This a ranch and resort on the Obudu Plateau in Cross River State. It was developed in 1951 by M. McCaughley, a Scot who first explored the mountain ranges in 1949. He camped on the mountaintop of the Oshie Ridge on the Sankwala Mountains for a month before returning with Mr. Hugh Jones a fellow rancher in 1951. Together with Dr Crawfeild, they developed the Obudu Cattle Ranch. (Tracing the Origin of Obudu, 2017). Although the ranch has been through troubles since, it has been rehabilitated to its former glory.

Since 2005, a cable car climbing 870 metres (2,850 ft) from the base to the top of the plateau gives visitors a scenic view while bypassing the extremely winding road to the top.]The resort is found on the Obudu Plateau, close to the Cameroon border in the northeastern part of Cross River State, approximately 110 kilometres (68 mi) east

of the town of Ogoja and 65 kilometres (40 mi) from the town of Obudu in Obanliku Local Government Area of Cross River State.[9] It is about 30 minutes drive from Obudu town and is about a 332 kilometres (206 mi) drive from Calabar, the Cross River State capital. Charter air service is available to the Bebi Airport which lies between the village of Obudu and the resort. The ranch has in recent times seen an influx of both Nigerian and international tourists because of the development of tourist facilities by Cross-River State Government, which has turned the ranch into a well known holiday and tourist resort center in Nigeria.

- **IBENO BEACH**

This is one of the most beautiful beaches in the country and the longest coastline sand beach in Nigeria and West Africa. (*Ibeno Beach 2020).* It is situated in Jamestown in Akwa Ibom. The city is said to be named after the local government where it is located. According to historians, the beach is one of the oldest beaches in Nigeria.

From the foregoing, we can see that the tourism sector has got a lot of potentials, which other Nations are exploiting for their overall National development and GDP growth. As we have seen, proceeds from the sector in many instances as in Canada far outweigh that from other sectors and also a source of employment for millions.

Some countries in Africa are already doing well, Kenya for example makes more than 1.5 Billion USD annually from tourism, (Adeola,F. 2021). The Kenyan tourism sector accounts for 10% of their economic output employing over 2million people (just the tourism industry alone). Tanzania on the other hand makes 2.6 Billion USD annually from tourism, while South Africa makes more than 8 Billion USD from tourism in a year. It is high time the "song of diversification" of Nigeria`s monoeconomic nature of Oil and Gas into something really practicable and functional. The airports and seaports and more recently train stations (which are areas every visitor to the country will see first) should be upgraded for the purpose of tourism. Apart from the Federal level, each state of the federation should decide to look inwards and develop and harness the natural environment and sites, for the purpose of tourism. In the US, for example New York State alone in the year 2019, made 117 Billion USD from tourism alone (this amount is about 4 times bigger than the entire Nigerian budget of about 30 Billion USD for 2020). Again too, the U.S state of Florida makes over 40 Billion USD annually from tourism alone (Adeola,F. 2021).

Not to be ignored too is that Nigeria is the biggest and most populated Black Nation in the entire world, with beautiful places, nature, culture, diverse food, climate, dresses and all kinds of traditional events. Nigerians are well read and educated, all over the world you find them receiving education and excelling at it, so much so that other Africans (the good, the bad and the ugly) claim to be Nigerians just to be part of the success story(both good and bad as well) of Nigeria. However, the selling point of Nigeria is that people will like to know and see where we are from, our very root so as to experience us in our rich diverse culture, etc. Even, many African-Americans will like to trace their roots back to Nigeria, but unfortunately, many prefer to go to Ghana, why? Because of challenges of terrorist groups such as Boko-Harram, kidnappings, bad roads, no electricity etc. If only government can make the environment right, (as in fix the country by attending to those factors enumerated earlier) good money in the form of "raw cash" and foreign earnings can be made from tourism, thereby freeing oil money a bit.

4.0 CONCLUSION

The Nigeria's states too, can take cue from what has been discussed so far in this paper, by making more investment in tourism, either as a government or through collaborative initiatives such as the public private partnership (PPP) arrangements. To encourage more investor through PPP initiatives, the government should create the enabling environment by fixing our roads and other infrastructure, take care of insecurity challenges by overhauling the entire security architecture of the Nation (which includes creating state policing, strengthening the vigilante community policing system, etc). Arrest the ugly trend and situation of banditry, killer herdsmen etc, then visitors will come around with their own cash to "see" and then to invest. All these will boom up the country's economy, bring unemployment level down, reduce the incidencies of youth's restiveness and thus bring about a sustainable national development. Thus promoting tourism as a tool for national development and self-sufficiency is indeed possible, workable and of immense value if ONLY and ONLY if, we keep "our house right" by maintaining a good enabling environment and applying the different suggestions discussed herein.

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FROM GRASS TO GAS: HARNESSING ENERGY FROM NATURE FOR THE PURPOSE OF SELF-SUFFICIENCY AND JOB CREATION "A REVIEW"

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ABSTRACT

The rising energy prices and concerns about long term sustainability have once again brought renewable energy (green energy) sources to the fore front. Fossil fuel provides the bulk of the world's primary source of energy. Since they are non-renewable natural resources with little to conserve, the earth's supply of fossil fuel (especially oil and gas) may soon get completely depleted. Additionally, the rising cost of petroleum and other allied products most especially in Nigeria has triggered a need to develop alternate sources of energy, one of which is biogas. This paper focuses on a cheap way of producing fuel (Biogas) from natural sources (i.e. grasses from cleared field, etc) for the purpose of cooking and other uses, such as powering lamps, powering vehicles etc.

Keywords: Anaerobic digestion; biogas; sustainable development; bio-digesters; methane

1.0 INTRODUCTION

Energy has been described as the cornerstone of all developments across board. Yet in our part of the world, there is energy crisis and scarcity. To mitigate this challenge, there is every need to resort to alternatives. Especially considering the backdrop that that there is a rising cost of fossil gas, with its potentially diminishing supplies and the attendant pollution problems associated with petroleum and its allied products, as well as the present on-going desert encroachment issues; all these put together, provide the need to consider sustainable alternative sources of energy for the livelihood and general development of a Nation. Achieving "Sustainable Development" is a formidable challenge in the present world. It concerns technologies

that can help manage growth while considering economic, social, and environmental sustenance of the society. (Tenusri and Mandel 1997)

There is an urgent need to solve the present problems faced by the society without creating any long term negative impact, which could become a critical issue to resolve for the future generations. Energy need is an important ingredient in the modern economy, and must be evaluated in the context of the other aspects of development. In fact, modern energy services must be evolved and deployed in all aspects of the development process – e.g., energy and communications, energy and industry, energy and the environment, energy and agriculture, energy and education, and energy and public health and safety .Even right here at the Polytechnic, we are definitely a part of the Country, so we are not shielded from the energy challenge. Sometimes you wish to carry out research or some other task within the school premises and there will be no power and so you are forced to go home. Also the sanitation level of the environment becomes challenged when there is no power to pump water to the various conveniences, the noise and carbon emissions level from the individual generating sets of various units and departments, is not only polluting, but also affects the Learning Environment,etc.

In the light of the above, alternative sources of energy becomes a must. One good alternative is biogas technology. Biomass can be used to provide sustainable supply of the required energy through biogas, biodiesel, producer gas, etc notwithstanding whether the biomass is "waste" of some process **(such as cleared out grasses of the open field or others, which is the focus of this paper)** or is cultivated specifically as fuel for energy generation, it is considered a "green" technology (Renewable Energy) since:

- The life cycle of the fuel is short (could even be less than 3 months) The net carbon dioxide emission from the fuel is zero – as the CO_2 emitted is generated by burning the carbon that the plant had fixed by taking CO_2 from the atmosphere and converting it to food (glucose) with the help of photosynthesis.
- The cycle can be water neutral as well
- If biogas or biodiesel is produced from biomass, the leftovers can be put back into the field as high quality manure.
- The remaining biomass could also be used with a gasifier to make producer gas. The ash could be spread in the fields as micronutrient, completing its cycle as well.

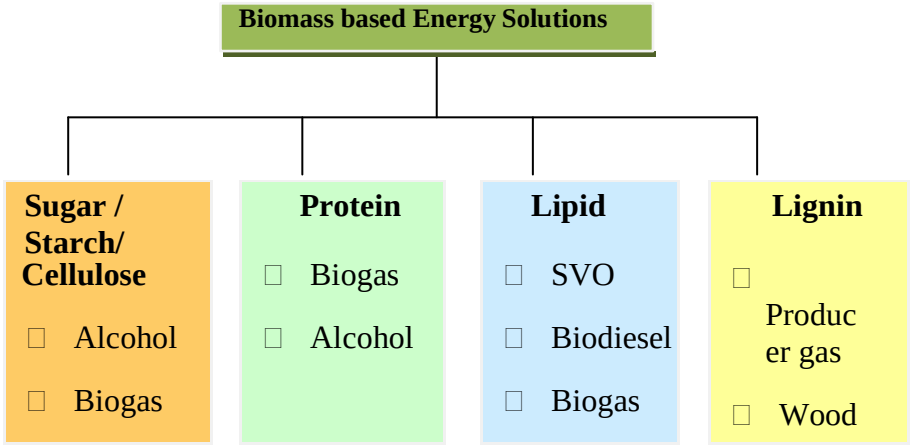

Figure 1: Options for biomass based energy

While applying the criteria for sustainability to evaluate various options for harnessing energy from biomass, biogas route turns out to be the promising option. From Figure 1, it can be seen that sugar, starch, cellulose, protein and lipid can be readily converted to biogas. Conversion of lignin is considerably difficult. Further research will be required to economically convert lignin to biogas. (Richards, 1994)

2. HISTORY/CONCEPT OF BIOGAS TECHNOLOGY

Biogas is a combination of gases, consisting mostly of methane, produced during the natural decomposition of organic matter in an airtight environment via a process called anaerobic digestion (AD) in a containing air-tight vessel called biodigester. Methane is the same flammable component found in the fossil natural gas, only instead of taking 65million years to make (as applicable in fossil gas), biogas can be made in 48hours to 72hours. (Zuru et al., 2004). Biogas includes any organic material not derived from fossil fuels, including agricultural crops, agricultural crops, agricultural and forestry wastes and residues, and construction wood wastes, among others. Four ingredients are needed for biogas production and they are:

- Organic matter
- Bacteria
- Anaerobic condition
- Heat

The idea of producing flammable gas from decomposing plant matter was brought up by the ancient Persians. The idea culminated to the building of the first sewage plant in 1859 in Bombay, India. The concept was then brought to the U.K. in 1895 when the generated biogas was utilized to light up street lamps. Further advancements in the biogas systems were witnessed in Germany and U.K. at the onset of the 1900s for sewerage treatment purposes. Centralized drainage systems spread across Europe and anaerobic digestion was viewed as a means to minimize the amount of solid waste in the sewage. The resultant gas was sporadically utilized as an energy source to power vehicles.In the 1930s, farm manure was used to produce methane gas in Bombay. An improved design that used a floating steel gas drum was developed at the start of the 1960s, which became the cornerstone of the government of India's outreach program to offer villagers a convenient means to cook their foods. In the same year, China rolled out the same initiative, and by 1980, there were more than 5 million biogas plants. The 1980s saw the replacement of the

rectangular biogas plant design by the dome shaped design. The biogas program was exported to Nepal, which is today known as Biogas Sector Partnership (BSP). The skyrocketing prices of oil in the 1980s led many people to embrace biogas. (Abu, 2010) However, the prices of oil dropped later, which translated to a significant drop in electricity bills. This phenomenon reduced the biogas enthusiasm, but few biogas plants managed to survive. The biogas programs in India, China, and Nepal have scaled up steadily over the years. Today, interest in biogas around the world has gathered momentum and more people and setting up biogas plants to produce biogas. India invests more than 6 billion indian rupees (INR) each year in the biomass generation sector, producing more than 5000 million units of electricity in the process. The industry also creates annual employment of 10 million man days in remote villages. (Marwan, 2007). By definition, biogas is a kind of biofuel generated through biological breakdown of organic matter such as food scraps, manure, wastewater sludge, and crop residue in the absence of oxygen. This breakdown of organic matter without the presence of oxygen is known as anaerobic digestion. Anaerobic digestion takes place in a large tank commonly known as a digester. Inside this digester, bacteria convert these organic wastes into methane gas, a reliable source of energy.

