



10TH INTERNATIONAL
RESEARCH CONFERENCE FOR
HUMANITIES, EDUCATION, SCIENCES,
SOCIAL SCIENCES & MANAGEMENT

GOMBE STATE UNIVERSITY - NIGERIA

CONFERENCE PROCEEDINGS

Theme **Africa's Development Crisis:**
Addressing Emerging Issues

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GOMBE STATE UNIVERSITY - NIGERIA

THEME

Africa's Development Crisis: Addressing Emerging Issues

DATE: Wednesday 8th - Thursday 9th May, 2024

TIME: 09:00 am (GMT+1)

CONFERENCE LOC

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Gombe State University

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DAY ONE: Wednesday 8th May, 2024

Conference Briefing via Google Meet - 9:00am - 9:30am

Online Visual Presentation via Google Meet - 9:30am - 1:00pm

WhatsApp Video Presentations - 3:00pm - 4:00pm

DAY TWO: Thursday 9th May, 2024

Conference Briefing via Google Meet - 9:00am - 9:30am

Online Visual Presentation via Google Meet - 9:30am - 1:00pm

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***Book of
Proceedings***



EMOTIONAL INTELLIGENCE AND SOCIO-ECONOMIC BACKGROUND AS DETERMINANT OF ACADEMIC ACHIEVEMENT AMONG STUDENTS OF AHMADU BELLO UNIVERSITY ZARIA, KADUNA STATE-NIGERIA

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Abstract

This paper investigated the relationship of Emotional Intelligence, Socio-Economic Background and Academic Achievement among Students of Ahmadu Bello University Zaria, Kaduna State-Nigeria. Correlation designed was used for the study. Sample size of two hundred and seventy (270) students was drawn from five faculties in Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Hypotheses formulated for the study were tested with Pearson Product-Moment Correlation (PPMC) and it was revealed from the study that all the hypotheses were rejected. The results showed that significant relationship exists between emotional intelligent and academic achievement ($r = 0.761$, $p = 0.001$). Also, significant relationship exists between socio-economic background and academic achievement ($r = 0.711$, $p = 0.000$). It was therefore recommended that, among others, The University counseling psychologists and lecturers should focus on teaching emotional intelligence as a strategy to develop academic behaviours and attitudes of students at the university. When students are educated to be emotionally intelligent, their general performance can be improved; and parents should give their children the adequate support needed, so as to enhance their academic achievement.

Keywords: Emotional intelligence, socio-economic background and students' academic achievement.

Introduction

Education is an important pillar of societal development, shaping individuals and communities while driving progress and development; it is of the most significant outcomes of an academic achievement of students' in tertiary institutions. Academic achievement is the attainment obtained by a child in the lesson taught, which may

include experience, knowledge, skill and the likes. The knowledge and skill are measured in student's Cumulative Grade Point Average (CGPA); the child's good or poor performance does not depend solely on attribute the child is born with, but his family background, social contacts, teachers, overall climate in his school, and assessment procedure.

Academic achievement may be defined as excellence in all academic disciplines, in class as well as co-curricular activities. Cohen and Garcia (2006) define academic achievement as "knowledge attaining ability or degree of competence in school. Task usually measured by standardized test and expressed in a grade or unit based on students' performance/achievement". Cohen and Apfel (2009) refer to academic performance as "the knowledge obtained or skill developed in the school subjects usually designed by the test scores or marks assigned by the teacher". Achievement of student in the classroom takes a central role in the academic development of the students. Parents, teachers and school administrators take cognizance of the academic well-being of the students.

Yardsticks are set by school authorities to measure performance, the standard set by the university will determine whether a student is performing well or not. In the assessment of performance, Pekrun and Elliot (2006) argued that achievement is the behaviour of an individual that can be directly observed by another individual. Therefore, academic achievement has been seen as a term used for student based on how well they are doing in studies and classes. Academic achievement for university student is also seen as the extent to which a student has achieved his educational goals. This means that the student's academic performance is measured by the extent to which he or she has reached the educational goal he has set for himself. The university measures academic achievement in several ways which include Continuous Assessment Test (C.A.T) and a number of standardized test and examinations (Pekrun & Perry, 2007).

In education, emotions have been considered as supplementary for learning process. It is an essential element of one's personality and also of life. In both personal and professional survival, emotional intelligence plays a significant role. Elias (2004), however, has started to indicate that Emotional Intelligence can be considered as a necessary component of any educational society, he defined it as a set of skills necessary for effective social interaction and classroom success: emotional recognition and regulation, self-control, goal setting, social responsibility, empathy, problem solving, conflict resolution, and skills needed for leadership and effective group participation. Goleman (1996) cited in Aruna (2014) concluded that Emotional intelligence can predict academic success better than traditional measures of intelligence. There are numerous factors that affects Academic achievement of students and one of such is emotional intelligence.

In the span of last twenty year, Emotional Intelligence (EI) concept has become very popular parameter of a person knowledge, skill and abilities in office, profession, school,

personal life and overall success. Now it is being considered widely that emotional intelligence is also required for the job satisfaction, motivation, decision taking in adverse situations etc. It is felt now that inclusion of emotional intelligence in higher education is needed because it will make students able to reduce their academic pressure and in becoming a better decision maker. Emotional intelligence is not only useful for their academic life but also useful for post academic life.

It has, however, been established that despite an individual having the intellectual potential to succeed at institutions of higher learning, he or she may experience difficulty dealing with emotional issues, have poor relationships, and be ineffective in his or her decision making (Goleman 1998 cited in Aruna 2014). These observations, among others, have led to the realization that individuals from changing populations may require more than intellectual abilities to exist and thrive academically. High emotional intelligence can contribute positively to student learning process (Svetlana, 2007). Students low on emotional intelligence may find failure more difficult to deal with, which undermines their academic motivation, (Drago, 2004 cited in Aruna, 2014).

Walsh-Portillo (2011) has reported a significant positive relationship between academic success and higher emotional intelligence on the basis of various studies. Therefore, Ahmad (2012), have asserted that the fundamental purpose of the school, college, and university education that students need is not only to get mastery in academics or subject matter but to study and realize how to manage their emotions, be responsible and empathetic, and get practice to make accurate judgments and sound decisions. Moreover, the students can make alternative choices and deal with conflict, and can play a positive role in the community as constructive, committed and effective citizens.

Jatinder (2014) found significant correlation between Emotional intelligence and Achievement scores while Nelson and Low (2004) in one of their studies emphasized that Emotional intelligence skills have a great impact on students' achievement and retention especially during transition period of high school graduates in the first year of college. However, Yazici, Seyis and Altun (2011) observed that One of the dimensions of emotional intelligence "being aware of the emotions" was found to be a positive predictor of academic success of students, moreover the academic achievement differed by socio-economic status. Students with higher level of socio-economic income had meaningfully higher academic average than academic average of students with middle socio-economic income and low socio-economic income.

Socio-economic background relates to a combination of an individual's income, occupation and social background. Socio-economic background is a key determinant of success and future life chances. According to Richman, Johnson and Boxham (2006), parent's education is one of the strongest predictor of cognitive performance and academic attainment of students, among other aspects of socio-economic status. Mukherjee (1999) states that socio economic status is used as a measure of an individual's or group's social position in the community. He also reported that mothers' education is

the strong predictor of students' academic achievement. Socioeconomic status is a term used by sociologists, economists, and other social scientists to describe the class standing of an individual or group.

It is measured by a number of factors, including income, occupation, and education, and it can have either positive or negative impact on a student's life (Ashley, 2019). Oakes and Rossi (2002) assert that it is a fact that in families where the parents are privileged educationally, socially and economically, they promote a higher level of achievement in their offspring. According to Jeynes (2002), the socio-economic status of a child is usually determined by parental occupational status and income level, and the environment in which the child is brought up. It is also affected by parents' involvement in learning activities and effective parent-teacher relationship. It is understood that low socio-economic status negatively and depressingly affects students' academic motivation and leads to test anxiety due to high additional stress and tension at home, thereby affecting students' academic achievement in the long run. Studies by Eamon (2005) and Jeynes (2002) have established that socioeconomic status affects students' outcome. According to McNeal (2001), socioeconomic status has also been shown to override other educational influences such as parental involvement in their children's schooling. Munir, Faiza, Jamal, Daud and Iqbal (2023) lamented that socio economic status predicted academic outcomes and higher socio-economic students fare better academically.

On the basis of researches quoted it can be said that fair amount of studies have been conducted on Emotional intelligence and Socio-economic status and their correlation with Academic achievement but there is dearth of studies showing predictive value of Emotional intelligence and Socio-economic status on Academic achievement of students. An attempt was made to fill the research gap of the same. The present study aims to throw light by predicting Academic achievement of students in tertiary institution employing the variables Emotional intelligence and Socio-economic status.

Statement of the Problem

In the educational landscape of Nigeria, specifically within Ahmadu Bello University Zaria, Kaduna State, there is a growing concern about the intricate interplay between emotional intelligence, socio-economic background, and academic achievement among students. This complex nexus warrants an in-depth exploration as it holds significant implications for both individual student success and the broader educational system. Emotional Intelligence concerns have garnered increasing attention in recent years due to their pervasive impact on students' overall well-being and academic performance. The University environment can be stressful, demanding, and unfamiliar, posing challenges to students' level of intelligence. Furthermore, the assumption that I know it all by most students often discourages them from seeking necessary support on their emotional intelligence which may hinder their academic progress.

Socio-economic background is a multifaceted factor that encompasses financial resources, family support systems, and access to educational opportunities. In a region characterized by varying degrees of economic disparities, understanding how socio-economic factors influence students' academic pursuits is crucial. Students from disadvantaged backgrounds may face additional barriers, including inadequate access to educational materials, limited access to extracurricular activities, and higher work-family responsibilities, which could affect their academic performance and overall well-being.

Academic achievement is a central concern of any educational institution, as it reflects the effectiveness of the educational process. To ensure that students reach their full potential, it is essential to examine how emotional intelligence and socio-economic factors influence their academic outcomes. Low emotional intelligence can lead to decreased motivation, impaired concentration, and diminished overall cognitive functioning, while socio-economic disadvantages may limit access to resources that promote academic success. Therefore, this research aims to comprehensively investigate the relationship between emotional intelligence, socio-economic background, and academic achievement among students at Ahmadu Bello University Zaria, Kaduna State, Nigeria.

Objectives

The objectives of this study are as follows:

- i. to ascertain the relationship between emotional intelligence and academic achievement among students of Ahmadu Bello University Zaria, Kaduna State-Nigeria.
- ii. to ascertain the relationship between socio-economic background and academic achievement among students of Ahmadu Bello University Zaria, Kaduna State-Nigeria.

Research Questions

The study answered the following research questions:

- i. What is the relationship between emotional intelligence and academic achievement among students in the study area?
- ii. What is the relationship between socio-economic background and academic achievement among students in the study area?

Hypotheses

The following hypotheses were tested at 0.05 alpha level of significance:

- i. There is no significant relationship between emotional intelligence and academic achievement among students in the study area.
- ii. There is no significant relationship between socio-economic background and academic achievement among students in the study area.

Methodology

The design adopted in conducting this research is correlation design. The population of this study was made up of 300 level students of Ahmadu Bello University, Zaria. Their number stands at eight hundred and eighty-seven (887) students across the five (5) faculties that was randomly selected. The sample of this study is 270 students. This sample is drawn from the entire population of 300 level students which is 887. The selection conforms with the Krejcie and Morgan (1970) prescription. The proportionate sampling technique was used in the allocation of samples to the various five faculties. This is because the faculties differ in their population and to ensure equitable distribution of the sample, a proportionate sampling technique was appropriate. However, the research purposefully target 300 level students of Ahmadu Bello University, Zaria. These students at 300 level have stayed enough in the college. Three instruments were used for this study. The instruments are Emotional Intelligence Inventory (EII), Socio-Economic Background Inventory (SEBI) and Cumulative Grade Point Average (CGPA) of students'. To ascertain the validity of the instrument, the researchers submitted the copies to experts in the field of educational psychology for validation. All the instruments were validated to determine the face and content validity, their relevance and appropriateness in the study. The reliability coefficient was established using Cronbach Alpha. Thus, emotional intelligence has the reliability of .763 while socio-economic background scale has the reliability index of .879. The instruments are reliable as both have an appreciable internal consistency.

The data collected were analyzed using inferential statistics. Pearson Product Moment Correlation PPMC(r) was used to test the study hypotheses. The hypotheses were tested at a 0.05 alpha level of significance. SPSS version 25.0 was used for the analysis.

Results

Hypothesis 1: There is no significant relationship between emotional intelligence and academic achievement among students of Ahmadu Bello University, Zaria.

Table 1: Pearson Product-Moment Correlation (PPMC) statistics on the relationship between emotional intelligence and academic achievement

Variables	N	Mean	Std.dev	Df	Correlation matrix	P
Emotional Intelligence	270	30.38	12.35	268	0.761**	0.001
Academic achievement	270	3.02	0.589			

** . Correlation is significant at the 0.05 level (2-tailed)

Results of the Pearson product-moment correlation (PPMC) statistics showed that a significant relationship exists between emotional intelligence and academic achievement. This is because the computed p-value of 0.001 is lower than the 0.05 alpha level of significance with a correlation index r level of 0.761. The relationship between the two variables is directly proportional. Therefore, the null hypothesis which states that there is no significant relationship between emotional intelligence and academic achievement among students of Ahmadu Bello University Zaria is hereby rejected.

Hypothesis 2: There is no significant relationship between socio-economic background and academic achievement among students of Ahmadu Bello University, Zaria.

Table 2: Pearson Product-Moment Correlation (PPMC) statistics on the relationship between socio-economic background and academic achievement.

Variables	N	Mean	Std.dev	Df	Correlation matrix	P
Socio economic background	270	50.2593	8.92115	268	0.711**	0.000
Academic achievement	270	3.02	0.589			

***.* Correlation is significant at the 0.05 level (2 tailed)

Results of the Pearson product-moment correlation (PPMC) statistics showed that a significant relationship exists between socio-economic background and academic achievement. This is because the computed p-value of 0.000 is lower than the 0.05 alpha level of significance at a correlation index r level of 0.711. The relationship between the two variables is directly proportional. Therefore, the null hypothesis which states that there is no significant relationship between socio-economic background and academic achievement among students of Ahmadu Bello University, Zaria is hereby rejected.

Discussions

The finding of this study revealed that a significant relationship exists between emotional intelligence and academic achievement. The relationship between the variables is directly proportional. It enables individuals to realize their potential, productivity, possible contribution to the community they live in and to adequately cope with everyday stressful situations. This finding agrees with that of Jatinder (2014) who found significant correlation between Emotional intelligence and Achievement scores while Nelson and Low (2004) in one of their studies emphasized that Emotional intelligence skills have a great impact on students' achievement and retention especially during transition period of high school graduates in the first year of college.

Finding of this study also revealed that a significant relationship exists between socio-economic background and academic achievement. This finding collaborates with that of Munir, Faiza, Jamal, Daud and Iqbal (2023) lamented that socio economic status predicted academic outcomes and higher socio-economic students fare better academically. The finding also agrees with that of Jeynes (2002) who posited that the socio-economic status of a child is usually determined by parental occupational status and income level, and the environment in which the child is brought up. It is also affected by parents' involvement in learning activities and effective parent-teacher relationship. It is understood that low socio-economic status negatively and depressingly affects students' academic motivation and leads to test anxiety due to high additional stress and tension at home, thereby affecting students' academic achievement in the long run.

Conclusion

From the result of this study, it is concluded that emotional intelligence and socio-economic background have significant relationship with academic achievement. Thus,

students with high emotional intelligence will show a positive attitude toward learning while students from low socio-economic background will have poor academic achievement and vice versa.

Recommendations

1. The university counseling psychologists and lecturers should focus on teaching emotional intelligence as a strategy to develop academic behaviours and attitudes of students at the university. When students are educated to be emotionally intelligent, their general performance can be improved.
2. Parents should give their children the adequate support needed, particularly in the area of finance. This will further enhance their academic achievement.

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EXPERIMENTAL MODELLING AND SIMULATION OF STAND - ALONE EXPERIMENTAL PHOTOVOLTAIC ARRAY FOR DIFFERENT CLIMATIC CONDITIONS IN BAUCHI METROPOLIS

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Abstract

Standalone renewable energy based on photovoltaic systems accompanied with battery storage system are beginning to play an important role over the world to supply power to remote areas. The current state and the future potentials of renewable energy have increased globally to minimize the usage of other resources such as fossil fuel, which affect the environment. Abubakar Tatari Ali Polytechnic, Bauchi (ATAP) is a case where renewable energy will count for 75% of its energy consumption. Solar energy is abundantly available, so we have to extract and utilize it in a very efficient way. The central aim of this research is to develop an improved yet simple model that can simulate and accurately predict the output power of an installed photovoltaic array in school of Engineering of the Abubakar Tatari Ali Polytechnic, Bauchi and for different climatic conditions. The systems modelled consist of an array of PV modules, a lead-acid battery, and a number of direct current appliances.

Keywords: *Stand-alone, Photovoltaic, Renewable energy, PV system, Solar energy.*

Introduction

Conventional fossil fuel energy sources are largely responsible for global warming which is believed to be playing an ever-increasing role in charting other energy resource utilizations and development directions into the foreseeable future. To be more specific, electrical energy generation worldwide is currently being realized via burning of fossil fuels with the attendant productions of greenhouse gases. Consequently, fossil fuel displacements via rapid penetration of renewable and environmentally friendly sources of electricity productions are central to mitigating the global warming phenomena. Some

recent projections (IAEA, 2007) indicate that the total global energy will almost triple by 2050. As a consequence, renewable energy sources which currently supply somewhere between 15% and 20% of the total energy demand are expected also to grow in leaps and bounds in the twenty-first century. Figure 1 conceptualizes the schematic overview of the genesis of renewable energy sources and the underlying conversion process. It is unarguable that the Sun is the sole driver of all terrestrial based renewable energy sources being exploited by researchers for the benefit of mankind. Both industrialized and some developing countries have adopted those viable renewable resources in their national energy mix policies so as to mitigate the negative environmental impacts of fossil fuels.

Different geographical regions experience different weather patterns, so the site where we live is a major factor that affects the photovoltaic system design from many sides; the orientation of the panels, finding the number of days of autonomy where the sun does not shine in the skies, and choosing the best tilt angle of the solar panels. Photovoltaic panels collect more energy if they are installed on a tracker that follows the movement of the sun; however, it is an expensive process. For this reason, they usually have a fixed position with an angle called tilt angle β . This angle varies according to seasonal variations (Masters, 2013). For instance, in summer, the solar panel must be more horizontal, while in winter, it is placed at a steeper angle.

Statements of the Problem

The world focus is now on the need to have an environmentally-sound source that can be used for safe and clean energy production. Designers need a reliable tool to predict energy production from solar cells in order to make sound and appropriate decisions regarding their use. Many models of varying complexity describing the behavior of a solar cell exist. However, several factors need to be considered in choosing an appropriate model for detailed simulation studies. To minimize the computational effort which is involved in long-term performance prediction, the model should be kept as simple as possible without sacrificing the required accuracy.

CASE STUDY: ABUBAKAR TATARI ALI POLYTECHNIC IN BAUCHI, NIGERIA

Bauchi State occupies a total area of $49,119\text{km}^2$ representing about 5.3% of Nigeria's total land mass and is located between latitudes $9^{\circ} 3'$ and $12^{\circ} 3'$ north of the equator. Longitudinally, the state lies between $8^{\circ} 50'$ and 11° east of Greenwich meridian. The latitude and longitude makes it a relatively sun-rich region with an annual solar irradiance of about $2,500\text{kWhm}^{-2}$. This implies that solar energy systems would be very efficient in this part of the world.

Description of the Experimental Photovoltaic Array

Commercial modules generally consist of 36 or 72 series connected solar cells to form cell string of designed power rating per module depending on the area of each solar cell and its fabrication technology. Herein, the M55 Siemens solar module used in this research consists of 36 series connected solar cells with rated power of 55watts. The dimension of

each solar cell is 10.29cm x 10.29cm and fabricated using polycrystalline silicon technology.

For the sake of operational reliability, photovoltaic modules are equipped with in-built blocking and isolation (bypass) diodes as illustrated in Fig. 1. Without these diodes, some solar cells excited by non-uniform solar irradiance pattern will consume the power generated by other cells. These diodes therefore eliminate the power loss associated with non-uniform solar irradiance scenarios arising from partial overcasts and or dust accumulations. Under ideal conditions, premised on uniform solar irradiance and dust free module assumptions, the bypass diodes are reverse biased and act as open circuits while the blocking diodes are forward biased and act as short circuits. It is therefore not essential to include such diodes in the mathematical model to be developed subsequently.

2.2 Experimental photovoltaic array used as test rig

The experimental photovoltaic array installed at the School of Engineering; ATAP Bauchi is used as test rig in this research work. The PV array comprises five M55 Siemens modules connected in parallel with rated maximum voltage of 17.4V and maximum power rating of 265Watts. The photovoltaic array is of fixed orientation at optimally determined inclination angle facing southward for all year round maximum solar energy harvest and at a location devoid of overcasts from nearby trees and building.

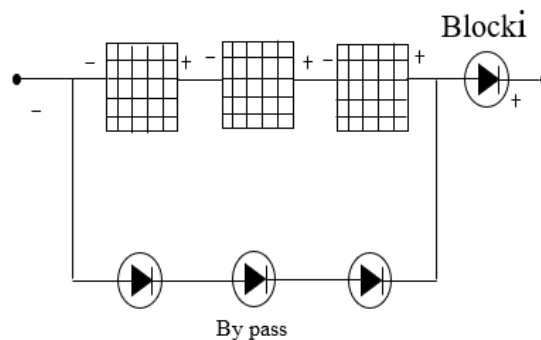


Fig. 1: Series String of Solar Cells with Bypass and

2.3 Experimental setup

The schematic representation of the overall experimental setup design is shown in Fig. 2 with all pertinent equipment clearly labeled. The critical equipment required is pyranometer for solar irradiance measurement. All other measuring instruments utilized are of digital variety so as to secure the desired accuracy in the field data acquisitions. Provisions have been made for both manual and automatic data measurement capabilities including pragmatic PV array cooling arrangement in the experimental setup.

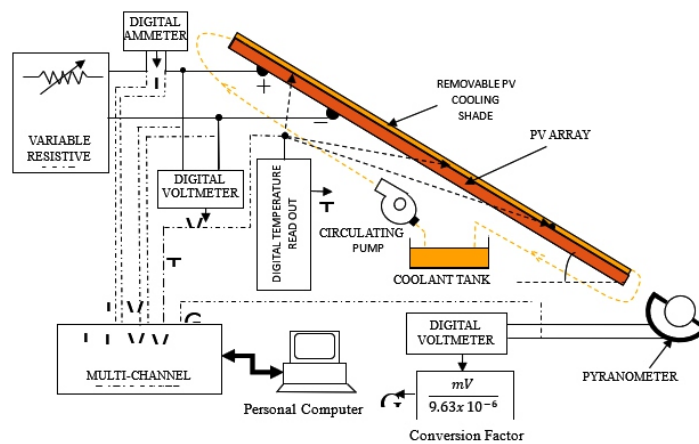


Fig. 2: Experimental Setup Showing Major Equipment and PV Cooling Arrangement

2.4 Measurement equipment

The measurement requirements in this research work are critical in the attainment of the model development embarked upon in this research work. The choice of equipment for the various measurements has been given due and careful consideration. In what follows, the various equipment facilities used are briefly described from the standpoints of their accuracies, specifications and calibration needs for all the measurement tasks.