Biogas is majorly a mix of methane and carbon dioxide. It may also contain traces of siloxanes, hydrogen sulfide, and moisture. The resultant energy in the anaerobic digestion (biogas) can be used directly for cooking by burning it in the presence of oxygen. It can also be converted into electricity by using it to convert water into steam, which turns a turbine connected to a generator. Just like natural gas, biogas can be easily compressed and used to power automobiles. Better still, biogas can be purified and upgraded to the natural gas standards when it's converted to biofuel known as biomethane. The process of anaerobic digestion leaves behind a nutrient-rich matter called digestate, which is commonly utilized as fertilizer. (Yvonne et al., 2014)

Most organic matter begins the process of decomposition when it is exposed to oxygen and sunlight. However, organic matter can also decompose without any oxygen, by the process of anaerobic fermentation. This happens due to the bacteria present in the matter which acts during the absence of oxygen. Landfills see a lot of such decay, especially when the waste material becomes wet and receives little sunlight. As a result, a lot of methane and nitrous oxide is produced and released into the atmosphere. Biogas is the result of this decay, and it is an energy source like no other.

3. ADVANTAGES OF BIOGAS

- It's a renewable energy source
- The raw materials used in the production of biogas are renewable. Trees and crops will continually grow, which means manure, food scraps, and crop residue will constantly be available.
- It's eco-friendly
- Production of biogas happens without oxygen, which technically means there is no form of combustion involved. No combustion means there is zero

emission of greenhouse gasses to the atmosphere. However, carbon dioxide is produced in the biological breakdown process (anaerobic digestion), as well as in the course of using the biogas. The difference is the carbon dioxide produced is far less compared to that produced by fossil fuels. In fact, the amount of carbon dioxide produced when using biogas is equal to the amount needed for plants to grow. This, in a way, balances the carbon dioxide in the atmosphere.

- Reliable
- The fact that it is produced from renewable sources makes it reliable. Other renewable energy sources like solar and wind depend on the weather patterns or day time factors to continually produce electricity. Biogas production continues regardless of the weather. The biogas production process goes on uninterrupted (24/7).

- Reduces the amount of waste going to landfills
- We all know that overflowing landfills cause environmental impacts such as foul smells and toxic liquids draining into underground water sources. Instead of disposing of these organic materials to landfills, they can be used to produce biogas.

- Requires low capital investment
- The technology used to produce biogas is pretty cheap. Biogas plants can be developed right at home using locally sourced materials. The resultant gas can be used directly for cooking and generation of electricity. Biogas can also be compressed to achieve the quality of natural gas and utilized to power automobiles. The raw materials used for the production of biogas such as manure, crop residue, food scraps and wastewater sludge are absolutely free. This makes the cost of biogas production significantly low.

- Creates green jobs
- Biogas plants have created millions of jobs in most countries, especially in the area of waste collection and biogas generation. For example, in India, the biogas industry creates more than 10 million man days jobs each year in rural areas.

- Minimizes overreliance of fossil fuels
- Many countries like India and China have invested a lot of money in the biogas sector. This has helped these countries cut back on fossil fuel use. This act has particularly helped China, the world's top consumer of energy, to cut back on the use of fossil fuel sources of energy like oil, gas, and coal.

- Improves environment
- Waste collection and management significantly improves in areas with biogas plants. More people get involved in waste collection in order to get a source of income. This leads to overall sanitation and hygiene of the areas.

- Produces enriched organic manure

- The process of biogas generation leaves behind enriched organic manure (digestate), which is a perfect supplement or replacement of chemical fertilizers.

- Saves women and children from daunting household chores

- Collecting and carrying firewood on a daily basis is a daunting task. Also, exposure to smoke from the firewood can cause health complications. Biogas provides a great reprieve from these activities. Also, biogas minimizes the time needed for cooking and cleaning of utensils.

4. Operating temperature (mesophilic/thermophilic)

As mentioned previously, temperature is an important operational parameter and can also be used to classify AD systems into two categories: mesophilic (30 – 40 °C) and thermophilic (45 – 60 °C) systems. The range below 20 °C is termed psychrophilic and is not suitable for anaerobic digestion as the reaction rate is very slow. Mesophilic systems are considered more stable and require less energy input than thermophilic digestion systems. However, the higher temperature of the thermophilic digestion systems facilitates faster reaction rates and faster gas production. Operation at higher temperatures also facilitates hygienisation of the digestate. As in developing countries with a tropical climate, the prevailing systems are not heated and are therefore typically operated in the mesophilic temperature range. (Yvonne et al., 2014)

5. MATERIALS AND METHODS

The choice of the basic AD design is influenced by the technical suitability, cost, the design selection is largely determined by the prevailing and proven design in the region, which in turn depends on the climatic, economic and substrate specific conditions. (Updated Guide Book, 1984).

For a prototype form of demonstrating this concept, we use the following materials:

- Leaves, Cow dung and Salt (substrate)

- Pipes, gums, plastic bottle can and plastic custard container and gas regulator (to form the bio-digester and conduits for gas and fertilizer rich nutrient), See the appendix for the details.

6. CONCLUSION

There is every need to popularize and highly recommend this technology. As it can serve as the panacea to our energy needs and considering that our tropical environment really favours its operation. Furthermore, considering that Auchi polytechnic is strategically and well rated as the best Polytechnic in Nigeria and even in Sub-Saharan Africa, there is an urgent need to establish and create a Centre for Renewable Energy Technology (CRET). This will be purely biogas

based. Such that all the organic wastes from the institution, ranging from waste papers, cleared grasses and even human wastes: All could be channeled to the proposed CRET and thus converted to scalable and sellable resources which can contribute to the entrepreneurial needs of the school and as well increase its internally generated revenue (IGR). Also noting that, that will also harmonize with our value system as an institution since the Polytechnic Mission Statement states: "To Offer Training in Skills and Knowledge in Science, Technology and the Arts for the use of the Brain, Mind and Hands, for Promoting Self-reliance, Technological Advancement and Sustainable National Development".

The following pages are the appendix pages on practical works conducted and duely carried out

PLATE3; USING KNIFE TO SHRED SOME LEAVES (GRASS) INTO THE CONTAINER

PLATE 7; COVERED MINI BIODIGESTER

PLATE.8 FINAL GUM APPLICATION

PLATE. 12 FIRMING THE COVER AFTER GUM APPLICATION

FIG.9 GUM APPLICATION

PLATE. 10 HEATING THE NAILS TO EASE MARKING OUT

PLATE.11 HOT NAIL FOR MARKING OUT

PLATE. 4 LEAVES ADDITION TO MINI DIGESTER

PLATE.6 PREPARING GUM FOR SEALING OF ALL EDGES

PLATE. 5 SMALL QUANTITY OF SALT ADDED TO THE LEAVES TO SERVE AS CATALYST TO THE GAS FORMATION

PLATE**.13, USING HOT NAIL TO BORE HOLE IN WASTE WATER CAN COVER FOR EFFLUENT STORAGE**

PLATE. 14 FINAL SET UP OF MINI BIODIGESTER

TESTING FOR FLAMMABILITY

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RAIN WATER HARVESTING TECHNIQUE: A TOOL FOR SUSTAINABLE NATIONAL FOOD SECURITY.

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ABSTRACT

Water as a natural resource is highly essential for every living thing(humans, animals and plants inclusive). Without good supply of it, food productivity will go on the decline, little wonder, water supply has been observed to have a profound impact on the quality of life and it is also a major determinant of productivity and poverty levels of any Nation. In the current trends of global climate changes and its unfavourable impacts, it becomes compulsory to devise ways of having predictable and readily available water supply for effective agricultural practice for sustainable food security. This paper attempts to explain the methodology of harvesting of roof-gutter-water for irrigation purpose. And as a case study we hereby recommend that the constructed rain harvester in the School of Engineering currently lying fallow be used to demonstrate the potential of this technology.

Keywords: Rainwater harvesting, Natural resources, Water, Sustainable food security.

INTRODUCTION

The world population is expected to increase by 2.2 billion by 2050 with corresponding increase in food production by 50% and a 15 percent increase in water withdrawals (Food and Agriculture Organization of the United Nation {FAO}, 2017). Increasing food production means allocating more resources to agriculture by ensuring continuous food production throughout the year. Increasing irrigation can aid in increasing food production; however, the amount of water available for agricultural use is not increasing due to the limited water resources globally. Agriculture uses the most water, by

far, with a water use of more than 80% of available fresh water.nThus agriculture will be the biggest global user of water in 2050. (FAO, 2017). In addition, due to the growing water demand and declining precipitation in some regions, the pressure on the available water resources will increase, thus resulting in high levels of water stress in many regions (United States Agency for International Development {USAID}, 2013). Water stress may have a negative impact on agricultural production and economic development as water shortages directly lead to reduced crop production. In water stressed areas, agricultural production levels can be increased by improving water management and increasing water efficiency ('more crop per drop'). Therefore, there is a need to tap into other conventional water sources like rainwater harvesting. (Mutekwa and Kusangaya, 2006)

The potential of rooftop rainwater harvesting can be fully exploited to achieve maximum results. Rainwater harvesting is a viable solution to cope with the increasing water demands, water scarcity and climate change variability as a secondary source of water (Alem 1999; Kahinda & Taigbenu 2011). Climate change being a global challenge, Nigeria is not exempted. Studies conducted to assess the impact of climate change on agriculture indicate that the continuous rise in temperatures and increasing spatial variability of rainfall will lead to reduced agricultural yields. (USAID, 2013). Nigeria, however, is well endowed with several natural resources of which water resources is among and with proper water management techniques being adopted, this can aid in adapting to the expected climate impacts (USAID, 2013). The agricultural sector in some parts of Nigeria is greatly affected by water-related disasters such as floods, droughts, and landslides, which contribute to about 70% of the natural disasters, destroying over 800,000 ha of crop land annually and causing large losses to the economy (Ministry of Energy and Mineral Development 2007). By adopting rainwater technologies, these disasters can then be minimized.

This paper therefore aims to assess the potential of rainwater harvesting for domestic and agricultural use. Give a brief report on survey conducted on the level of awareness and useability of RWH and thus recommend and stimulate interest on the advantages of the practice of RWH.

RAINWATER HARVESTING (RWH) CONCEPT

Rainwater harvesting (RWH) is the collection and storage of rain, rather than allowing it to run off. Rainwater is collected from a roof-like surface and redirected to a tank, cistern, deep pit (well, shaft, or borehole), aquifer, or a reservoir with percolation, so that it seeps down and restores the ground water. Dew and fog can also be collected with nets or other tools. Rainwater harvesting differs from stormwater harvesting as the runoff is collected from roofs, rather than creeks, drains, roads, or any other land surfaces. (Van et al., 2013) The uses of RWH include watering gardens, livestock, irrigation, domestic use with proper treatment, and domestic heating. The harvested water can also be committed to longer-term storage or groundwater recharge. *(Kinkade-Levario, 2007).*

Rainwater harvesting is one of the simplest and oldest methods of self-supply of water for households, and residential and household-scale projects, Rooftop rainwater harvesting is used to provide drinking water,

domestic water, water for livestock, water for small irrigation, and a way to replenish groundwater levels. In regards to Urban agriculture, rainwater harvesting in urban areas reduces the impact of runoff and flooding. The combination of urban 'green' rooftops with rainwater catchments have been found to reduce building temperatures by more than 1.3 degrees Celsius. (Amos et al., 2018). Rainwater harvesting in conjunction with urban agriculture would be a viable way to help meet the United Nations Sustainable Development Goals for cleaner and sustainable cities, health and wellbeing, and food and water security. The technology is available, however, it needs to be remodeled in order to use water more efficiently, especially in an urban setting. *The basic idea in RWH is: "Prevent the water from going underground before trying to recover it again"* **.**Water being a universal solvent is highly crucial for the movement of dissolved nutrients and other essential minerals in the soils via the roots of plants for its growth. This water should be saved and stored during periods of plenty and reuseable during period of scarcity. This is the basis of a sustainable use of a natural resource such as water for a sustainable food security with the practice of RWH.