2.5 Proposed PV Array Model: Mathematical Development

The solar cell is the basic building block of any photovoltaic array and is always the starting point of PV modeling technique (Atiku, 1994). Its equivalent electrical circuit earlier shown in Fig. 10(b) as model II and repeated in Fig. 15, for convenience, has been extended to represent the array model developed in this section. Applying Kirchhoff's current law on the equivalent circuit results in the current flowing to the load as is given in equation (1).

$$I = I_L - I_D - I_p \quad \dots (1)$$

It is obvious from the figure that the parallel (shunt) current, I_p , is given by equation (2) as follows:

$$I_p = \frac{V + IR_s}{R_p} \quad \dots (2)$$

Furthermore, from the theory of a p-n junction diode (Hansen, 2000), the diode current, I_D , may be expressed as in equation (3)

$$I_D = I_o \left\{ e^{\frac{(V + IR_s)q}{AKT}} - 1 \right\} \quad \dots (3)$$

Substituting equations (2) and (3) into equation (1) results in equation (4) as:

$$I = I_{pv} - I_o \left\{ e^{\frac{(V+IR_s)q}{AKT}} - 1 \right\} - \frac{V+IR_s}{R_p} \quad \dots (4)$$

From equation (40), the model input parameters are: A, I_{pv}, I_o, R_s, R_p and defined as follows:

- A: Diode ideality factor
- I_{pv} : Light Current
- I_o : Diode Reverse Saturation Current
- R_s : Series Resistance
- R_p : Parallel (Shunt) Resistance

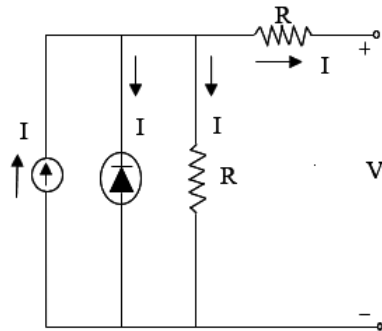


Fig. 3: Equivalent Electrical Circuit of a Solar

3.1 Experimental Results

While Table 1 shows the minimum and maximum temperature in Bauchi for year 2022

Table 1: The monthly average values of daily global solar radiation (Wm^{-2}) in Bauchi, Nigeria.

Month	Average Monthly, (Wm^{-2})
January	2380-2520
February	2990-3230
March	3760-4000
April	4310-4680
May	5230-5690
June	6240-6890
July	6850-7110
August	6110-6280
September	5420-5560
October	4010-4180
November	3010-3070
December	2420-2530

3.2 Results of seasonal solar irradiance and temperature variations

The solar irradiance data has been processed for the three micro-climatic conditions viz.: Harmattan, Cloudy and Clear Sunny days; thereby resulting into three seasonal solar

irradiance databases. Also, the PV temperature measurements were similarly processed for each micro-weather condition. In addition, fairly comprehensive statistical characterizations of midday solar irradiance and temperatures for the three seasons are summarized in Table 2

Table 2: Summary of Statistical Characterizations of Solar Irradiance and Temperature for the Observed Micro-climatic Seasons at Experimental PV Site

PV Measured Parameters	Statistical Information	Micro-climatic Seasons		
		Harmattan	Cloudy	Clear Sunny
	Maximum	605	60	965.4
	Average	586.7	600	950.8
	Minimum	560	590	927.3
Solar Irradiance (W/m ²)	Median	565.75	592.5	950.5
	Mode	592	598	950.4
	Maximum	30	39.5	50
	Average	29	38	46
	Minimum	26.5	36	40.4
Temperature (°C)	Median	30.5	37.5	45.5
	Mode	30	38.5	45

3.3 Results of measurements of experimental PV array parameter variations

The experimental PV array test rig studied as earlier stated is of polycrystalline silicon technology and comprises 5 M55 Siemens solar modules connected in parallel. The leading parameters of each PV module, based on standard test conditions (STC) by the manufacturer and equivalent STC parameters of the experimental PV array test rig are presented in Table 3. The variations of these parameters with respect to temperature and solar irradiance have been exhaustively characterized from the field measurements carried out on the experimental PV array test rig

Table 3: PV Module and Array Parameter Values at STC

Parameter Type	M55 Siemens Solar Module Data Specification	Photovoltaic Array Rated Parameter Values
V_{oc}	21.7V	21.7V
I_{sc}	3.35A	16.75A
V_{mp}	17.4V	17.4V
I_{mp}	3.05A	15.25A
P_{pm}	53W	265W

3.4 Array conversion efficiency computation

Efficiency is the most commonly used parameter to compare the performance of one PV array to another. Notwithstanding the earlier definition in Table 3, we repeat its definition here for convenience, as the ratio of the maximum electrical power that the PV array delivers to the load and the solar power input (P_{in}). This definition is expressed via equations (5) and (6).

$$\eta = \frac{P_{out}}{P_{in}} \quad \dots (5)$$

$$\eta_{max} = \frac{P_{mp}}{P_{in}} = \frac{I_{mp}V_{mp}}{AG} \quad \dots (6)$$

Where A = PV array cross-sectional area (m²)

G = input solar irradiance (W/m²)

The experimentally determined maximum conversion efficiencies (η_{max}) of the PV array operating at maximum power point for the three micro climatic conditions are also presented in Table 4.

Table 4: PV array Fill Factor and Conversion Efficiency for Harmattan, Cloudy and Clear Sunny Seasons

Climate Type	PV array Parameters	Performance	Typical Operating Parameters	
	Fill Factor	Efficiency (%)	Temperature (°C)	Irradiance (W/m ²)
Harmattan	0.718	13.11	29	586.6
Cloudy	0.711	12.50	38	600.0
Clear Sunny	0.708	12.43	46	950.8

3.5 Effects of temperature on array fill factor and conversion efficiency

The effects of temperature on the array Fill Factor and Conversion Efficiency for the three micro-climatic seasons of harmattan, cloudy and clear sunny have been determined. The results are presented in Table 5.

Table 5: Effects of Temperature on Fill Factor and Conversion Efficiency for the Three Climatic Seasons

Temperature (°C)	Micro-Climatic Variant					
	Harmattan		Cloudy		Clear Sunny	
	Fill Factor	Conversion Efficiency (%)	Fill Factor	Conversion Efficiency (%)	Fill Factor	Conversion Efficiency (%)
25	0.733	13.52	0.724	13.44	0.732	13.98
30	0.720	13.07	0.718	13.07	0.727	13.62
35	0.715	12.66	0.713	12.69	0.721	13.24
40	0.706	12.28	0.709	12.34	0.716	12.87
45	0.703	11.94	0.704	11.97	0.711	12.50
50	0.699	11.58	0.698	11.62	0.705	12.12
55	0.692	11.22	0.691	11.22	0.670	11.76
60	0.687	10.86	0.687	10.88	0.691	11.35
65	0.684	10.50	0.681	10.53	0.687	11.01
70	0.676	10.14	0.675	10.16	0.681	10.65
75	0.669	9.78	0.669	9.81	0.674	10.28

3.6. Effects of solar irradiance on array fill factor and conversion efficiency

Similarly, the effects of solar irradiance on array Fill Factor and conversion efficiency for the three weather conditions have been equally determined. The results are presented in Table 6.

Table 6: Effects of Irradiance on Fill Factor and Conversion Efficiency for the Three Climatic Seasons

Irradiance (W/m ²)	Micro-Climatic Variant					
	Harmattan		Cloudy		Clear Sunny	
	Fill Factor	Conversion Efficiency	Fill Factor	Conversion Efficiency	Fill Factor	Conversion Efficiency
200	0.642	10.84	0.586	9.47	0.604	9.39
300	0.679	11.86	0.675	11.28	0.669	10.75
400	0.685	12.19	0.692	11.83	0.683	11.24
500	0.712	12.87	0.704	12.22	0.696	11.63
600	0.719	13.13	0.711	12.50	0.702	11.90
700	0.756	13.36	0.715	12.69	0.707	12.12
800	0.725	13.59	0.717	12.84	0.709	12.26
900	0.727	13.63	0.719	12.99	0.711	12.39

Conclusion

Increased energy utilization and global pollution awareness have made green/renewable energy more and more valuable recently. In this paper, renewable energy has been briefly explored and solar energy has been highlighted. It is concluded that among several renewable energy resources, the photovoltaic (PV) effect is the most fundamental and feasible way because of the abundance and easy access to solar radiant energy. In conclusion, with the government's further supports on solar PV systems to urban areas, it would make it a more popular choice and enhance sustainable development thereby reducing dependence on grid power and reducing carbon footprints. The field measurement based analytical model and RFBNN architecture for PV performance evaluation yielded superior results when compared with that of the manufacturer datasheet based mathematical model. Although the results analyzed appear to be location specific, they could be adapted to other locations with similar climatic conditions most especially in the northeast zone and other zones in Nigeria.

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DEVELOPMENT OF A MULTI-PURPOSE RECHARGEABLE MACHINE

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Abstract

The study focuses on the development of a versatile rechargeable machine system designed to charge electronic devices while minimizing electricity consumption and promoting environmental sustainability. Its primary objective is to design and assess the performance of a multi-functional electric charger capable of concurrently powering devices and recharging its internal battery. Notably, a key innovation lies in its ability to deliver power to devices while simultaneously recharging. Efficiency analysis in the study encompasses three key metrics: motor efficiency, energy efficiency, and power efficiency. The attained power efficiency stands at 82.96%, achieved with output and input voltages of 230 and 278 volts, respectively, and current values of 1.805 and 1.8 amps. Similarly, an energy efficiency of 82.96% was obtained. Motor efficiency calculations, based on a driving shaft speed of 1440 RPM, yielded efficiencies of 33.49% for direct current and 29.77% for alternating current. In summary, the multipurpose rechargeable machine system presents an efficient solution for device charging, encapsulated within a compact, mobile package.

Introduction

The proliferation of electronic and electrical devices in everyday life underscores the growing reliance on batteries to enhance mobility and convenience. Rechargeable batteries offer a convenient solution for replenishing energy when levels become depleted. These batteries are engineered to store electricity obtained from the utility grid, ensuring a readily available power source for future use. Chargers come in diverse voltages and designs tailored to meet varying battery specifications. The size of the battery being charged significantly influences the selection of the charger. Small battery chargers, for instance, are suitable for charging batteries with voltages ranging from 6 to 12 volts. Conversely, larger chargers cater to heavy-duty batteries with voltages spanning from 12 to 48 volts, as indicated in. As highlighted in, chargers are engineered to deliver a consistent supply of direct current (D.C.) to the battery being charged,

countering the battery's discharge current. At the core of this process lies the accumulator, emphasizing the necessity for a fundamental understanding of its operation when designing a charger. The energy needed to convert alternating current (AC) power from the utility grid into the direct current (DC) electricity stored in the battery is often underestimated, as noted in. As outlined in, many battery chargers typically require human intervention for monitoring and control. However, in this project, an automatic battery monitor is implemented to significantly reduce the need for human oversight by approximately 85%, aiming to prevent overcharging of batteries.

An essential component in electrical systems, a power supply circuit is designed to provide a range of alternating current (AC) and direct current (DC) voltages necessary for the proper operation of equipment. Electronic devices require various source voltages to function optimally. Transistors and integrated circuits (ICs), for instance, rely on low DC voltages for operation. Conversely, devices such as cathode ray tubes (CRTs) necessitate high voltages to function effectively. Batteries serve as the primary source for supplying all these required voltages, as indicated in.

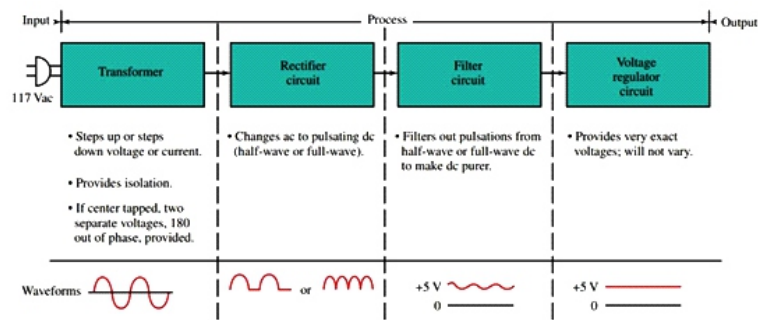


Figure 2.1: Block diagram for power supply components (7)

Material and Methods

Materials

The system is made up of several different components which are shaft, flywheel, bearing, pulley, main alternator, DC Motor, and 100 amps battery.