NATIONS PRACTICING RWH

Kenya has already been successfully harvesting rainwater for toilets, laundry, and irrigation and areas in Australia use harvested rainwater for cooking and drinking. Studies done by researching the feasibility and practicality of RWH in India found it was most beneficially used for small-scale irrigation, which provides income with the sales of produce, and the overflow is used for groundwater recharge. (Amos et al., 2018)

Missions to five Caribbean countries have shown that the capture and storage of rainwater runoff for later use is able to significantly reduce the risk of losing some or all of the year's harvest because of soil or water scarcity. (United Nations Development Programme {UNDP}, 2021)

In addition, the risks associated with flooding and soil erosion during high rainfall seasons would decrease. Small farmers, especially those farming on hillsides, could benefit the most from rainwater harvesting because they are able to capture runoff and decrease the effects of soil erosion. (Amos et al., 2018)

Many countries, especially those with arid environments, use rainwater harvesting as a cheap and reliable source of clean water.To enhance irrigation in arid environments, ridges of soil are constructed to trap and prevent rainwater from running down hills and slopes. Even in periods of low rainfall, enough water is collected for crops to grow. *(Rainwater harvesting 2012)***.** Water can thus be collected from roofs, dams and ponds can be .constructed to hold large quantities of rainwater so that even on days when little to no rainfall occurs, enough is available to irrigate crops.

Frankfurt Airport has the biggest rainwater harvesting system in Germany. The system helps save approximately 1 million cubic meters of water per year. This system collects water from the roofs of the new terminal which has an area of 26,800 square meters. (*Kumar, 2012*)

The water is collected in the basement of the airport in six tanks with a storage capacity of 100 cubic meters. The water is mainly used for toilet flushing, watering plants and cleaning the air conditioning system.

Rainwater harvesting was adopted at The Velodrome – The London Olympic Park in order to increase the sustainability of the facility. A 73% decrease in potable water demand by the park was estimated. Despite this, it was deemed that rainwater harvesting was a less efficient use of financial resources to increase sustainability than the park's blackwater recycling program. (Learning legacy, 2011)

OTHER INNOVATIONS

Instead of using the roof for catchment, the Rain Saucer, which looks like an upside-down umbrella, collects rain straight from the sky. This decreases the potential for contamination and makes RainSaucer a potential application for potable water in developing countries. Other applications of this free-standing rainwater collection approach are sustainable gardening and small-plot farming. (*Kumar, 2012*)

A Dutch invention called the Groasis Waterboxx is also useful for growing trees with harvested and stored dew and rainwater. (Rainwater harvesting, 2012).

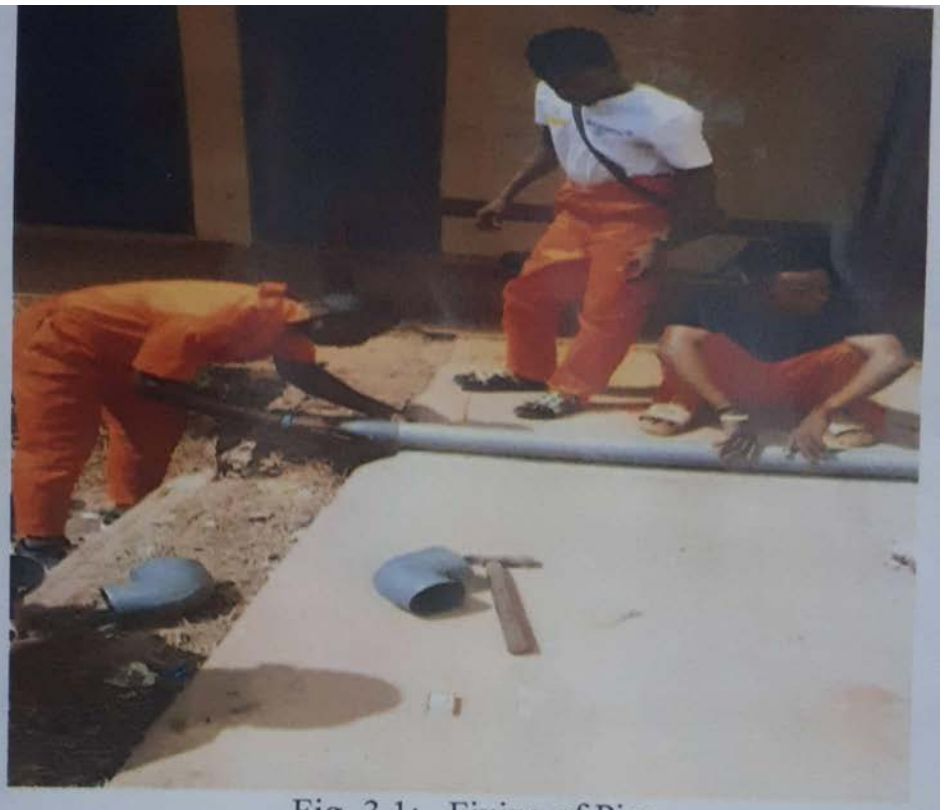


Fig. 3.1: Fixing of Pipe

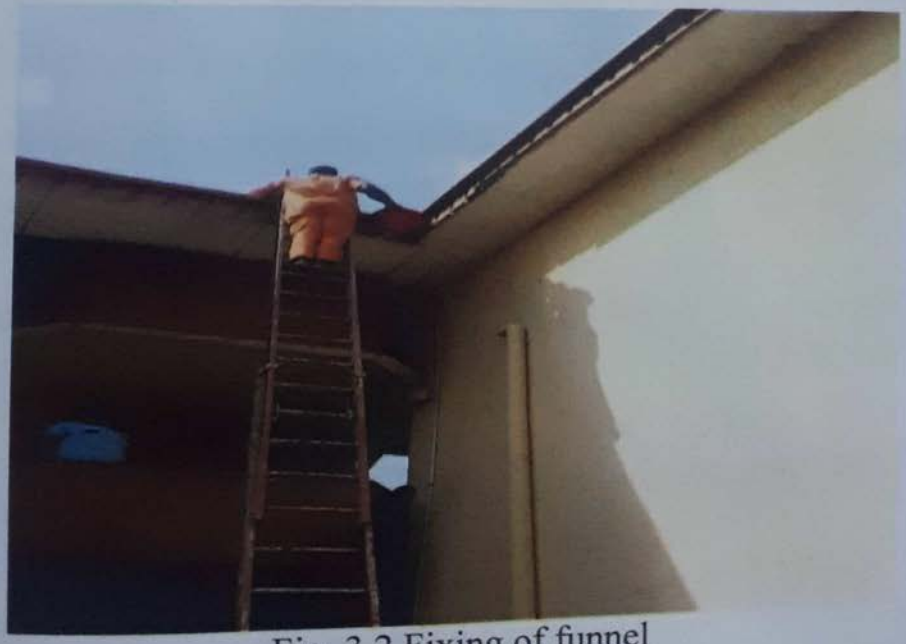
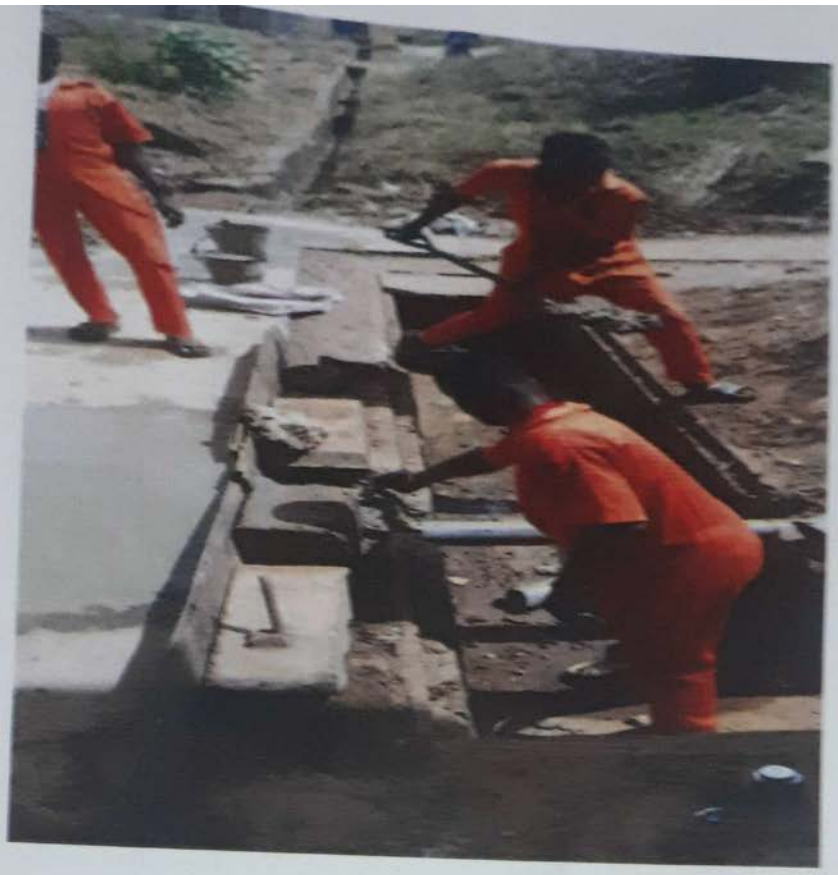


Fig. 3.2 Fixing of funnel



Form work

Concrete cover

A section of a building showing how rainwater is harvested.

Roof gutter for transporting rainwater to the collection system

PLATES OF SCHOOL OF ENGINEERING MINI-RWH

This section deals on some pictures (plates) of School of Engineering of Auchi Polytechnic, Auchi (SEAPA), Etsako-West part of Edo State, South-South Nigeria. We participated in connecting the RWH system to an existing Underground tank

Also the materials used in installing a RWH unit in (SEAPA) are hereby listed:

PVC 4 inches pipe; Elbow 4 inches; Gum; Clips; Funnels; Nails; Binding wire; Cement; Granite; Sand; Wood; Wire mesh etc.

CONCLUSION/RECOMMENDATION

The harvested water from the School of Engineering (SEAPA) unit is being stored in an existing but abandoned underground water reservoir. This water although

originally meant for the sanitation needs of (SEAPA), but due to a newly installed borehole unit, the water (which is now free and presently unused) can now be utilized for the purpose of irrigation and other Agricultural purposes. The department of Agricultural and Bioenvironmental Engineering under (SEAPA) can collaborate with the department of Agriculture under School of Applied Sciences in Auchi Polytechnic to establish a Demonstration Farm Unit in the Green areas around the RWH unit for the purpose of research and training of Students. Household crops like corn can be planted and watered from the RWH unit, making fresh maize to become available all-year-round. Thus, this can become a self-sustaining project helping to enhance the food security of the institution and the Nation at large.

In view of Auchi communinity being erosion prone (due to the nature of soil here and judging from the several gullies and landslides taking place in the community), the government should endeavor to provide incentives to ALL house-and-property owners to practice RWH, that way the volume of run-off water will be drastically reduced, thereby helping to alleviate the problem and tribulations of the formation of more death-threatening gullies. The stored water, apart from domestic uses can also serve as irrigation for backyard gardens and small household farms. This will make more food available and thus help out in the Nation's food security challenges.

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THE IMPACT OF FAST FOOD INDUSTRY ON NIGERIA FOOD CULTURE

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ABSTRACT

This research is aimed at assessing the impact of fast food industry on Nigeria food culture. Survey design method was implored and data collected through the use of questionnaires administered to selected fast food restaurants located in Auchi metropolis, Etsako west local government area of Edo state (using non probability sampling method in selection of sample restaurants).Simple percentage and chi-square methods for analysis were used to analyze data collected. The findings revealed that most customers of fast food restaurants prefer local foods and they patronize the fast food restaurants because of the novel and trendy meals served that was indicated by the frequency of patronage of fast food by age ranges of between 20 to 35 (77.3%), indicating more young adults prefer and enjoy fast food meals against older adults. It also reveals the extent of influence fast foods have on the population of study in relation to the local food culture they are exposed to in the rural community. However, Fast food industry in the study area has not reduced people interest in cooking and eating local food. Conclusively, the availability and presence of fast food operations in Auchi metropolis have not imparted negatively on food culture of the populace. Therefore, it is recommended among others, that fast food operations should endeavour to prepare more of the healthy traditional varieties of Nigerian dishes to promote its rich and diverse culture.

Keywords; Fast food, Culture, Industry, Restaurant and Patronage.

INTRODUCTION

Background of study

Food is very important to the existence and survival of humanity; it contains essential nutrients to sustain health. However, the preparation and mode of consumption depend on the people's culture or way of life. The way of life of a people is generally regarded as culture. Food therefore, either through cultivation or cooking can be influenced by cultural practices handed down through generations or by environment influences. Fast food operation is a sector in the hospitality and catering industry that deal mainly with

quick preparation, packaging and service of food to customers. Food may be regarded as any edible substance either solid or liquid ingested (eaten) to sustain and maintain life. Healthy foods intake support healthy life styles and encourage development of the body system as well as prevent life threatening diseases. The meals served in fast food restaurants are typically less nutritionally valuable compared to locally prepared and culturally inspired food or dishes.

Some studies have referred to fast food as convenient foods that are bought from store shelves (preheated and precooked) food that require little or no preparation before consumption, to an extent, they are correct. Khurshid & Syeedun (2005)opined that "convenient" aspect ascribed to fast food was disputed as incorrect, she emphasized that unlike fast food that can be eaten instantly without any prior preparation, convenience foods must be heated, stirred, baked, thawed and even may be supplemented with other foods. In Nigeria fast food restaurants are well distributed around the nation with different varieties of meal services, from drive-through to meal delivery in homes or offices. They are also known as quick service restaurants or as eat-in/ take away/take out operations, while, franchise operations that are part of restaurant chains, have standardized fully/partly prepared meals conveyed to each restaurant from a centrally located kitchen in another part of the city or town. Globally, fast food outlets have continued to show resilience despite the recession. (Euromonitor,2010). As at 2014, over 800 quick service restaurants have been established in Nigera (AFFCON,The report,2015) Today, however, the list of brand names in the industry is being extended, so far without an end in sight as high sales volumes entrants to spring up incessantly(Mojekwu, Anyafulu & Babatunde,2014). The growth in demand for convenient and affordable food has incorporated convenience stores, supermarkets and other food retailers into the fast food sector. (Jaworowska & Agnieszka, 2013)

Deliens et al., (2014) observed that the main target customers are tilted towards the children and young adults, who are enticed by fancy advertisement promotion, freebies, Apps and social media as a strategy to draw the attention of this market segment. Several studies have

revealed a global increase in fast food consumption which is very common among students ; Schroder & McEachern (2005) discovered that 82% of students in United Kingdom consume fast food, while similar study of 86% of students in Malaysia university consume fast food. In the study carried out by Arulogun &Owolabi (2011) found out that 80.5% of university students consume flour based fast foods weekly and the risk it poses to this segment of the population is of immense concern, jeopardizing their food habit and health; especially students leaving home and faced with academic pressure and independence. As well as time constraints workers, who depends on take outs for lunch or dinner. The youth (18-40 years) constitutes more than 60% of the Nigeria population (NPC, 2009), with this, comes the emerging fast food culture that is rapidly evolving among various segments of the society, especially the children, youth, members of the middle class. The nouveau riche especially perceived the emerging fast food culture as a mark of high social status or a way of displaying affluence and high standard of living. The concept of ready cooked food for sale is closely connected with urban development. Homes in emerging cities often lacked adequate space or proper food preparation areas, some parts of the world, urban dwellers are encouraged to purchase pre-prepared meats or starches such as bread, noodles, where possible because of the fear of fire engulfing the apartment as well as the cost of fuel used in cooking (Laudan & Racheal 2001)

In Europe, eating out became common after World War II which previously was considered a luxury. Workers and working families needed quick service and inexpensive food for both lunch and dinner. Fast food shops began in the 18th century in Britain with the service of fish and chips, the Americans popularizing it by introducing the drive -through in the early 50's. The United African Company (UAC) foods started pastry shops as part it departmental chains to caters for shoppers, which, later emerge as the first quick service restaurant in Nigeria called Mr. Biggs fast food restaurant and later followed by others. Nigeria is diversified in culture and language, but food is a unifying factor. Basically, almost same kinds of food crops are farmed all over the country and with a slight difference in preparation and cooking.

Three major reasons for the surge in the demand for fast foods in Nigeria can be attributed to international travel and exposure (Diaspora experience), increase in average disposable income and affordability of eating out and increase in work time and busy city (congestion) especially working women as well as the desire for less stressful food preparation and cooking on the part of young adults. Mojekwu, Anyafulu& Babatunde (2014) attributed the growth of fast food market in Nigeria to the sheer size of population, improving product quality, growth of sophistication of Nigeria consumer and marketing activities of fast foods companies.

The relationship between food and culture.

Nigeria is a country with diverse cultural group. Odunuga (2011) viewed culture as a powerful human tool for survival, but it is largely a fragile part of the society today. It is constantly changing and easily lost phenomenon, because it exists only in our minds. Culture can be lost or transferred as the case may be, but in this research, the food culture sustenance of Nigerians is being examined. Food is a symbol of hospitality, social status and religious significance. The relationship between culture and food of a people cannot be separated, because foods are influenced by cultural taboos, people's tradition, interest, religion and value. The Hausa people eats lot of grains made in different forms; tuwo (shinkafa, masara, dawa) waina, kunu, masa and dankwa while the Igbo and Yoruba people eats more of cassava and yam products; akpu, abacha, amala lafun and garri. All these carbohydrate food are accompanied with deliciously prepared vegetable based soups and sauces with assorted meat and fish. Snacks or light nutritious foods such as, kulikuli, roasted and boiled groundnut and corn, shredded cassava with coconut, roasted plantain and plenty of fruits and vegetables in season. Culturally, most foods are eaten by Nigerians using the palm and fingers to manipulate them before chewing and/or swallowing, while, this cultural practice may be a taboo or disgust in some cultures, but it is the most fulfilling way of eating traditional foods generally in Africa and particularly in Nigeria. Yam is a staple in Nigeria, but different in shape and texture from the European variety; culturally, with many nations on the African continent , it is eaten pounded into a smooth paste-like texture, while in some part yam is eaten

boiled, roasted, pottage –form, as well as fried and made into fried yam balls in yet another part.

Nigerian food culture include traditional foods eaten by our ancestors for centuries, they are nature inspired foods, grown naturally (organic) and harvested with much care and cooked with much love. They were not grown with chemical inducers for high plant yield, (inorganic) but were whole food in their natural form, not processed with harmful additives, but package in natural containers like leaves, jute, clay and cast iron. Nigerian foods are very essential to Nigeria culture; each society has its own unique traditional way of producing meals for societal consumption. As the society increase in size, as a result of socio-cultural development, so also the modern systems of food production. The fact remains that major changes have been adopted into the traditional food in Nigeria generally due to the exposure to other food culture and new technologies. Some studies states that behavioural patterns involved in the food-finding processes had to be taken into account in order to understand cultural types. The pattern of work determines the time an individual create for leisure and recreation; same apply to time and energy required to prepare and cook nourishing fresh food, locally sourced ingredients from the market can be time consuming. The preference would be a fast meal with little or no stress.

People who have same cultural identity share the same food habits, while people of different culture shares different assemblages of food variables. The relationship between food and culture in a society is inseparable. Culture is a specific set of ideas, beliefs practices, customs which distinguishes society from others. Aside culture, parental food habits affect food behaviour of children. Anand,(2011) posited that young people establish eating habit and food preference from home and normally carry it on to adulthood, as parent with increasing disposable incomes are likely to impress their children by taking them to fast food eateries. Therefore, unhealthy eating habits of today will increase diseases outbreak, tomorrow, because of decrease in the function of the immune system. Some past studies have argued that the society existence is maintained by functional dependence (interdependence) of the various parts, that is human being have certain primary needs

for survival, need for food, clothing, shelter and security from the functionalist perspective, the fast food industry appeared in the society to fill the gap created by the busy life style of people in the 21st century. The hectic and tight schedule in lifestyle made it absolutely inconvenient for most employees and students to cook their meals, but, rather opt for more readily available convenient fast foods. Thus; the industry functionality maintained the whole society.

Influence to food behaviour

Daliens (2014) described several factors that influence people's preference for food as individual factors, social network, physical environment, and macro environment. Ajala-Damisa(2021) explained that eating behaviour was strongly influenced by social factors, such as cultural food habits and physical environmental factor, in essence it means what people eat is determined by what they see others who inspire them eat. The food choices made by individual affect their values and behaviours. Hauser (2013) defines food choices as a person's set of value and strategies for prioritizing, negotiating, managing and balancing personal values about food. Making choice of food signifies a classified behaviour that is pertinent in today's society. Globalization has undoubtedly affected consumer's preference and value for consumption of food product.

Detrimental aspect of fast food consumption

Fast food are described as quick, easily accessible and cheap alternative to home cooked meals, high in saturated fat, sugar, salt and calories. Instant foods packaged and sold over the shop counters are also referred to as fast or convenience with high doses of preservatives and salt which are detrimental to health when consumed often. Foods, such as instant noodles eaten by children without being accompanied by any protein nutrients (as often seen in most Nigerian homes) can cause malnourishment in growing children. Globally, Nigeria has the second highest number of children affected by malnutrition, with more than 2.5million suffering from acute malnutrition. According to Ajala-Damisa (2021) consumption of over processed or junk food is contributing to the problem of under nutrition among the poorest in Nigeria, improving consumption of locally available nutritious food still remains a

viable recommendation. Over time research has linked the consumption of fast foods to obesity and overweight. It is also believed that those who eat meals from fast food have high calories, higher saturated fat, carbohydrates and sugar intake than their non fast food consuming counterparts. In addition, those that ate in fast food restaurants have a higher BMI than those who ate home cooked foods (Nielson & Poplein, 2003). The frequent consumption of fast food is unhealthy and puts consumers at risk of developing obesity, weight increase and type 2 diabetes, heart and artery diseases. (Jekamowski, 2001). Consumption of more vegetables, fruits and grains help to prevent the risk, which is associated with high intake of fast foods.

Socio-cultural implication of fast food industry on Nigerian food culture.

All over the world, food bring people together in homes and functions, food influences are always regarded as interference by the older generation, but the younger, adventurous generation are always excited to taste new menu and experiment with new food and beverage. In India, fast food industry is also having adverse effect on their food culture, which instigated some traditional and fundamentalist to stand against food habit transformation and also reiterated the ignorance of the foreign fast food entry without any apparent previous cultural training (Khurshid et, al., 2005).