Methods

In the production process of the multipurpose rechargeable machine system, a sophisticated mechanical arrangement is employed to efficiently harness and utilize energy. A motor, equipped with a 4-inch pulley, propels a shaft that hosts two additional pulleys interconnected via a belt mechanism. One of these pulleys, measuring 5 inches in diameter, is affixed to the motor pulley, ensuring synchronous rotation of Shaft 1 and the motor. On the opposite end of Shaft 1, a 14-inch pulley drives Shaft 2, which accommodates a flywheel and variously sized pulleys. Through a belt linkage, the 14-inch pulley on Shaft 1 imparts twice the rotational speed to Shaft 2, resulting in rapid spinning of the flywheel and subsequent energy storage.

Utilizing a pulley and belt system, an alternator is driven from one end of Shaft 2, featuring an 8-inch pulley. The alternator utilizes the stored energy in the flywheel to generate the required current output. Upon reaching maximum current capacity, the generated current powers the motor through an electrical connection, effectively bypassing the original power source.

This innovative configuration enables a reciprocal power exchange between the alternator and the motor, facilitated by shafts, pulleys, and belts. As a result, the system achieves a state of self-sustaining operation, effectively harnessing free energy.

Energy Efficiency: this type of energy has to do with the electrical energy in general, the amount of energy charged and the energy consumed by discharging with the equation below.

$$\text{Energy Efficiency} = \frac{\text{energy from discharging}}{\text{energy from charging}} \times 100\%$$

$$\text{energy efficiency} = \frac{\text{discharging voltage} * \text{discharging current} * \text{time}}{\text{charging voltage} * \text{charging current} * \text{time}} \times 100\%$$

Efficiency in terms of power: this has to do with the power in terms of electricity where the voltage and currents are being calculated.

$$\text{efficiency} = \frac{\text{power output}}{\text{power input}} \times 100\%$$

Input power = $V_{IN} \times I_{IN}$;

Where $I_{IN} = I_{OUT} + I_{CC}$ assuming I_{CC} is 5mA

Output power = $V_{OUT} \times I_{OUT}$

Results and Discussions

The calculated Power Efficiency stands at 82.96%, achieved with output and input voltages of 230 and 278 volts, respectively, and currents of 1.805 and 1.8 amps for output and input, respectively, representing single-phase operation at the pilot stage of production. While three-phase operation could potentially enhance efficiency further, the current research focuses on single-phase operation. Similarly, Energy Efficiency was calculated at 82.96%, utilizing the same voltage and current parameters as in the Power Efficiency calculation. In comparing the performance of the proposed system to existing charging systems, key criteria include adaptability, portability, and current capability. Testing involved both old and new devices such as the iPhone 3G and iPhone 14, demonstrating the system's ability to accommodate a range of devices and power requirements. Through ongoing enhancements and iterative improvements, this rechargeable machine system is poised to offer a comprehensive solution for charging electronic devices in diverse settings, ensuring convenient access to power wherever needed.

User feedback is invaluable for refining and enhancing the functionality and usability of any product, including the multipurpose rechargeable machine. While initial feedback indicates that the machine performs its intended function effectively, the recognition of areas for improvement underscores a commitment to ongoing refinement and innovation. Indeed, the success of an invention lies not only in its initial creation but also in its continuous evolution to better meet the needs and expectations of users. By actively soliciting and incorporating user feedback, the development team demonstrates responsiveness to user needs and a dedication to delivering a truly valuable and impactful solution. The overhead costs for the project include expenses related to experimental tests, miscellaneous items, and transportation, totalling 27,000 naira. Additionally, the cost of labour amounted to 30,000 naira. And this research work is very eco-friendly which is sustainable and more effective without having to worry about pollution and climatic pollution.

Conclusion

The multipurpose rechargeable machine system presents an efficient and versatile approach to device charging, packaged for mobility. Achieving a Power Efficiency of 82.96% and Energy Efficiency of 82.96% underscores its effectiveness. Looking ahead, its potential impact is particularly promising for deployment in developing countries, offering an affordable charging solution. Future iterations may explore leveraging the existing chassis while modifying internal components to provide a range of additional services, expanding its utility and versatility to address evolving needs.

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DESIGN AND IMPLEMENTATION OF A SMART GREENHOUSE

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Abstract

A smart greenhouse is a structure that allows the creation of an indoor microclimate for crop development and protection from adverse outdoor conditions. The techniques for climate control are to tune the crop needs and avoid unnecessary energy consumption. The use of fuzzy logic controller (FLC) represents a powerful way to minimize and facilitate management of climate conditions of the smart greenhouse. This microclimate is controlled by actuator components, which are the fans, heater and humidifier, as heating and cooling elements to provide the best environmental conditions for the crop and the design of fuzzy logic controller for the regulation of climate parameters in the greenhouse system to ensure that the temperature and humidity values of the greenhouse did not exceed 27°C and 60% respectively. The main components of the fuzzy logic controller include the fuzzification interface, knowledge-based, decision making logic and defuzzification interface. The controller senses the changes in the temperature and humidity through input sensors and processes to take control action. The circuit was designed and drawn using Proteus software and the controller has been designed using Matlab/Simulink software. The model of the system was developed using Matlab/Simulink software. The developed controller controlled the microclimate parameters of the sensors. The relay outputs for the fans, heaters and humidifier can be activated in normal scheduled operating mode. An integrated Liquid Crystal Display (LCD) is used for real-time display of the data acquired from the various sensors. The system works smartly and hence reduces human intervention. The implementation of the fuzzy logic based control system for the regulation of climatic parameters under greenhouse through heating and cooling to ensure an optimum temperature and

humidity values of 27^oc and 60% respectively. The obtained results show a good management performance to the greenhouse environment. It is recommended that more sensors should be added so as to monitor more parameters.

Keywords: Temperature, humidity, Fuzzy Logic Controller, LCD.

Introduction

Greenhouse is a kind of place which can change plant growth environment, create the best conditions for plant growth, and avoid influence on plant growth due to outside changing seasons and severe weather. Agricultural production is to be increased to assure food security for the growing population. This can be achieved by developing and adopting technologies which can maximize agricultural production. For plant of given genetic makeup the factors that affect the plant growth are light, temperature, humidity and nature of the growing medium. Hence the crop growing environment is to suitably modify to maximize production leading to optimum productivity. The environmental factors to be modified include light, temperature, relative humidity, carbon dioxide concentration and nature of growing environment. In the case of open field cultivation, only the growing medium can be controlled and the environmental factors which affect crop growth cannot be controlled manually, whereas in greenhouses all the environmental parameters can be suitably controlled or modified. Crops can be cultivated, anywhere during any season inside a greenhouse by modifying crop growing environment. Automatic regulation of crop growing environment is of great importance and most of the cultivators are unable to manage it manually. Greenhouses are framed structures covered with transparent material, in which crops can be grown under the conditions of at least partially controlled environment and are large enough to allow a person to walk within them to carry out agricultural operations. A greenhouse protects plants from wind, precipitation, excess solar radiation, temperature extremes, pests and diseases.

Problem Statements

The Greenhouse system is a complex system. Any significant changes in one climate parameter could have an adverse effect on another climate parameter as well as development process of the plant. One of the fundamental challenges in greenhouse research is that the microclimate parameters are hard to be controlled manually and the automatic control of such parameters is also a difficult task, as it is expensive and some of the physical factors are inter-related such as temperature, humidity are related in a way that when the temperature increases the humidity decreases, therefore controlling both together is a difficult task. To achieve better enhancement of the growth of plants in greenhouse, Data Acquisition using Arduino will be introduced with the microcontroller-based circuit to monitor and record the values of temperature, humidity and sunlight of the natural environment that are continuously modified and controlled in order to optimize them to achieve maximum plant growth and yield. This makes the proposed system to be an economical, portable and low maintenance solution for greenhouse applications.

Microclimate control in greenhouse

Covering material of greenhouse is acting as a barrier between greenhouse microclimate and ambient climate. The presence of greenhouse cover causes changes in the microclimatic conditions as compared to that of outside by reducing radiation and air velocity, by increasing temperature and vapour pressure of the air and by making the fluctuations of carbon dioxide concentrations. Each of these changes has its own impact on growth, production and quality of the greenhouse crop, some of them being detrimental and hence greenhouse microclimatic conditions are to be cultivated and ambient climate.

Light

Light may be considered as the most important environmental factor in greenhouse cultivation. As it influences a wide range of processes related to photosynthesis, energy balances including transpiration, phase transitions and morphology. In general, low light intensity is the most important environmental restraint to maximum photosynthesis and growth (Manohar and Igathinathen, 2012).

Temperature

Temperature control in greenhouse is necessary for optimum growth and development of plants. It influences initiation and development of productive organs. Temperature manipulation to induce flowering has commercial value in horticulture (Manohar and Igathinathen, 2012). Temperature affects time from sowing to flowering. When outdoor temperatures are too low, it is relatively easy to maintain temperature within the desired limits in greenhouse. Heat can be added through the heating system or it can be removed by natural ventilation. However, as seasonal temperatures increases, precise control of day temperature becomes more difficult. It generally requires forced ventilation evaporative cooling to control excess temperature.

Relative humidity

Greenhouse is an enclosed space and hence the relative humidity inside the greenhouse will be more compared to ambient air due to moisture added by evapotranspiration process. Ventilation and sensible heat inputs lowers the relative humidity to some extent. For the purpose of maintaining relative humidity levels, evaporative cooling is employed for humidification and if relative humidity is on the higher side, ventilators, cooling coils are used for dehumidification. For most of the crops, the acceptable range of relative humidity is between 50 to 80% and for plant propagation work relative humidity up to 90% may be desirable (Manohar and Igathinathen, 2012).

Related works

There are many previous studies in this area which should be reviewed for helping in proposing a system with solvable problem in greenhouse. Nachidi *et al.* (2006) have proposed system to control of air temperature and humidity concentration in greenhouses is described by means of simultaneous ventilation and heating system by using Takagi-Sugeno (T-S) fuzzy models and the parallel Distributed Compensation

conditions in a greenhouse, using this T-S fuzzy model, the stability analysis and control design problems can be reduced to significant conditions expressed as Linear Matrix Inequalities (LMIs). But the system was designed to monitor and control only two environmental parameters. An improvement can be made to add more sensors for monitoring and control of more environmental parameters for proper growth and development of the plant.

Abdul-Aziz *et al.* (2009) proposed system has a measurement which is capable of detecting the level of temperature monitoring system using wireless sensor and short message service this system also has mechanism to alert farmers regarding the temperature changes in the greenhouse so that early precaution steps can take and testing several types. This extended to include more environmental variables to be monitored in the agricultural greenhouse which relates to the increment of fruits and vegetables productivity. For example, other than temperature, the soil and water acidity level in the greenhouse also pay an important role to the quality of fruits, enhanced to produce a system that can trigger automatic actions of related components, such as the sprinkler, lighting and air ventilators, rather than just send alert notification message, the proposed system is enhance by implementing artificial intelligent components to enable advanced implementations such as self-learning, predicting, and define ambiguous situation which provide preventive measures. But no irrigation system is provided in the developed greenhouse model. An improvement can be made to add soil moisture or time based sensor and water pump to control the amount of water needed by the plant at a right time for optimum

Palaniappan *et al.* (2009) have proposed an embedded greenhouse monitoring and control system to provide a highly detailed micro-climate data for plants within a greenhouse environment with an innovative method of growing temperate crops in a tropical environment using microclimatic conditions. The greenhouse was equipped with conventional wired sensors to provide readings of the air temperature, light intensity and nutrient solution temperature in the mixing tank. The acidity and concentration of the nutrient solution were manually measured, and adjusted accordingly, and high resolution data, collected with the deployment of a network of wireless sensors to provide sufficient data to develop a model for the growth of these crops under aeroponic conditions. The researcher claimed that the reliability of the star network was relatively high, with many nodes performing with a data transmission rate above 90%, where the minimum data transmission rate for all the nodes was 70%. But the humidity sub-system was not included. An improvement can be made to add humidity sensor which will monitor the humidity of the greenhouse model for better crop production.