Olutayo & Akanle (2009) posited that though fast food is becoming increasingly prominent in Nigeria, not much is known of the cultural meaning attributed to the phenomenon. Socio- cultural implication are controllable compared to the adverse health issues associated with consistent consumption. Pasta such as instant noodles, have dominated the Kitchens of mothers as against yams, potatoes, cereal pap (gruel) and other nourishing cultural foods they were brought up with, because of its convenience.

Statement of problem

It is alarming to know that convenient fast food has almost taken over traditional meals, people no longer have time to cook local dishes, and if this is true, then Nigerian food culture is becoming endangered. This research wants to examine the possible impact of food eaten in fast food restaurant on the food culture of Nigerians. Harvard health (2016)

observed that a major change in the global food industry is the rapid expansion and promotion of the western fast food. "Fast food is the western culture's gift through globalization to the world" today, fast food is not just the western culture but the world culture.

Objectives of study

1. The objectives of this study are to assess the impact of fast food industry on Nigeria food culture.
2. Identify the frequency in fast food restaurant patronage in study area.
3. Determine the level of customer's interest in local dishes/meals.

Methodology

Background of Study area

Auchi is a town located in Etsako West Local Government area of Edo State. It is also the head quarters of the Local Government Area. Auchi has an area of 946km^2 and a population of about 197,609 as at 2006 census. Etsako west Local Government Area comprise of major towns as Auchi, South Ibie, Agbede, Awani, Jattu, Jagbe and Iyamu. The town is an Agricultural community, hence the farm produce are fresh vegetables, corn, groundnut, yams and cassava. The common and popular soup is made of groundnut served with pounded yam.

The research design used for this study is a survey method; well designed questionnaires were used to collect data. The population comprise of customers and staff of the selected eateries. The staff include top management staff (managers), middle level staff(supervisors) and lower level staff, a non probability sampling technique(Haphazard convenience sampling) was implored in selecting the sample restaurants in Auchi. The sample populations are Mr. Biggs (a franchise), Valchi kitchen and fries and Zaris foods. This sample population selection was based on the availability and structure of restaurants in study area. . A total of 90 questionnaires were distributed, 86 returned well filled, while 4 were not properly answered had to be discarded, unused.

Data analysis techniques

Simple percentage method was used in analyzing the data collected, and chi-square was implored in testing the hypothesis cited in the study.

Socio-economic characteristics of respondents

The results of the socio-economic factors of respondents indicates that at an average percentage female 57% respondents are more than male 43% as customers and staff in the study area. This study also shows that more singles 78%, young adults patronize and employed at the fast food operations more than married 22%. It also reveals that age ranges of 20-35 (74.4%) are attracted mostly to the fast food industry either as customers or employees. Compared to the age ranges 36-51(23.4%), this, may indicate that the latter may be married and eat more homemade foods or occupied with other work related activities. It indicates as well that students 45.5% form more of the customers; they are more occupied with academic work to care for cooking of food.

Table I. Variable **Customers** (44) **Staff** (Mr.Biggs, Zaris &Valchi) (42)

	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Marital status				
Single	32	72.7	35	83.3
Married	12	27.3	7	16.7
Gender				
Male	20	45.5	17	40.5
Female	24	54.5	25	59.5
Age Range				
20 – 35	34	77.3	30	71.4
36 – 50	8	18.2	12	28.6
51 – above	2	4.5	-	-
Educational Level				
SSCE	10	22.7	22	52.4
First degree	26	59.1	18	42.9

Master degree	7	15.9	2	4.7
PhD	1	2.3	-	-
Occupation				
Civil servant	15	34.0	-	-
Students	20	45.5	-	-
Others	9	20.5	-	-
Placement				
Top management	8	18.2	3	7.1
Middle management	21	47.7	6	14.3
Lower management	15	34.1	33	78.6

Source: Field Survey, 2020

Table 11: Frequency of fast food Restaurants patronage.

The response of the frequency of patronage with 34.9% respondents often eats at fast food restaurants while 25.6% indicates that they never patronize fast foods operations, it may be because of finance or dislike for the kind of foods served at quick service restaurants.

Responses	**Frequency**	**Percentage %**
Very often	10	11.6
Often	30	34.9
Rarely	24	27.9
Never	22	25.6
Total	86	100%

Source: Field Survey, 2020

Table 11I: Preference for fast foods supersedes that of local meals.

In the table below it reveals that 38.4% respondents agree to preference of fast food over local meals while 23.3% strongly disagree. This implies that there is a high level of preference for fast food despite the developed taste for local foods.

Responses	**Frequency**	**Percentage %**
Strongly agree	5	5.8
Agree	33	38.4
Indifferent	12	13.9
Disagree	20	23.3
Strongly disagree	16	18.6
Total	86	100%

Source: Field survey, 2020

Table IV: The frequency of cooking/eating locally prepared meals.

This table indicates that respondents often 47.7% eat but not very often 23.3% eat locally prepared meals, while 11.6% never eat or cook local meals. It implies that respondents in the study area eat more food cooked in the locality possibly because it is rural community and appreciable numbers of the population are not exposed to eating out.

Responses	Frequency	Percentage %
Very often	20	23.3
Often	41	47.7
Rarely	15	17.4
Never	10	11.6
Total	86	100%

Source : Field, survey 2020

Table V: Local meals are tastier and nutritious than fast foods.

The table V above shows that 40.7% of the respondents agree that meals locally prepared is tastier than fast foods restaurants meals, collaborated in findings of Mojekwu et al.,(2014) while 15.1% disagree. It implies that local meals are still valued over meals from fast food restaurants nutritionally in study area.

Responses	Frequency	Percentage%
Strongly agree	19	22.0
Agree	35	40.7
Indifferent	15	17.5
Disagree	13	15.1
Strongly disagree	4	4.7
Total	86	100%

Source: Field Survey, 2020

Table VI: Cooking when tired or busy can make an individual go for fast foods.

This study shows 41.9% agreed that when tired or busy fast foods meals may be an option as against 12.8 % who are indifferent to any option. It implies that when options are available under stressful conditions, individual will chose the easier options, irrespective of the meal.

Responses	**Frequency**	**Percentage%**
Strongly agree	11	12.8
Agree	36	41.9
Indifferent	11	12.8
Disagree	16	18.6
Strongly disagree	12	13.9
Total	86	100%

Source: Field Survey,2020

Test of Hypothesis

Ho: Fast food industry patronage has no significant relationship on Nigerian food culture.

Hi: Fast food industry patronage has a significant relationship on Nigerian food culture.

Table VII: Analysis and discussion of findings

Values	Top Management	Middle management	Lower management	Customers
Observed	27	22	17	20
Expected	21.5	21.5	21.5	21.5
O-E	5.5	0.5	-4.5	-1.5
$(O-E)^2$	30.5	0.25	20.25	2.25
$(O-E)^2/E$	1.41	0.01	0.94	0.11

At a degree of difference $= 3$, P-V ≤ 0.05

Calculated value $= \chi^2$ (3). = 2.47

Tabulated value = 7.815

Chi-square analysis of the relationship between fast food patronage and Nigerian food culture shows that the chi-square calculated value(χ^2 (3). = 2.47, $P/V \leq 0.05$) is lower than the tabulated value, (χ^2 = 7.815, $P/V \leq 0.05$). Therefore, the null hypothesis is rejected while the alternative hypothesis is accepted which states, that Fast food industry patronage have a significant relationship on Nigerian food culture. This reveals the extent of influence fast food have on the population of study in relation to the local food culture they are exposed to in the rural community.

Discussions of findings

The frequency of patronage of fast food restaurants by young female 54.5% is higher than male. While the age ranges of between 20 to 35 are involved as customers 77.3% or staff 71.4%, indicates that more young adults prefer and enjoy fast food meals against older adults as well as work in study restaurants. The research findings include ; fast food industry in the study area have not reduced people's interest in cooking and eating locals food as well as know the tasty and nutritional value of locally produced meals.

Conclusion

This study analyzed the influence of fast food patronage on the food culture of Nigerians in Auchi metropolis; it provides understanding on how fast food has affected food culture amongst various categories of people. Fast food culture, originally an American and British culture is gradually becoming a world culture, as the population has increased their preference for quick service meals, which offer convenience of eating and speed of preparation and service. From the analysis, it is concluded that fast food industry meals are gradually eroding the need for a well prepared local meals especially among the youths.

Recommendations

Therefore , based on findings from the research study, the followings are recommended;

- Fast food operators should offer more organic, natural, and culturally inspired meals.
- The indigenous foods should be prepared with creativity to appeal to the youths, thereby encouraging healthy eating habits among them.
- The government should also play major role in supply of constant electricity to encourage bulk purchase of fresh foods for storage, because this will enable eateries provide nutritionally balanced meal with no detrimental effect on storage.
- Parents should train their children on local meals to enable them development early healthy eating habits. Take them to local eateries, food festivals and teach them to cook them.

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APPRASIAL OF THE NATIONAL BUILDING CODE AND ITS IMPLICATIONS FOR BUILDING CONSTRUCTION IN NIGERIA

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ABSTRACT

This paper is an appraisal of the National Building Code of 2006 and its implications for Building Construction in Nigeria. It assesses the importance of the National Building Code in Nigeria, and identifies the challenges in its implementation. In achieving these objectives, the study adopted the Survey Techniques. The random Sampling Techniques was used in the selection of the sample size of 300 in which a structured questionnaire form was administered to professionals -Builders, Architects, Engineers, Quantity Surveyors and Town Planners in the Built Environment in Edo State, Nigeria. 260 responses were received. Descriptive analysis was used in the treatment of gathered data. The study revealed that the level of implementation of the code by professionals is very low as most of them rarely make reference to the National Building Code in construction. It also shows that there is significant importance in the use of the National Building Code. It is concluded that the National Building Code is a welcome document and the provisions are comprehensive and covered most areas that concern Building. The study recommended that the building code must be pursued and followed by all stakeholders to set standards in Building Construction in Nigeria.

Key words: Building Construction, Implications, National Building Code, Professional.

INTRODUCTION

BACKGROUND

A Building code is the minimum acceptable standard used to regulate the design, construction and maintenance of Buildings for the purpose of protecting the health, safety and general welfare of the Building's users (Obiegbu, 2008) The (National Building Code) 2006 sets out the minimum standard on building pre-designs, designs, construction and post- construction stages

with a view to ensuring quality, safety and proficiency in the Building Industry. The National Building Code became necessary because of the following prevailing conditions: lack of plan of towns and cities; incessant collapse of buildings; built environment abuse, fire infernos and other disasters; dearth of referenced design standards for professionals; use of non-professional and quacks; use of untested products and materials and lack of maintenance culture. (National Building Code, (2006)). This Code came into being after a long time of pondering the idea. It became pertinent that there was need for such a document that would check-mate several unprofessional practices among the professionals of the Built Environment. (Anejo & Ahmed, 2008)

This paper therefore aims at appraising the National Building Code and the implications for Building Construction in Nigeria with the objectives of:-

i. evaluating the implications of the National Building Code on professionals involved in building construction.
ii. assessing the importance of the National Building Code for building construction.
iii. identifying the challenges in the implementation of the National Building code for building construction in Nigeria.