Chen *et al.* (2011) developed a simple greenhouse to describe the effect of shading nets on the inside temperature of a greenhouse by assuming steady state thermal conditions. The detailed microclimate data of an experimental greenhouse with internal and external shading nets were collected during various weather conditions. The model was

validated using experimental data collected from various conditions. The prediction accuracy of the model for air temperature was about 1.5. It is concluded that this model could be applied to evaluate greenhouse. But there was no humidity sub-system in the model, as it was assumed the humidity was constant. An improvement can be made to add humidity sensor for proper growth and development of the plant.

Junxian and Haiqing (2011) designed a greenhouse surveillance system based on embedded web server and use it in acquisition and transmission of greenhouse information. Experiment results show that the working performance of the system is quite stable and can reach the design requirements in real-time data acquisition and remote control. But the monitoring of the environmental parameters can only be achieved through 3G network, and once the network is weak or becomes unavailable the monitoring of the parameters cannot be achieved. An improvement can be made to add microcontroller which will perform the tasks to achieve system requirement with or without data or network access.

Khandelwal (2012) developed GSM modem based automation system to control greenhouse microclimate. The system consists of various sensors to collect information about greenhouse temperature, relative humidity, light intensity, rain sensors and transistor switches and relay nodes for automation control. There is a data server to store the information about the environmental conditions inside the greenhouse. Based on the requirement of crop, automation system will maintain required environmental conditions for crop growth. But rain sensor was used for the irrigation which can only be used when rain is detected. An improvement can be made to use soil moisture sensor which dispenses water using automatic mechanism when the water in the soil is needed by the plant.

Methodology

Modelling of greenhouse microclimate

In a greenhouse, the state climate can be represented by two variables, namely, inside air temperature and absolute humidity. A simplified greenhouse climate model adequate for control purposes describes the dynamic behavior of the state variable with the following two differential equations (Tchamitchian and Tantau, 1996)

Energy balance

The energy fluxes affecting the greenhouse air are due to the exchanges with outside air by ventilation (E_v), and through the cover (E_c), to the energy supply (E_h), by a heating system and the energy contribution by a solar radiation (E_s). This balance can be written as follows:

$$T_a(\mathbf{k}+1) = \frac{t_s}{C_{cap,q}}(E_h - E_v - E_c + E_s) + T_a(\mathbf{k}) \quad \dots(1)$$

$E_v = C_{cap,q,v} V (T_a - T_o)$, $E_c = h_T(T_a - T_o)$, $E_s = \tau S_o$ and the symbols are described in table I. The two control variables that appear in this balance are the heating supply (E_h), and the

ventilation rate (V).

Water vapour balance

The greenhouse air exchanges water with the outside air by ventilation (W_v) and through the cover (W_c), following the dynamic model:

$$w_a(k+1) = t_s(-W_v - W_c) + w(k) \quad \dots(2)$$

$$\text{Where } W_v = \frac{V}{c_{cap,h}}(W_a - W_0) \text{ and } W_c = \frac{V_h}{c_{cap,h}}(W_a - W_0).$$

Exact Fuzzy Modeling of the Greenhouse

The objective of this section is to derive a T-S fuzzy model by applying the model-based fuzzy control design methodology described in Tanaka and Wang (2001), based on nonlinear equations (45) and (46).

$$T_a(k+1) = \frac{t_s h_T}{c_{cap,q}}(T_0 - T_a) + \frac{t_s c_{cap,q,v}}{c_{cap,q}}V(T_0 - T_a) + \frac{t_s}{c_{cap,q}}E_h + \frac{t_s \tau}{c_{cap,q}}S_0 + T_a(k),$$

$$T_a(k+1) = (1 - a_1)T_a + a_2V(T_0 - T_a) + a_3E_h + a_4T_0 + a_5S_0 \quad \dots(3)$$

$$w_a(k+1) = \frac{t_s}{c_{cap,h}}V(w_0 - w_a) + \frac{t_s h_w}{c_{cap,h}}(w_0 - w_a) + w_a(k),$$

$$w_a(k+1) = a_5V(w_0 - w_a) + (1 - a_6)w_a + a_6w_0(k), \quad \dots(4)$$

$$\text{Where: } a_1 = \frac{t_s h_T}{c_{cap,q}}, \quad a_2 = \frac{t_s c_{cap,q,v}}{c_{cap,q}}, \quad a_3 = \frac{t_s}{c_{cap,q}}, \quad a_4 = \frac{t_s \tau}{c_{cap,q}}, \quad a_5 = \frac{t_s}{c_{cap,h}}, \quad a_6 = \frac{t_s h_w}{c_{cap,h}}.$$

Equations (47) and (48) can be written as:

$$\begin{bmatrix} T_a(k+1) \\ w_a(k+1) \end{bmatrix} = \begin{bmatrix} 1 - a_1 & 0 \\ 0 & 1 - a_6 \end{bmatrix} \begin{bmatrix} T_a(k) \\ w_a(k) \end{bmatrix} + \begin{bmatrix} a_3 & a_2(T_0 - T_a) \\ 0 & a_5(w_0 - w_a) \end{bmatrix} \begin{bmatrix} E_h \\ V \end{bmatrix} + \begin{bmatrix} a_4 & a_5 & 0 \\ 0 & 0 & a_6 \end{bmatrix} \begin{bmatrix} T_0(k) \\ S_0(k) \\ w_0(k) \end{bmatrix} \dots(5)$$

Considering the solar radiation, outside temperature and absolute humidity as disturbances, the model without disturbances is as follows:

$$\begin{bmatrix} T_a(k+1) \\ w_a(k+1) \end{bmatrix} = \begin{bmatrix} 1 - a_1 & 0 \\ 0 & 1 - a_6 \end{bmatrix} \begin{bmatrix} T_a(k) \\ w_a(k) \end{bmatrix} + \begin{bmatrix} a_3 & a_2(T_0 - T_a) \\ 0 & a_5(w_0 - w_a) \end{bmatrix} \begin{bmatrix} E_h \\ V \end{bmatrix} \quad \dots(6)$$

Implementation of Smart Greenhouse System.

The monitoring and controlling unit and sensing and response unit based on sensor network got different results based on effective management of greenhouse environment. These different responses were discussed based on the greenhouse management.

The Monitoring and Control Unit

After safe system booting, a welcome and guidance message on the LDC can be recognized as shown in Figure 1. Three navigation buttons: set, up and down can be

selected according to the operation mode: start, increase and decrease the environmental parameters respectively. As shown in Figure 2, a set button can be used to start using the system.

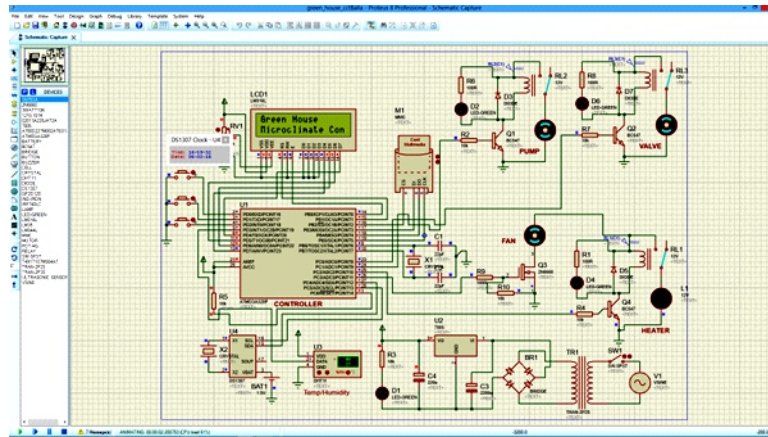


Figure 1: The Circuit design

The Sensing and Response Unit

The sensing and response unit receives the preset sensor values at the monitoring and control unit. Then these values were stored at the FLC memory to maintain the environmental conditions of the greenhouse accordingly. Two environmental conditions can be maintained: temperature and humidity. In the following, the associated response to the change of each parameter can be explored.

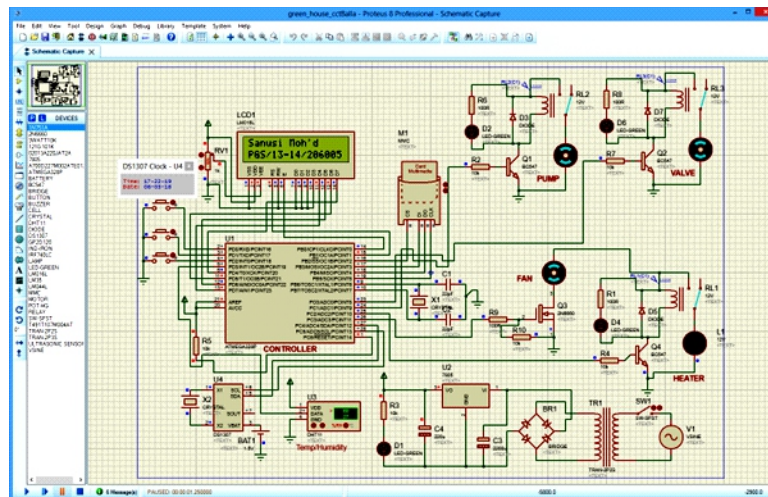


Figure 2: Circuit Design with LCD Displaying Some Information

Results

The following presents some simulations to show the applicability of the method used. During the night, the system was able to achieve the desired climatic condition and the

imposed constraints were fulfilled because there was no disturbance coming from the sun.

Effect of Day light on Temperature

Figure 16 shows the response of temperature in a day light. It was observed that the disturbance from the sun has no much effect on the set-point, as the measured values of the temperature follows correctly the set-point. Therefore, the results obtained was satisfactorily.

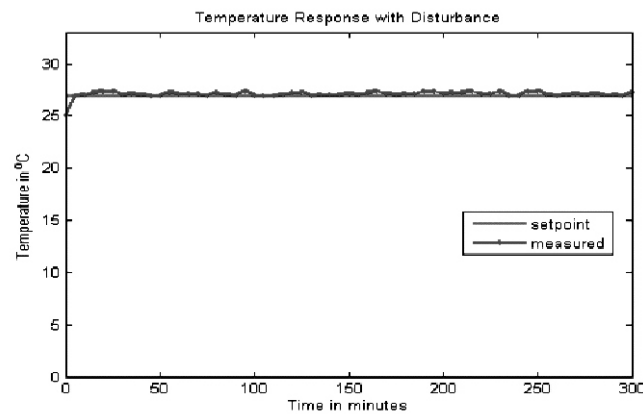


Figure 3: Temperature response with disturbance

Effect of Nightfall on Temperature

During the night, the system was able to achieve the desired climatic condition and the imposed constraints were fulfilled because there was no disturbance coming from the sun. Figure 17 shows the behavior of the controlled greenhouse during the night. It was observed that, the feedback values of the temperature maintained the set-point value due to the absence of disturbance, hence an optimal result was achieved.

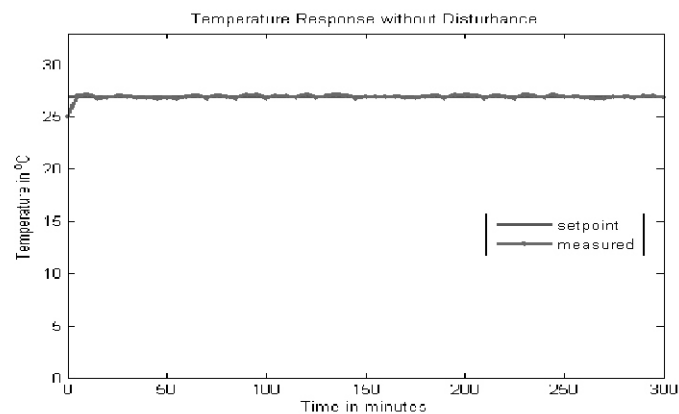


Figure 4: Temperature response without disturbance

Humidity Response with Disturbance

Figure 5 shows the behavior of the humidity in the controlled greenhouse during the day. It was observed that the disturbance had little effect on the set-point because the measured values of the humidity follow correctly the set-point value. Therefore, the result obtained was satisfactory.

Humidity Response without Disturbance

During the night, it was observed that the system was able to achieve the desired climatic condition and the measured values of the humidity maintained the set-point due to the absence of disturbance. Therefore, the response show that the result obtained was satisfactorily.

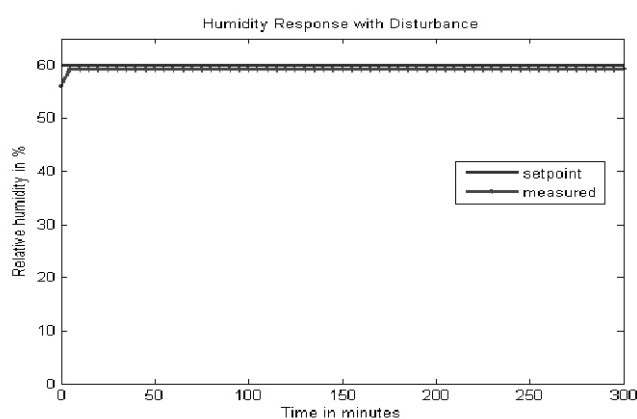


Figure 5: Humidity response with disturbance

Humidity Response without Disturbance

During the night, it was observed that the system was able to achieve the desired climatic condition and the measured values of the humidity maintained the set-point due to the absence of disturbance. Therefore, the response show that the result obtained was satisfactorily.

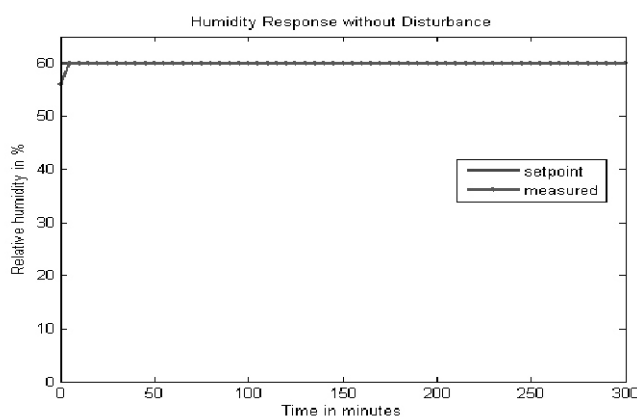


Figure 6: Humidity response without disturbance

Discussion

An experiment was done to record the temperature and humidity readings in the greenhouse developed model. The reason of this experiment is to make sure that the designed system is functioning well and the data can be recorded correctly. More than one experiments were carried out to test the reliability and feasibility of the system designed.

Conclusion

In this research, a model of greenhouse microclimate parameters was developed. This research has successfully showed that the design of a fuzzy logic controller capable of regulating temperature and humidity inside greenhouse was achieved; and fuzzy logic controller can be applied to develop a system for monitoring and control of climate parameters under greenhouse. The experimental tests performed and the results obtained showed that the robust fuzzy logic controller effectively achieves the desired climatic conditions in a greenhouse. It can also be concluded that the overall performance of the fuzzy controller to maintain temperature and humidity within a given range around the set-points is satisfactory.

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HEAVY METALS CONCENTRATION IN TILAPIA SPECIES IN TUNGAN KAWO DAM OF KONTAGORA, NIGER STATE, NIGERIA

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Abstract

The well known long term toxic effects of heavy metals lead, (Pb), nickel (Ni), manganese (Mn), zinc (Zn), cadmium (Cd) and chromium (Cr) to man are of both scientific and environmental concerns. The presence of these heavy metals in water create a societal health risk in dams that are otherwise useful for drinking water and fisheries as is of the case in Tungan Kawo dam. Fish play an important role in human nutrition and therefore need to be carefully and routinely screened to ensure that there are no high levels of heavy metals being transferred to man through their consumption. One of such recommendations is important to monitor changes in sediment composition because the contaminants within the sediments can act as a source of pollutants long after the original source of pollutants has been abated. Once metals and nutrients have settled into the sediments they can again become processes in natural situations.

Keywords: *Heavy metals, fish, tilapia, Tungan kawo dam, Kontagora*

Introduction

The indestructible nature and long term toxic effects of heavy metals including lead (Pb), nickel (Ni), manganese (Mn), zinc (Zn), cadmium (Cd) and chromium (Cr) to man as a result of consumption of organisms obtained from polluted rivers has raised scientific and environmental concerns (Kar *et al.*, 2008; Alaa and Werner, 2010; Oronsaye *et al.*, 2010 ; Javed and Usmani, 2011; Abdel-Baki *et al.*, 2011; Ekeanyanwu *et al.*, 2011; Olowoyo *et al.*, 2012; Kumar *et al.*, 2012). Weathering of soils and rocks and a variety of anthropogenic activities are two independent factors that result into the presence of heavy metals in water hence creating a societal health risk in rivers that are otherwise useful for domestic purposes as is of the case of Tungan Kawo Dam in Kontogora.

Different aquatic organisms often respond to external contamination in different ways, where the quantity and form of the element in water, sediment, or food will determine the degree of accumulation. The region of accumulation of heavy metals in vegetables,

sediments and within fish varies with route of uptake, heavy metals, and species of fish concerned. Their potential use as bio-monitors is therefore significant in the assessment of bioaccumulation and biomagnifications of contaminants within the ecosystem. Many dangerous chemical elements, if released into the environment, accumulate in the soil and sediments of water bodies. The lower aquatic organisms absorb and transfer them through the food chain to higher trophic levels, including fish (Abida et al, 2009). Similarly, under acidic conditions, the free divalent ions of many metals may be absorbed by fish gills directly from the water. Hence, concentrations of heavy metals in the organs of fish are determined primarily by the level of pollution of the water and food under certain conditions, chemical elements accumulated in the silt and bottom sediments of water bodies can migrate back into the water, i.e. silt can become a secondary source of heavy metal pollution.

Heavy metals are natural trace components of the aquatic environment, but rather their levels have increased due to domestic, industrial, mining and agricultural activities (Leland *et al.*, 1978; Mance 1987; Kalay and Canli, 2000). Discharge of heavy metals into river or any aquatic environment can change both aquatic species diversity and ecosystem due to their toxicity and accumulative behaviour (Health, 1987).

Aquatic organisms such as fish and shell fish accumulate metals to concentrations many times higher than present in water or sediment (Olaifa *et al.*; 2004, Gumgum *et al.*; 1994). They can take up metals concentrated at different levels in their different body organs (Khaled, 2004) certain environmental conditions such as salinity, pH, water accumulation in the living organisms up to toxic concentrations and cause ecological damage (Guvem *et al.*, 1999). Thus heavy metals acquired through the food chain as a result of pollution are potential chemical hazards, threatening consumers. At low levels, some heavy metals such as copper, cobalt, zinc, iron and manganese are essential for enzymatic activity and many biological processes. Other metals, such as cadmium, mercury and lead are not known to play essential role in living organisms and are toxic even at low concentrations. The essential metals also become toxic at high concentrations (Bryan, 1976). Studies carried out on fish have shown that heavy metals may have toxic effects, altering physiological activities and biochemical parameters both in tissues and in blood of fish (Larson et al, 1985).

The consequence of heavy metals pollution can be hazardous to man through his food. Therefore, it is important to monitor heavy metal in aquatic environment (water, sediment and biota). The use of water in agriculture is growing due to water scarcity, population growth and urbanization which all lead to the generation of yet more waste water in urban areas. However, waste water irrigation poses several threats to the environment through contamination by nutrients, heavy metals and salts. Increase loads of heavy metals in waste water may increase the risk of ground water contamination (Olaifa *et al.*, 2004) The major anthropogenic sources of heavy metals include waste water, run-off from roads and industrial wastes from mining, manufacturing and metal finishing plants. Heavy metals may also be leached from soils and rocks in contacts with

water. The massive disposal of quantities of metal waste at landfills can lead to metal pollution of ground and surface water (Guven et al, 1999). The aim of this work is to determine and compare the concentration of heavy metals (Co, Pb, and Cu) in tilapia and cat fish in Tiga dam Kano state, Nigeria. The high level of pollution caused by heavy metals and their threat they pose to consumers and public health cannot be over emphasized. So, this work will create awareness on the harmful effect of heavy metals consumption and suggest ways by which pollution by heavy metals can be reduced.

Materials and Methods

Study Area

The Tungan Kawo Dam is located State between latitude $10^{\circ}21'58.51'' - 10^{\circ}23'28.50''N$ of the equator and between longitude $5^{\circ}19'29.23'' - 5^{\circ}20'59.23''E$ in Tungan Kawo village, northwest of Kontagora, 7km along Kontagora – Yauri road in Kontagora Local Government Area of Niger State. The Dam has a catchments area of 143km^2 with a total storage capacity of 17.7M Cubic meters, 20m high and Dam crest length of 1000m. The Dam was commission in May 1991. It is the largest source of water supply in Kontagora Township. The people of Tungan Kawo and its environs are predominantly farmers and have remained so for years. In this area, vegetables are irrigated with dam water and all kinds of available waste and polluted waters. Similarly, to enhance the yield of these vegetables, fertilizers and manures are occasionally added to the soil.

Seasons

Cool and dry season	-	December – February
Hot and dry season	-	March – May
Warm and wet season	-	June – August
Warm and dry season	-	September – November

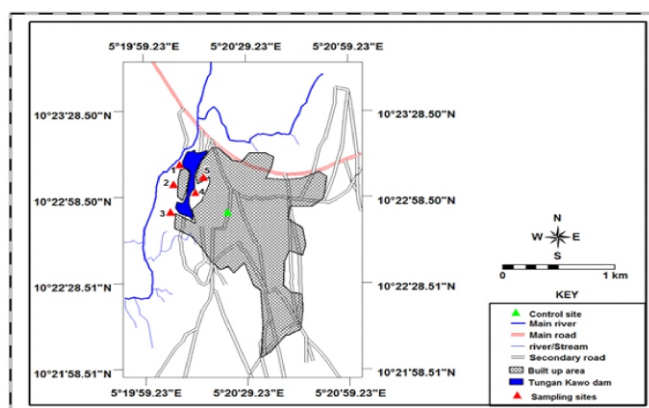


Figure 1: Tungan Kawo Dam showing sampling sites

Source: Adapted and modified from Europa Technologies google earth image, 2010

Fish samples

One species of adult tilapia fish samples were caught and collected from the dam. The

fish samples were washed, weighed and dried in an oven at 105°C for 3 days until gaining constant weight. After cooling in desiccators, the samples were grinded by carbide mortar and pastel and made into powder and homogenised. The powdered samples were finally stored in a pre-cleaned dry plastic bottle and preserved in desiccators for further analysis (Ahmad et al, 2010). The same procedure was carried out for all the samples throughout the seasons.

Fish Samples pre-treatment and Digestion

Fish samples (*orheochromis niloticus*) were collected, rinsed with distilled water and frozen at 0°C. Samples were subsequently de-frozen and rinsed with de-ionized water prior to sample preparation. 10g fresh weights was taken and homogenized in previously cleaned polythene plastic and digested with 20cm₃ 1:1 concentrated HNO₃ and H₂O₂ on a thermo stated hot plate maintained at 100°C inside a fume hood until white fume emanated from the solution. The resulting digest was then cooled, filtered and made up to the mark in a 50cm³ standard flask with distilled water (Ahmad et al, 2010).