LITERATURE REVIEW

History of building codes: Building Codes have a Long history that dates back to the I9th century. The Code of Hammurabi in Babylon provided requirements that took building integrity very seriously. According to this code, if a building collapses, "The Builder is to be put to death. The enactment of laws regulating construction developed with the cities as they grew and experienced the threats and consequences of fire, collapse, and high loss of life. The Roman Empire instituted Building codes after the great fire of London in 1966 which destroyed 15,000 buildings (Obiegbu, 2008). In the United States, the great Chicago fire in 1871 killed 250 people, „destroyed 17, 000 structures and left nearly 100, 000 people homeless. Four years later, Chicago city enacted a new building code and a prevention ordinance (Lamoreaux, 2002). As is often the case, Building Codes are the after-thought of a tragedy than a fore-thought preventive strategies. As cities grew and experienced their own disasters, their building codes were developed based on individual experiences, more than scientific knowledge (Jambol, 2008). In 1905, the first national building code was established in the United State, this code regulated the type of building components that could be used in construction materials (Bamisile, 2010). Modern building codes rely more on measurable performance rather than in the rigid specification, if the code for materials and methods are established in scientific and engineering principles that have been thoroughly tested over the centuries (Mbamali, 2007).

LAYOUT OF THE NATIONAL BUILDING CODE

The code is divided into four sections which are in turn divided into parts: The first section deals with the administrative aspect of the implementation (Ethic code), which depends on government; The second section deals with the technical aspect of the code which is to be implemented directly by the professionals in the Building industry. The third section provides for the control of building works and while the fourth section is a schedule showing the referenced

standards with the sections. Also included in the Code is the form for attestation by the various professionals with respect to their respective inputs into the whole construction process.

IMPLICATIONS OF THE NATIONAL BUILDING CODE FOR BUILDING CONSTRUCTION IN NIGERIA

A building of whatever description and purpose is the product of the process of design and production (Bala, 2008). The design of the building gives us mental picture of both the prospective structure and purpose (function), The design process is concerned with the size, shape and disposition of the spaces (form) and services, it defines the fabric and nature of the building, which includes architectural and engineering (structures; services; electrical, mechanical, geo- technical) drawings (Bamisile, 2010).

CHALLENGES IN THE IMPLEMENTATION OF THE NATIONAL BUILDING CODE

According to Balogun (2008), the code in its implementation would pose challenges to the stakeholders in building industry and development control. Being a new law to guide construction and control development in the country, the code may pose some challenges to the professional in the industry, the public, the technocrats and the government. The major challenge is in the effort to ensuring compliance with the code. The professional such as the Builder, Architect, and the Surveyor in the pre design stage must be familiar with the provisions of the code to make compliance possible at the pre design stage. The client or the proposed building owner should in this regard employ a qualified, developed company who has adequate number of qualified staff. The Architect and Engineers are expected to be preoccupied at the design stage. In this regard, the Architect should ensure that design is made according to the code guideline and the professional ethic. The Engineer (structural, mechanical, electrical and water) is expected to make a design according to the architectural design specifications. (Bala, 2008) The technocrats and Development Control Department should comply with the code approval provision. „This can he achieved by avoiding corruption, political influence and official negligence. At construction stage, the initial challenge is faced by the developer, the building construction team which comprises the Builder, Architect and Engineer. The supervision of building construction should be done in conformity with the building code provisions.

IMPORTANCE OF THE NATIONAL BUILDING CODES FOR BUILDING CONSTRUCTION

The National Building Code was the product of many years of pain taking efforts by the seven professions in the Building Construction Industry, resource persons and other stakeholders coordinated by the National Council on Housing and Urban Development (Anosike & Mosaku,(2008) The following are the importance of the national building codes for building construction:

• **Aesthetics**: Any regulation of the aesthetics of buildings is usually included in zoning or other municipal by-laws;

• **Building use**: the said use of a building is generally in the fire code; • The codes enable property professionals to generate consistent and comparable performance information about their buildings, with key management imperatives:

• **Decision making**: with a trust worthy and reliable information base, managers are able to make better, faster, more confident decisions about their buildings, and in particular, how to reduce environmental impacts.

• **Communication**: as well as enabling the cooperate property industry to speak the same language, the codes should have a good practice structure for communicating performance to key stakeholders such as senior management, staff, shareholders, customers and local community

• **Enhanced corporate reputation**: through the industry good practice, supporting code compliance as well as requests for increase in Environmental performance information

• **Better risk management**: with a clear picture of environmental risks and potential liabilities are better equipped to reduce exposure to risks.

• **Informed Procurement**: the ability to set sophisticated environmental specifications Associate with new building empowerment of existing buildings.

• **Benchmarking**: standardization enables us to answer the questions that may arise from construction.

IMPLICATIONS OF THE NATIONAL BUILDING CODE ON PROFESSIONALS

It is expected that the National Building Code of 2006 would have a positive impact on professionalism in the Building construction industry because it has spelt out the inputs and services to be provided by the various professionals and also the standards for building materials and component also stated (Abiola & Makonjuola, 2005). National Building Code clearly demarcates and assigns roles and responsibilities to all members of the building construction industry for the production of all buildings.

1)The Professional (registered) Builder has the responsibility of the Building Production Management, (Section 12.1) (National Building Code) where the Builder is expected to prepare the following documents (Section 2.32):

i) Construction Methodology Programme,
ii) Project Quality Management Plan
iii) Project Health and Safety Plan
iv) Building Conditions Survey Documents
v) Construction Budget Plan
vi) Project Monitoring & Evaluation Documents

2) . Other documents being the contract drawing and specifications prepared by the Registered Architect and Engineers; Priced Bills of Quantities prepared by the Registered Quantity Surveyor. The provision of (section 13.12.4) specifically provides that the Registered Builder is to carry out the Management of the execution of the building works including the supervision of artisans and tradesmen.

3.) All completed works at all levels must be attested to for compliance with the provision of the Code by Registered Architects, Builders and Engineers,

4.) While Registered Architects, Engineers and Surveyors are required to produce the "As Built" drawings/survey of buildings (Section 2.1 1), the "Building Maintenance Manual" is to be prepared by the Registered Architects, Builders and Engineers (Section 2.24.5.) The building Condition Survey Report is to be similarly prepared by a joint team of Registered Architects, Builders, Engineers and Quantity Surveyors (Section

2.21.6.) The Code Enforcement Division/ Section/Unit is to comprise all registered professionals in the built environment as provided for in (Section 3.1.1) spells out the eligibility to the headship on the committee open to all or any of them.

METHODOLOGY

In achieving the stated objectives for this work, these objectives, the random sampling techniques was used in the selection of the sample size, and 300 well-structured questionnaires measured on a likert scale were administered to professionals in the Built Environment in Edo State, Nigeria. 260 responses were received. The method used for data analysis was the Descriptive analysis. The questionnaire requires the respondents to rank their answer on a likert scale of 4 points. And the mininmum mean score to be accepted as important is 2.5

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS.

The results of the questionnaire analysis are presented in the following tables. **Table 1: Table 1: Profession of Respondents and Percentage Responses**

Profession	Professional Associations	Numbers Distributed	No. of Respondents	Percentages (%)
Builders	NIOB	80	80	30.77
Architects	NIA	66	50	19.23
Engineers	NSE	70	62	23.85
Q/Surveyors	NIQS	42	35	13.46
T/Planners	NITP	36	33	12.69
Total		300	260	100%

Field survey (2020)

Key: **NIOB**: Nigeria Institute Of Builders, **NIA**: Nigeria Institute Of Architect, **NSE**: Nigeria Society Of Engineers, **NIQS**: Nigeria Institute Of Quantity Surveyors, **NITP**: Nigeria Institute Of Town Planners

Table 1: shows the breakdown of the questionnaire:- From 260 respondents out of 300 questionnaires, Builders have 30.77%, Architects 19.23%, Engineers 23.85%, Quantity Surveyors 13.46% and Town Planner 12.69%. It can also be observed that all the respondents claimed that they belong to their respective Professional Body

Table 2: Importance of the National Building Code

S/No	Code Importance	1	2	3	4	$\sum^{f}$	$\sum^{fx}$	M(%)	RII
1	Aesthetics	5	15	90	150	260	905	3.48	0,87
2	Building Use	4	14	91	151	260	909	3.49	0,87
3	General information	3	13	93	152	260	916	352	0.88
4	Decision making	1	11	94	154	260	921	2.54	0.64
5	Communication	2	12	95	154	260	931	3.58	0.90
6	Enhanced corporate Regulation	4	14	96	155	260	944	3.63	0.91
7	Better risk management	2	13	97	156	260	947	3.66	0.92

Field Survey (2020) 1: Not Important, 2: Less Important, 3: Important, 4: Very Important.

Table 2 shows the responses from respondents on the importance of the National Building Code. The result shows that aesthetics in design average has average score of 3.48, meaning it is important, while Building use has average 3.49 (important), Code generating information average 3.52 (important), decision making average 3.54 (important), and communication average 3.55 (important), enhanced corporate reputation average 3.63 (important), better risk management average 3.64 (important). The result indicates that the respondents believed that the use of the National Building Code is important.

Table 3: Rate of Code Implementation at Different Stages

S/N	Code Importance	1	2	3	4	$\sum^{f}$	$\sum^{fx}$	M(%)	RII
1	Provision of the perimeter survey	48	52	70	90	260	722	2.77	0.69
2	A development permit to authority design.	52	48	90	70	260	698	2.68	0.67
3	Architectural design.	48	70	90	52	260	666	2.56	0.64
4	Structural designs	90	52	48	70	260	618	2.37	0.59
5	Submission of plan to planning authority construction.	70	48	90	52	260	644	2.47	0.62
6	Develop to notify the building authority.	52	90	48	70	260	656	2.53	0.63
7	Inspection of all construction work.	90	70	48	52	260	562	2.16	0.54
8	Provision of inspection record card.	52	90	70	48	260	634	2.43	0.61
9	Final inspection post construction.	48	52	70	90	260	722	2.77	0.69
10	Issuance of certificate of fitness	52	90	70	48	260	634	2.43	0.61
11	Provision of building maintenance manual.	70	52	48	90	260	678	2.60	0.65
12	Provision of building condition survey.	90	48	52	70	260	622	2.39	0.60

Field Survey (2020) 1: Strongly disagree 2: Disagree, 3: Agree, 4: Strongly agree

Table 3 shows responses from questionnaires on the rate of the Code implementation at different stages derived from Professionals in the built Environment. It shows that provision of perimeter survey has average of 2.77, which means the respondents agree that at pre-design stage the survey is needed, a developmental permit to planning authority averaged 2.68 (agree), architectural design average 3.50 (agree), structural design average 2.37 (agree), submission of plan to planning authority averaged 2.47 (agree), developer to notify planning authority averaged 2.53, inspection at all construction work averaged 2.16 (agree), provision of inspection record card averaged 2.43 (agree), final inspection averaged 2.77 (agree), issuance of certificate of fitness averaged 2.43 (agree) , provision of maintenance manual averaged 2.60 (agree), provision of building condition report averaged 2.39 (agree). This indicates that the respondents agree all the rate of the building code implementation at different stages in Building Construction

Table 4: Challenges of the Code's Implementation

S/No	Code Importance	1	2	3	4	$\sum^{f}$	$\sum^{fx}$	M(%)	RII
1	Knowledge	10	20	40	190	260	930	3.57	0.89
2	Strategies	15	15	60	170	260	905	3.48	0.87
3	Development for building regulation	15	25	70	150	260	870	3.34	0.84
4	Tools for implementation	20	20	70	150	260	870	3.34	0.84
5	The will to implement	25	15	60	160	260	875	3.36	0.84

Field Survey (2020) 1: Strongly disagree 2: Disagree, 3: Agree, 4: Strongly agree

Table 4 Shows responses from questionnaires on the challenges of the Code implementation. Knowledge averaged 3.57 meaning it is agreed upon that awareness is needed, strategies averaged 3.48 (agree), development of building regulation averaged 3.36 (agree), tools for implementation averaged 3.34 (agree), while the will to implement averaged 3.36 (agree).
This indicates that the respondents agree that these problems will affect the Code implementation in Nigeria.

Table 5: Measure to ensure that Professionals are consulted

S/N	Measure Pre-design	1	2	3	4	$\sum^{f}$	$\sum^{fx}$	M(%)	RII
	Provision of perimeter survey Design. Stage	4	8	88	160	260	924	3.55	0.89
2	Architectural drawing by Architect	2	6	52	200	260	970	3.73	0.93
3	Structural drawings by Engineers	4	9	67	180	260	943	3.63	0.91
4	Health and safety plan by the builder	1	5	34	220	260	993	3.82	0.96

5	Bill of quantities by the Q/Surveyors Construction stage.	2	7	41	210	260	979	3.77	0.94
6	Supervision of input by Engineers and Architect.	4	6	50	200	260	966	3.72	0.93
7	Building production management by Builder post-construction stage	2	3	25	230	260	1003	3.86	0.97
8	As- built drawings by Architect and Engineer.	5	8	97	235	260	912	3.51	0.88
9	Building condition survey by Builder, Architects, Engineers and Quantity Surveyors.	4	8	38	210	260	974	3.75	0.94

Field Survey (2020) 1: Not Important, 2: Less Important, 3: Important, 4: Very Important

Table 5 shows the respondents‟ assessment of the measures to ensure that professionals are consulted at all stages in Building Construction. It shows that provision of perimeter survey averaged 3.55, which means the respondents agree that at pre-design stage the survey is important, architectural design averaged 3.73 (important), structural design averaged 3.63 (important), health and safety plan averaged 3.72 (important), bill of quantity averaged 3.77, supervision of work based on input averaged 3.86 (important), building production management (important), as-built drawing averaged 3.88 (important), building maintenance manual averaged 3.51 (important), building condition survey averaged 3.75 (important). This indicates that the respondents agree that all the measures to ensure that professionals are consulted at different stages are important in Building Construction.

CONCLUSION

This study concludes that the National Building Code should be enacted by the legislative arms of government at all levels there by giving the code statutory backing. The study also recommends that the document must be pursued by all stakeholders to set standards in Building Construction in Nigeria. The National Building Code as presented is a welcome document and the provisions are comprehensive and cover most areas that concern building as it specifies the safety and health standards of users of the building and the workers.

RECOMMENDATIONS

Having taken a look through the provisions of the National Building Code, the following recommendations were made:

- The National Building Code, being a product of extensive work should have a collective effect of the seven key professional of the building industry and their regulatory bodies.
- Government at all levels should as a matter of utmost importance

establish the Building Code Enforcement systems and provide an enabling environment for it to blossom.

- There is also the need for the legislative arms of government at all levels to give the building code legal backing.
- The Building code is a very technical one. And should have technically trained and qualified practitioners to carefully study it at all related sections for a comprehensive understanding before application.
- There is the need for more sensitizations to be given on this important document to all the stakeholders, Professionals, Users, and Contractor.
- The Country needs to bring to the front burner the issue of research and development in building materials, elements and components. Building Research Institution is long overdue.
- The Nigeria Professionals in the Building industry should imbibe teamwork in their practice, rather than the separation principle on which the present practice is hinged.

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IMPORTANCE OF TECHNICAL DRAWING IN ADDRESSING CHALLENGES TO TECHNOLOGICAL DEVELOPMENT

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ABSTRACT

Technical Drawings allows engineers to create and interpret designs, calculate forces and stresses on structures, and work with manufacturers plan without errors. It is a tool for communicating ideas between people working on any project. Realizing its importance in technological advancement in an emerging society, the federal Government introduced Technical drawing with other courses into the secondary school curriculum in 1982 to inculcate soft skills in the young minds, but it is sad to note that almost after four decades, Nigeria is not still well grounded in the language used in the workshops where technological goods are produced. This paper examines the importance of Technical drawing to our national development, and why most secondary schools are not offering the subjects? It also examines why students are avoiding courses related to technical drawing in higher institutions despite its importance? The way forward on how to make the subject more attractive to the students are suggested in this paper.

Keywords: *Technical drawing, Technological advancement, Youth empowerment.*

INTRODUCTION

We live in a world where almost everything is made by hand. All the comfort of modern living is made possible directly or indirectly by hands; classrooms, roads, bridges, vehicles, airplanes among others. If we need a table, we go to a carpenter to describe the type of table, but how long will it take us to describe the type of table we need? How often are strangers misled because it is difficult to describe in words the places they seek? How often do we hear of building collapses because the plans and specifications are not well interpreted? The answers to these questions and similar questions are found in the role of technical drawing in construction and manufacturing industries in an emerging economy.

Technical Drawing is defined by Author Collins English Dictionary (2014) as "Communication between the designer and the manufacturers to bring ideas in reality by means of drafting".

Technical drawing or drafting is the graphical representation of structures, machines, and components by the use of lines only. These lines may be straight,

curved or crooked. Technologically, goods like cars, airplanes, radios, televisions, computer sets among others are conceived in the minds of engineers but cannot be described accurately except by drawing graphics (Igbinowanhia & Aliu, 2013).

Technical drawing is a short - hand language used in the workshop which is described by means of drawings of whatever has been manufactured or what is intended for manufacture (Aideloje & Eguaoje, (2001). It is used in industries where technological goods are manufactured through the help of "Working Drawing" designed by craftsmen through technical drawing.

These drawings are sometimes referred to as technical illustrations, and they include: electrical drawings, engineering drawings, plumbing drawings, structural drawings, architectural drawings, mechanical system drawings and building drawings among others.

These drawings are used in different technological workshops such as metal, electrical/electronics and auto workshops.

In metal workshops, drawings are used to illustrate how metal sheets and rods are assembled to produce chairs, tables, railway tracks, body of vehicles. In electrical/electrons workshops, drawings are used to illustrate all electrical installations, production and repair of electrical works. In Auto workshop, drawing is needed to illustrate all auto mobile equipment, production, repairs and assembly of cars parts, forging of metals among others.

As a universal language, Technical Drawing (T.D) is governed by rules regarding methods of drawing and symbols used. These rules and symbols are laid down by the International Standards Organization (ISO). A basic knowledge of T.D is desirable for every student who has passed through a secondary school, whether he aspires to be lawyer, doctor, policeman or economist. He/she will need to develop the ability to express him/herself through simple drawings and to be able to carry out little repairs at home following the manufacturer's manual.

In Nigeria, parents and students view technical drawing as one of the 'trade' subjects to be acquired in training institutes or as mere Fine Art, which involves just painting and sketching of objects- to appreciate the work of creation or show the artistic beauty. Igbinomwanhia, D.I & Aliu, S.A. (2013). Therefore, one may say "Fine art and photography can take the place of T.D". This opinion is wrong because fine art or photography cannot show accurate details of sizes and shapes of different parts of an object. Fine art also uses colors and shading to reflect the artist's appreciation of natural beauty, and photograph cannot show the accurate measurement of an object. While T.D uses few lines to describe the length, breath and width of an object, colors and shading are not allowed except when used to show the different materials of a component.

On historical reflection, technical drawing is one of the subjects that were introduced into the Nigeria curriculum in 1982 when the 6-3-3-4 system of education was introduced. At present, in the senior secondary school level, it is taken as an elective course, taught to students who intend to take careers as technicians, technologists, engineers or go further to the tertiary institutions to major in technological and engineering related programmes. At the higher education level, it is a basic course for engineering and science related students. However, the syllabus and course specifications of the different technologically inclined programmes in the Polytechnics (Engineering, Environmental, Architectural technology, etc) show that technical drawing is a core subject. It is a compulsory course or a pre-requisite course for students of

technology and engineering disciplines in Polytechnics, Universities, and Technical colleges of education in Nigeria. It was as a result of its importance in the development of an individual and the emerging economy of any nation that it was re-introduced among the natural science and other science related courses in Nigeria (FRN, 2013).

As a tool for communicating ideas, the following professionals need T.D at some point in their career:

- Anyone who builds or creates
- Application designers
- Plumbers
- Architects
- Construction workers
- Computer engineers
- Electricians
- Production designers

There are two types of drawings used in T.D, pictorial drawings and orthographic drawings. T.D involves manual work and computer aided design system (CAD) used for production. There are two types of computer aided design systems used for production of Technical drawings: these are the two dimensions (2D) and three dimensions (3D).

2D (CAD) system such as Auto CAD or micro station replaced the paper drawing system. The lines, circles, arcs, and curves are created within the software. One needs a basic knowledge in science and mathematics to be able to use the Auto CAD.

Since technology is the "application of scientific knowledge to the practical aims of human life or to the changes and manipulation of the human environment" (Britannica, 2009), one needs to acquire the knowledge/ skill of Technical drawing at a tender age. In an emerging economy, technological advancement is usually driven by need and reward whether internally or externally. That is why the saying "necessity is the mother of invention". For instance, the Chinese don't actually need everything they produce but they know they will get reward when they export their products to other countries.

For Nigeria to advance technologically according to (Okoro, 2014), firstly there should be a serious investment in Science, Technology, Engineering and Mathematics (STEM) education and research. Secondly people should see careers in these fields as being rewarding; both financially and prestige wise compared to the money and respect they can gain from other industries like entertainment, sports, and politics. This could be one of the reasons why Nigeria is not technologically advanced.

1.0 THE ROLE OF TECHNICAL DRAWING IN TECHNOLOGICAL ADVANCEMENT

The importance of Technical drawing in scientific and technological development in an emerging economy has been widely reported (Wolfgang, 2004); (Igbinomwanhia & Aliu 2013); and (Davis, 2017). Adequate knowledge/skills in Technical Drawing by an individual can enable him fit into a technical based occupation and hence become useful to himself and to the society.

Technical drawing is a means by which persons working in industries such as mechanical engineering, building technology, architecture, electrical engineering, and chemical engineering, among others communicate their ideas of the shape, form and dimension of the articles being made. In summary, Technical Drawing plays the following roles across all professions: according to (Wolfgang, 2004).

- Technical Drawing allows engineers to create designs, calculate forces and stresses on structures, and work with manufacturers plan without errors.

- It encourages tidy and accurate methods of presenting ideas out of the brain and into the technological world in the form of drawing.
- Knowledge of Technical Drawing allows one to think in three dimension; heights, width and depth of objects being drawn.
- A good knowledge of it can help one to be employed in industries such as engineering, building and construction among others.
- T.D is important as a tool for communicating ideas between people working on any project: Between organizations, countries, among others.
- It is also used to communicate complicated mathematical and scientific equations.
- It helps to develop spatial imagination.

The importance of Technical drawing cannot be over emphasized, so any nation that wishes to grow her economy must train her youths to acquire this soft skill at an early age so that they can "communicate" effectively in the workshop or work place. A study by Anetekhai (2014), had shown that this great course in the curriculum is not reflected in the lessons time table used by most senior secondary schools in Edo North, only few schools offer the course in senior secondary certificate examination **(SSCE**). Technical drawing plays a vital role in every field; it is the heart of engineering, environmental, technical studies among others.

If it is effectively taught to every student in their first three years of senior secondary school education, it would serve the dual purpose of giving a general technical knowledge and skills to all, as well as encouraging as many students as possible, to develop reflective thinking, motivate them to have interest to take to technical professions such as engineering, architecture, surveying, draughts man ship etc.

The effective implementation of Technical drawing Syllabus requires motivation of students' interests in it. Interest involves a sense of concern with and curiosity about something, Students' interest in learning is associated with their anxiety to learn. Interest is fundamental in any individuals' choice of task. It consists of feelings and tendencies towards concrete matters. A characteristic feature of interest is a manifestation of a different preference towards actions, events or plan. A student's interest in a course like Technical drawing will induce him to behave and act in a certain way towards the study of the course!. Therefore, this author agrees with Mbah (2007 as cited by Igbinomwanhia, & Aliu, 2013) that the uses of instructional techniques and a good conducive learning environment are motivational to students' interest in technical subjects such as technical drawing (TD). It instills in the students, the ability of reflective thinking that means it encourages creative thinking, which makes learners to apply or build upon previous learning to construct new knowledge and become effective problem solvers.