Sample Labeling

Samples were alphabetically labeled in order of categorization and simplify identification of samples.

Table 1. Showing alphabetical labeled of Fish samples

Site	Point A	Point B	Point C
1.	FS1a	FS1b	FS1c
2.	FS2a	FS2b	FS2c
3.	FS3a	FS3b	FS3c
4.	FS4a	FS4b	FS4c
5.	FS5a	FS5b	FS5c

Digestion of Fish Sample

Samples were digested as suggested by a method recommended by the FAO/SIDA (1993). 0.5g of each fish tissues (wet weight) were weighed out in an open beaker and 10ml of freshly prepared 1:1 nitric acid – hydrogen peroxide added. The beaker was covered with a watch glass till initial reaction subsided. The beaker was placed in a water bath on a hot plate and the temperature gradually allowed to rise to 160°C and the content boiled gently for approximately 2hrs to reduce the volume to 5ml. The digests were allowed to cool and transferred to 50ml volumetric flask and made up to mark with distilled water.

Table 2. Mean Concentrations of heavy metals in Tilapia fish tissues during Cold and Dry

Tissues	Cd	Cr	Cu	Ni	Pb	Zn	Mn	Fe
Muscles	0.45±0.17	2.25±0.25	0.13±0.03	0.79±0.14	1.12±0.02	2.23±1.94	1.40±0.47	5.31±0.19
Liver	0.07±0.01	2.44±0.24	0.14±0.02	5.44±0.28	2.17±0.03	3.31±0.11	1.52±0.10	5.06±0.24
Kidney	0.28±0.17	2.30±0.24	0.14±0.01	1.86±0.15	2.22±0.11	2.16±0.06	2.20±0.13	5.26±0.47
Gills	0.04±0.02	5.18±0.52	0.19±0.06	3.49±0.07	2.35±0.08	2.75±0.64	1.22±0.07	4.78±0.12
Bones	0.68±0.08	4.75±0.33	0.19±0.03	4.66±0.06	3.34±0.07	3.42±0.31	1.29±0.17	4.47±0.63

Table 3. Mean Concentrations of heavy metals in Tilapia fish tissues during Hot and Dry

Tissues	Cd	Cr	Cu	Ni	Pb	Zn	Mn	Fe
Muscles	0.85±0.05	3.22±0.02	0.15±0.01	0.92±0.03	1.23±0.01	3.56±0.01	1.71±0.06	4.00±0.63
Liver	0.10±0.01	3.78±0.04	0.22±0.16	5.88±0.04	2.24±0.01	3.38±0.01	1.59±0.06	4.02±0.49
Kidney	0.26±0.39	3.68±0.04	0.14±0.01	2.23±0.02	2.49±0.03	2.30±0.08	2.15±0.04	4.46±0.52
Gills	0.12±0.01	5.42±0.04	0.36±0.01	3.68±0.03	2.59±0.08	2.50±0.03	1.50±0.09	4.24±0.41
Bones	1.00±0.06	4.84±0.09	0.34±0.01	4.88±0.01	3.66±0.01	3.47±0.02	1.36±0.03	4.01±0.41

Table 4. Mean Concentrations of heavy metals in Tilapia tissues during Warm and Wet

Tissues	Cd	Cr	Cu	Ni	Pb	Zn	Mn	Fe
Muscles	0.83±0.05	3.23±0.01	0.16±0.01	0.96±0.01	1.26±0.01	3.61±0.02	1.87±0.02	5.87±0.33
Liver	0.12±0.01	3.78±0.01	0.16±0.01	5.91±0.02	2.29±0.02	3.43±0.02	1.75±0.02	5.57±0.34
Kidney	0.12±0.01	3.68±0.01	0.17±0.01	2.27±0.02	2.55±0.01	2.32±0.02	2.43±0.43	5.73±0.52
Gills	0.14±0.01	5.52±0.01	0.38±0.01	3.68±0.00	2.68±0.00	2.55±0.01	1.66±0.07	5.47±0.52
Bones	1.00±0.02	4.91±0.01	0.37±0.01	4.91±0.01	3.71±0.01	3.51±0.02	1.62±0.11	5.13±0.46

Table 5. Mean Concentrations of heavy metals in Tilapia tissues during Warm and Dry

Tissues	Cd	Cr	Cu	Ni	Pb	Zn	Mn	Fe
Muscles	0.72±0.02	3.19±0.02	0.13±0.01	0.91±0.03	1.22±0.01	3.58±0.03	1.69±0.05	7.30±0.52
Liver	0.08±0.02	3.72±0.02	0.13±0.01	5.85±0.03	2.26±0.03	3.39±0.03	1.60±0.05	7.40±0.36
Kidney	0.10±0.01	3.64±0.02	0.14±0.02	2.23±0.03	2.51±0.02	2.29±0.02	1.91±0.20	7.90±0.43
Gills	0.10±0.02	5.48±0.02	0.34±0.02	3.63±0.02	2.63±0.03	2.50±0.03	1.59±0.11	7.21±0.17
Bones	0.90±0.03	4.89±0.02	0.35±0.02	4.85±0.04	3.67±0.03	3.47±0.03	1.52±0.06	7.02±0.30

Heavy Metal Mean Concentrations in Tilapia Fish (*Orheochromis niloticus*)

The mean concentrations of the heavy metals determined in tissues of tilapia fish from Tungan Kawo dam were observed as follows:

Cold and Dry season: Muscles – Cd (0.45±0.17); Cr (2.25±0.25); Cu (0.13±0.03); Ni (0.79±0.14); Pb (1.12±0.02); Zn (2.23±1.94); Mn (1.40±0.47) and Fe (5.31±0.19), while the trend of occurrence is Fe > Cr > Zn > Mn > Pb > Ni > Cd > Cu; **Liver** – Cd (0.07±0.01); Cr (2.44±0.24); Cu (0.14±0.02); Ni (5.44±0.28); Pb (2.17±0.03); Zn (3.31±0.31); Mn (1.52±0.100) and Fe (5.06±0.24), while the trend of occurrence is Fe > Ni > Zn > Cr > Pb > Mn > Cu > Cd;

Kidney – Cd (0.28±0.17); Cr (2.30±0.24); Cu (0.14±0.01); Ni (1.86±0.15); Pb (2.22±0.11); Zn 2.16±0.06; Mn (2.20±0.13) and Fe (5.26±0.47), while the trend of occurrence is Fe > Cr > Pb > Mn > Zn > Ni > Cd > Cu; **Gills** – Cd (0.04±0.02); Cr (5.18±0.56); Cu (0.19±0.06); Ni (3.49±0.07); Pb (2.35±0.08); Zn (2.75±0.64); Mn (1.22±0.07) and Fe (4.780.12) and the trend of occurrence is Cr > Fe > Ni > Zn > Pb > Mn > Cu > Cd; **Bones** – Cd (0.68±0.08); Cr (4.75±0.33); Cu (0.19±0.03); Ni (4.66±0.06); Pb (3.34±0.07); Zn (3.42±0.31); Mn (1.29±0.17) and Fe (4.47±0.63) and the trend of occurrence is Fe > Cr > Ni > Zn > Pb > Mn > Cd > Cu.

Hot and Dry season: Muscles – Cd (0.85±0.05), Cr (3.22±0.02), Cu (0.15±0.01), Ni (0.92±0.03), Pb (1.23±0.01), Zn (3.56±0.01), Mn (1.71±0.06) and Fe (4.00±0.63), while the trend of occurrence is Fe > Zn > Cr > Mn > Pb > Ni > Cd > Cu; **Liver** – Cd (0.10±0.01), Cr (3.78±0.04), Cu (0.22±0.16), Ni (5.88±0.04), Pb (2.24±0.01), Zn (3.38±0.01), Mn (1.59±0.06) and Fe (4.02±0.49), while the trend of occurrence is Ni > Fe > Cr > Zn > Pb > Mn > Cu > Cd; **Kidney** – Cd (0.26±0.39), Cr (3.68±0.04), Cu (0.14±0.01), Ni (2.23±0.02), Pb (2.49±0.03), Zn (2.30±0.08), Mn (2.15±0.04) and Fe (4.46±0.52), while the trend of occurrence is Fe > Cr > Pb > Zn > Ni > Mn > Cd > Cu; **Gills** – Cd (0.12±0.01), Cr (5.42±0.04), Cu (0.36±0.01), Ni (3.68±0.03), Pb (2.59±0.08), Zn (2.50±0.03), Mn (1.50±0.09) and Fe (4.24±0.41), while the trend of occurrence is Cr > Fe > Ni > Pb > Zn > Mn > Cu > Cd; **Bones** – Cd (1.00±0.06), Cr (4.84±0.09), Cu (0.34±0.01), Ni (4.88±0.01), Pb (3.66±0.01), Zn (3.47±0.02), Mn (1.36±0.03) and Fe (4.01±0.41), while the trend of occurrence is Ni > Cr > Fe > Pb > Zn > Mn > Cd > Cu.

Warm and Wet season: Muscles – Cd (0.83±0.05), Cr (3.23±0.01), Cu (0.16±0.01), Ni (0.96±0.01), Pb (1.26±0.01), Zn (5.61±0.02), Mn (1.87±0.02) and Fe (5.87±0.33), while the trend of occurrence is Fe > Zn > Cr > Mn > Pb > Ni > Cd > Cu; **Liver** – Cd (0.12±0.01), Cr 93.78±0.01, Cu (0.16±0.01), Ni (5.91±0.02), Pb (2.29±0.02), Zn (3.43±0.02), Mn(1.75±0.02) and Fe (5.57±0.34), while the trend of occurrence is Ni > Fe > Cr . Zn > Pb > Mn > Cu > Cd; **Kidney** – Cd (0.12±0.01), Cr (5.68±0.01), Cu (0.17±0.01), Ni (2.27±0.02), Pb (2.58±0.01), Zn (2.32±0.02), Mn (2.43±0.43) and Fe (5.73v0.52), while the trend of occurrence is Fe > Cr > Pb > Mn > Ni > Zn > Cu = Cd; **Gills** – Cd (0.14±0.01), Cr (5.52±0.01), Cu (0.38±0.01), Ni (3.68±0.00), Pb (2.68±0.00), Zn (2.55±0.01), Mn (1.66±0.07) and Fe (5.47±0.52), while the trend of occurrence is Cr > Fe > Ni > Pb > Zn > Mn > Cu > Cd; **Bones** – Cd (1.00±0.02), Cr (4.91±0.01), Cu (0.37±0.01), Ni (4.91±0.01), Pb (3.71±0.01), Zn (3.51±0.02), Mn (1.62±0.01) and Fe (5.13±0.46), while the trend of occurrence is Fe > Cr = Ni > Pb > Zn > Mn > C > Cu.

Warm and Dry season: Muscles – Cd 9 0.72±0.02), Cr (3.19±0.02), Cu (0.13±0.01), Ni (0.91±0.03), Pb (1.22±0.01), Zn (3.58±0.03), Mn (1.69±0.05) and Fe (7.30±0.52), while the trend of occurrence is Fe > Zn > Cr > Mn > Pb > Ni > Cd > Cu; **Liver** – Cd (0.08±0.02), Cr (3.72±0.02), Cu (0.13±0.01), Ni (5,85±0.03), Pb (2.26±0.03), Mn (1.60±0.05) and Fe (7.40±0.36), while the trend of occurrence is Fe > Ni > Cr > Zn > Pb > Mn > Cu > Cd; **Kidney** – Cd (0.10±0.01), Cr (3.64±0.02), Cu (0.14±0.02), Ni (2.23±0.03), Pb (2.51±0.02), Zn (2.29±0.02), Mn (1.91±0.20) and Fe (7.90±0.43), while the trend of occurrence is Fe > Cr > Pb > Zn > Ni > Mn > Cu .> Cd; **Gills** – Cd (0.10±0.02), Cr (5.48±0.02), Cu (0.34±0.02), Ni (3.63±0.03), Pb (2.63±0.03), Zn 92.50±0.03), Mn (1.58±0.11) and Fe (7.21±0.17), while the trend of occurrence is Fe > Cr > Ni . Pb > Zn > Mn > Cu > Cd; **Bones** – Cd (0.90±0.03), Cr

(4.89 ± 0.02), Cu (0.35 ± 0.02), Ni (4.85 ± 0.04), Pb (3.67 ± 0.03), Zn (3.47 ± 0.03), Mn (1.52 ± 0.06) and Fe (7.02 ± 0.30), while the trend of occurrence is Fe > Cr > Ni > Pb > Zn > Mn > Cd > Cu.