Students need reflective thinking; a good environment and materials to actualize their ideas. So it has been recommended that government should invest on building and equipping laboratories and workshop where students can harness their potentials and make their contribution to the field of technological development. (Anetekhai,2014). Unfortunately, the reality is not yet as it should be in Nigeria. It has been observed that students enrolment in technical courses which houses technical drawing have been decreasing exponentially

in colleges, polytechnics and universities (Salami, 2006) and (Aina 2008). The laying of too much emphasis on strictly university education in Nigeria has continuously reduced the economic opportunities of those who are more technically oriented in academics (Ojimba, 2012).

According to (Ogwo & Oranu, 2006) as cited by (Ummadi, & Uwamieye, 2015) with technological advancement and globalization in workplaces, employers are now looking for employees or graduates who can transfer their knowledge or ideas to different content and under varying technological conditions, and able to respond independently and creatively, Technical drawing could be that effective tool, to communicate ideas in the production industry, either in building industries, Estate management, Urban and regional planning, Architectural design, or in engineering workshop.

Since it is the language of technology, a concerted effort towards effective teaching/learning of Technical drawing in educational institutions will be a boost or even panacea to the technological advancement in developing countries. In Nigeria today Governments lay emphasis on agriculture-food production, yes! Good idea- but what is the plan for adequate storage of these goods we are producing? Therefore, there is need to train the youths to acquire soft skills through reflective thinking on how to fabricate and forge machines to process, store and package these agricultural products. Knowledge of technical drawing is important to be able to acquire such skills.

2.0 PROBLEMS FACING TECHNICAL ADVANCEMENT IN NIGERIA

The problems facing technological growth in Nigeria are enormous. But it is sad to note that only a few secondary schools lay emphasis in technological courses in Nigeria, as earlier stated. Some school authorities believes that including technical courses such as T.D into the time table will obstruct the smooth running of the system because there are most often inadequate manpower and no workshops to perform the needed practical work. (Igbinomwanhia & Aliu, 2013). Other factors that impede the smooth teaching and learning of technical courses in our educational institutions include:

- Lack of proper mind set on the part of the students which is a major problem faced in the course of integrating technology into teaching and learning in Nigeria schools. From general observations, most students now want to learn quick ways of making money, no one wants to pass through rigorous experience in order to acquire employable skills which technical courses including technical Drawing demands.
- There is lack of sufficient continuing professional development for teachers who have to integrate new technologies into their teaching methods.
- Resistance to change: There is a “comfort with the status quo” which results in teachers and schools leaders believing that learning about new technologies is outside their job description. So many teachers of T.D still use manual means (drawing board, tee square, set squares among others) to teach.
- There is a gap between the idea of differentiated personalized instruction and the technologies available to make it happen as some teachers/ students do not possess the tools or time available to bring their ideas to the real sense.

- ❖ Many teachers "teach for test" because the syllabus and scheme of work for such training is omitted either because of strikes or otherwise, so technical drawing course which involves practical work is neglected.
- ❖ Older teachers seem to lack an understanding on how new technology works. This lack of understanding is exasperated when an older teacher is trying to teach a student who grew up using new technology.

3.0 CURRENT TRENDS IN TECHNICAL ADVANCEMENT IN NIGERIA

In 2018, the Word-Bank in conjunction with the Federal Ministry of Education (FME) through the National Board for Technical Education established that, there is a huge gap in the skills of graduates from institutions and the demands from the industries.

The report also entrenched the need for all stakeholders in the National economy to deviate from the present supply trend of graduates from institutions to a demand-driven trend of the industries by creating a forum titled "Innovation Development and Effectiveness in the Acquisition of Skills project'' (IDEAS). Based on this call for action, a workshop was organized in Abuja on 13th September, 2018 with the theme "Skills Development in Nigeria". One of the objectives of the proposed IDEAS was to increase the availability and competence of motivated instructors for skill development. The workshop communiqué called on all institutions, both private and public to establish IDEAS unit in their schools for the purpose of innovation development and acquisition of relevant skills for the national economy.

This is in line with (Eze, 2013) who was of the view that the impact of Tertiary Education Trust Fund (TETFUND), including Technical drawing on the development of the youth has not been felt, despite the huge government investment in training teachers in local and foreign institutions.

The knowledge or applications of Technical drawing is a pre-requisite for all technical courses. For Nigeria to contribute meaningfully in the technological world, the youths must be able to communicate effectively using graphic language which is technical drawing (T.D). We all enjoy the good fruits of technology! We use motor cars, trains, airplanes and ships for transportation of people and goods; radio, television sets, and musical equipment for our entertainment and also for communication. The "brain" behind the production of these technological goods is the Technical draftsman with the help of "Working Drawing". Unless we advance or equip the youths to acquire soft skills, which Technical drawing provides, it seems we will remain novice workers and our great nation will continue to be a consuming nation and this could adversely affect rural and urban development in Nigeria.

Baffa,(2017), noted that over the years, Tertiary Education Trust Fund (TETFUND) has been responsible for over 60% infrastructural development and training of staff in public tertiary institutions in the country. He further stated that, the agency would not relent in its current drive aimed at making local institutions to produce human capital development of lecturers and students to compete favorably in the global academic arena.

To maintain or consolidate government plans, the first Technical University (TECH-U) institution along Ibadan-Lagos express

way has been established to train students in, entrepreneurial practices, unique innovation, sustainability science and international best practices. This is because for too long, it seems universities in Nigeria have failed to nurture their products in a way that makes them industry ready hence, the skills gap crises continue in the country. The mission of the Tech-U is to nurture industrious and market ready graduates (that is industry integrated education) a model of blended theoretical knowledge and practical skills. Students offer training in unique areas like cyber security, mechatronics engineering, software engineering among others. All these courses involve T.D. The goal (focus) is to produce relevant man power that can practically advance the course of national development. (www.Tech-U.edu.ng/technical.varsity-one-year-after)

If technology must advance in Nigeria, the youths need to be introduced to T.D at an early stage of their educational career.

To further encourage the youths, the government embarked on the retraining of militant groups across the Niger Delta. Some of these youths were sent out to other countries to study some of the following courses:

-Transformer construction, -Trouble shooting and Maintenance of electrical equipment.

-Advanced Air Conditioning and Refrigerating Technology among others.

All these courses require knowledge Technical drawing (alphapartnerstrainigs.com/category/5-work-service-maintenace).

In Nigeria today, most people are not thinking of advancing technologically or making life better, almost everybody is thinking of making money. The few ones who are in the technological fields- interested in solving the technological problems of our great nation are not motivated, but discouraged and looked down upon. As such they give up and join the crowd or leave the country.

One other major reason why students shy away from technical courses including technical drawing is the teacher factor. Adodo, (2007) argues that one key overriding factor for the success of students performance in any course is the teacher. So, the job of the teacher in curriculum management is very important. The reason is that the teacher determines the success or failure of any curriculum. Despite previous efforts made by the government to supply adequate number of academic staff to technological institutions in Nigeria, it seems that very many qualified technological persons do not come into teaching (Iredia, 2012).

Another factor contributing to the problem of academic staff inadequacy in polytechnics and universities are brain drain. Technical lecturers are highly mobile, due to the fact that their services are needed everywhere in the labour market. As a result of this, lecturers in Nigeria public polytechnics and universities move to industries in order to earn more income. Industries/private universities and other organizations use higher salaries and better conditions of services to attract technical lecturers because they know their worth (Anetekhai, 2012).

The family background and the school curriculum content which the child is exposed to are other contributing factors which have great influence on the child's psychological, emotional, social and economic state (Egbochuku & Alika, 2008). And many of the parents have no time to monitor the curriculum their wards are exposed to in school. While some are facing financial problems, and also some of the students in Polytechnics are from poor homes, they cannot afford good schools where T.D is taught nor have one to encourage them or organize extra lectures for them. The family background affects the learner's reactions to life situations and level of performance. The

level of education and occupation of parents reflect their perception of importance of education which in turn influences the encouragement and involvement of such parents in their children's educational attainment (Okoro, 2014)

The need to encourage the students to develop interest in technical drawing cannot be over emphasized, for science and technology to succeed, technical drawing, which is the foundation or cornerstone, must be adequately and effectively delivered to students in technological and engineering disciplines. Since technical drawing is a language; it forms the power house that integrates all engineering and science subjects. Unless the youths can speak and communicate in the language used in the workshop it will be difficult to achieve a breakthrough in the technological world.

4.0 CONCLUSION

The idea of "do–it-yourself" by most people in developed countries is not restricted to those in the technical professions. Thus, little repairs can be done at home if the manufacturer's drawing "manuals" are followed closely. Technical drawing when taught to everyone in the first three years of senior secondary school system would serve the dual purpose of giving a general technical knowledge or skills to all as well as encouraging as many students as possible, to take to technical professions such as engineering, architecture, surveying, building technology among others.

-Also government should institute programs to provide scholarships for brilliant and indigent students. The program should also include technical graduates who want to set up small film.

-Government and private sectors should as a matter of urgency start paying people in science, technology, engineering and mathematics (STEM) special salary similar to what artistes, footballers and politicians earn. In short they should earn more, this could attract Nigerians in Diaspora to come and practice at home.

-We should all see careers in these areas as a service to humanity and the nation. And there should be reward both financially and prestige wise for those who venture into it. As it is in other industries like entertainment, sports, and politics!

-In conclusion, to move Nigeria to the next level technologically, we need to change our attitude "grab-my-own" or "share the money" that old mentality to a problem-solving mentality. Where the youth will use their brains through reflective thinking and the technical drawing as a tool to communicate their rich, God endow ideas.

RECOMMENDATION

1. A basic knowledge of Technical drawing is desirable and recommended for every student who has passed through secondary school education. Whether he aspires to be a lawyer, doctor, economist, politician, policeman or a man of any other profession he needs to develop the ability to express his thoughts through simple drawings. Therefore, Technical Drawing should be made compulsory for all students at the secondary school level to give them basic foundation of the course since it is a core course in higher institutions.
2. Funding of free education to female students for technical programmes by government at all levels could bridge the gap between boys and girls participation in engineering related courses, and also motivate their interest and performance in

technical subjects such as technical drawing.

3. Government should put an end to lecturers indiscriminate strikes action as this has adverse effects on learning of technological courses because these contain skills acquisition- which involve practical, and require a step by step process, where one cannot move to the next step if he/she has not mastered the first one.
4. Lecturers of technical drawing and all other technological teachers should be retrained on the use of AUTO CAD in drafting. Since human resources have been considered as very vital to every organization, so the right caliber of lecturers should be made to teach the course.
5. Drawing studios with well equipped computers, drawing boards and AUTO CAD software should be provided to enable students to be exposed to what to be encountered at the work place.
6. The need to encourage the students to develop interest in technical drawing cannot be over emphasized, so government should give bursary award to all interested technological and engineering students. This will help to motivate their interest.
7. There should be adequate sensitization to educate the younger ones to see the need to have interest on technical drawing as this will help them grow up as problems solvers as it will make them increase their ability for reflective thinking or analyzing issues logically.
8. Parents and students should not view technical drawing as merely one of the trade subjects to be acquired in "training centers" or along road side artist but as a course that is capable of lifting Nigeria to a greater height technologically. As such they should encourage their children at early stage of their career.
9. Government and ministry personnel's should monitor the equipments supplied to schools, to know if these equipments are used or not. In some cases even when equipment are there, they cannot be fixed or used by either lecturers or the students because they cannot interpret the manual to install it.

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