Discussion on fish Tilapia (*Orheochromis niloticus*)

The heavy metals concentrations determined in tilapia fish tissues are shown in tables above according to seasons and observed to be in similar trend of occurrence with variations among tissues and seasons. The table below shows comparative analysis of heavy metals concentrations in fish tissues with other reported values in the literature.

Table 11. Comparative literature values of heavy metals concentrations in Tilapia tissues

Metal	Muscle	Liver	Kidney	Gills	Bones	Source
Fe	7.30 ± 0.52	7.40 ± 0.36	7.90 ± 0.43	7.21 ± 0.17	7.02 ± 0.30	(a)
	75.19	720.48	-	515.23	-	(b)
Cd	0.85 ± 0.05	0.12 ± 0.01	0.28 ± 0.17	0.14 ± 0.01	1.00 ± 0.06	(a)
	0.19	2.16	-	1.96	-	(b)
	1.76	6.00	4.29	7.23	-	(c)
Cr	3.23 ± 0.01	3.78 ± 0.04	5.68 ± 0.01	5.52 ± 0.01	4.91 ± 0.01	(a)
	-	-	-	-	-	(b)
	1.32	2.65	2.43	5.67	-	(c)
Cu	0.16 ± 0.01	0.22 ± 0.16	0.17 ± 0.01	0.38 ± 0.01	0.37 ± 0.01	(a)
	2.80	154.43	-	46.3	-	(b)
Mn	1.87 ± 0.02	1.75 ± 0.02	2.43 ± 0.43	1.66 ± 0.07	1.62 ± 0.11	(a)
	1.98	13.89	-	4.24	-	(b)
Ni	0.96 ± 0.01	5.91 ± 0.02	2.27 ± 0.02	3.68 ± 0.03	4.91 ± 0.01	(a)
	-	-	-	-	-	(b)
	0.80	5.55	1.80	3.65	-	(c)
Pb	1.26 ± 0.01	2.29 ± 0.02	2.58 ± 0.01	2.68 ± 0.02	3.71 ± 0.01	(a)
	2.77	2.88	-	3.41	-	(b)
	2.67	7.37	6.34	5.56	-	(c)
Zn	5.61 ± 0.33	3.43 ± 0.02	2.32 ± 0.02	2.75 ± 0.64	3.51 ± 0.02	(a)
	27.60	112.15	-	87.46	-	(b)

(a) Present study; (b) Samir & Ibrahim (2008); (c) Abida et al (2009). International permissible limit in fish (mg/day) of heavy metals are:

Table 12. Showing International permissible limits in fish

Metal	Fe	Cr	Cu	Mn	Ni	Pb	Cd	Zn
FAO	43	1.0	10 - 100	2.0 - 9.0	-	0.5 - 6.0	0.5	30 - 100
WHO			30			2.0	2.0	1000
MAFF			20			2.0	0.2	50

Comparing the concentrations of heavy metals in the fish tissues reported by both Samir & Ibrahim (2008) and Aida et al (2009), all the metals concentrations are higher than those observed in the present study. In another study of heavy metals concentrations determined in tilapia species (*O. niloticus*) by Nnaji (2007), he reported higher concentrations of Zn (28.5 ± 0.41) and Cu (2.19 ± 0.05), but lower concentrations of Cd

(0.079 ± 0.0053); Cr (0.701 ± 0.048) and Pb (1.50 ± 0.082) when compared with the concentrations of these metals determined in the same tilapia fish. Saleh (2010) reported higher concentrations of heavy metals in fish muscle as Pb ($141.14 \pm 26.35 \text{ mg/kg}$), Cd ($46.42 \pm 24.08 \text{ mg/kg}$) and Cr ($34.29 \pm 9.56 \text{ mg/kg}$). Shrivastava et al (2011) also reported similar heavy metals concentrations of heavy metals as Cd (ND); Cr (0.25); Cu (1.39); Fe (10.5); Mn (0.78); Ni (0.04); Pb (0.22) and Zn (5.8). and the pattern of occurrence is $\text{Fe} > \text{Zn} > \text{Cu} > \text{Mn} > \text{Pb} > \text{Cr} > \text{Ni} > \text{Cd}$.

Recommendations

The deterioration in the physicochemical quality and rise in the nutrient level observed in this study is alarming, and periodic monitoring and preventative measures are required to save the aquatic system from eutrophication. Further work is therefore needed to determine the dynamics of the watershed's response to runoffs and land management practices under varying climatic conditions to better understand the complex physical and chemical processes causing the degradation observed in the present study. The findings also have important implications for the development of effective watershed management strategies for the control of point and diffuse-source pollution of the Tungan Kawo Dam.

It is important to monitor changes in sediment composition because the contaminants within the sediments can act as a source of pollutants long after the original source of pollutants has been abated. Once metals and nutrients have settled into the sediments, they can again become processes in natural situations. The application of numerous biosolids (e.g., livestock manures, composts, and municipal sewage sludge) to land inadvertently leads to the accumulation of heavy metals such as As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Mo, Zn, Tl, Sb, and so forth, in the soil should be regulated. Certain animal wastes such as poultry, cattle, and pig manures produced in agriculture are commonly applied to crops and pastures either as solids or slurries. Although most manures are seen as valuable fertilizers, in the pig and poultry industry, the Cu and Zn added to diets as growth promoters and As contained in poultry health products may also have the potential to cause metal contamination of the soil and so should also be regulated to avoid increase in the level of the metals already in the soil which eventually find their way into the dam during raining season.

The manures produced from animals on such diets contain high concentrations of As, Cu, and Zn and, if repeatedly applied to restricted areas of land, can cause considerable buildup of these metals in the soil in the long run, and so should be applied years after. Thus, environmental surveillance of Tungan Kawo dam sediment, water, irrigated vegetables and soil of the surrounding farmlands is highly recommended in order to closely monitor their quality and avoid the potential risk of metal toxicity with time.

Conclusion

The samples of tilapia fish obtained from Tungan Kawo dam during the wet and dry seasons were found to contain all the analyzed heavy metals (Cd, Cr, Cu, Ni, Pb, Zn, Mn,

Fe). The study indicated differences in heavy metals found in muscle, liver, kidney, gills and bones of Tilapia fish (*Oreochromis niloticus*) in Tungan Kawo dam. The present study shows that precautional measures need to be taken in order to prevent accumulation and future heavy metal pollution of fish species found in Tungan Kawo Dam. The level of heavy metals in fish (*Oreochromis niloticus*) is within safe level but continued monitoring of the heavy metals in the various species of fish should be done. The potential risk for human exposure to these metals emanates from the vegetables irrigated with the dam water, fish caught in the dam and water pumped to Kontagora metropolis, and subsequently consumed could be averted if measures are taken by the state government to build concrete walls round the dam to prevent run-off from the surrounding farmlands during the wet season.

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DEVELOPMENT OF A SELF SUSTAINED POWER SYSTEM FROM A DETACH 1KVA GENERATOR.

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Abstract

Self-sustained generator from a detach 1KVA Generator is an alternative source of power that is safe and efficient, the design and development is top notch. The system does not have an engine like the fuel generator which consumes fuel. Instead, it has a DC motor which is powered by a 12volts, 100Amps or above motor battery and recharges self while working. The materials for construction are; Capacitor, DC motor, speed controller; speed up gear, Ac to Dc charger, Battery, Ac alternator, Shafts and Gear. The alternator armature shaft was coupled directly with DC motor powered by a rechargeable battery. The DC motor rotates the armature of the alternator in the field coil at high speed when activated from the starting switch, which results in alternating current output voltages of 220V. The generator generates 1KVA of power with which you can use in home and offices to power some devices. The system is designed such that a built-in battery charger recharges the batteries at the same rate as the DC discharges the battery when drawing battery current. The System could be designed to any limit, depending on the capacity of the planned load. Result revealed an overall efficiency of 85% on a load of 0.5KVA and 1KVA respectively. The outcomes revealed that the generator can operate at higher efficiency if permanent magnet alternator is used and also if a higher charging system is incorporated to charge the battery.

INTRODUCTION

Issue of alternative power generation has become a matter of concern to researchers. The search for electricity generation, transmission and distribution is nobody business but everybody business. It has become a must for all professions to be involved in discovering alternative means for power availability, in order to enhance nation's economy. A self-sustained powered generator is a mechanical device that generates electric power without the use of fossil fuel. According to Diabana (2009), the electricity sector is unique among industrial sectors in its large contribution of emissions associated

with nearly all air issues. Electricity generation produces a large share of Canadian nitrogen oxides and sulphur dioxide emission, which contributes to smog and acid rain and formation of fine particle matter which is the largest uncontrolled industrial source of mercury emissions in Canada. Rasak (2015) discovered that since the generating capacity in Nigeria is about 6GW but actual available output is less than 2.5GW, As a result of timely routine maintenance causing significant deterioration in power output. Abdullah et al (2012) has observed that at present, the importance of alternative energy source has become even more crucial matter not only due to the continuous depletion of limited fossil fuel stock but also for the safe, better and greener environment. Adewumi (2014) has noticed that power generation, transmission and distribution has been an indispensable factor in the progress of an economy, ranging from manufacturing, banking, media, health care, aviation, etc. It has however been proved that power skyrocket the productivity of a country. Environmental pollution which leads to degradation or depletion of ozone layer is one of the major problems caused by the use of generator with fossil fuels (Ajav, 2012). Other problem includes land and water pollution, noise pollution, increase in price of fossil fuel year in year out, among others. Recently, increase in energy demand and limited energy sources in the world caused the researchers to make effort to provide new and renewable energy sources for the usage in an economical and safe way. Besides being clean and of low running cost, renewable energy possesses the privilege of abundance and can be used wherever available (Hassan and Mohammed, 2011). The self-excited induction generators (SEIG) have been found suitable for energy conversion for remote locations. Self-excited induction generators (SEIG) are frequently considered as the most economical solution for powering costumers isolated from the utility grid. SEIG has many advantages such as simple construction, absence of DC power supply for excitation, reduced maintenance cost, good over speed capability, and self-short-circuit protection capability. This inconsistent power supply has caused a surge of the search for alternative forms of power source with minimal operating costs. Industries adapted the use of natural gas generators as much saving was made compared to the traditional petrol or diesel-run generators Ajav E.A Et al 2014. And considering the effect of gasoline generators, which emit toxic fumes and pollutant like carbon monoxide, and particulate matter which make it uncomfortable to humans and animals. With the increasing demand for natural gas and the subsequent increases in prices there is need for continuous improvement on existing design. The objective of this research work is to construct and evaluate the performance of a 1KVA self-sustained power system from a detach 1KVA Fuel Generator using alternator as a means of power transmission.

MATERIALS AND METHODS

Speed-up gear
Speed controller
Ac to Dc charger
Battery
Ac alternator
Couplings

Shafts
Gears
DC motor
Capacitor

METHOD

The shaft is tighten to the DC motor, The DC motor, which is an electric motor that runs on direct current, is coupled to the alternator case using hex bolts of 5mm. The channel, which is a base, is constructed with metals and it houses the DC motor and the alternator. 12V, 100Arms deep cycle batteries are connected with 4mm insulated copper wires in series (to give 12V) to a switch that is off and from the switch to the DC motor. The insulated wires are used to connect the alternator AC output to both the load and 12V, 30A charger. The charger provides constant recharging of the batteries as the DC motor consumes energy from the batteries. The positive and negative terminals of the charger are connected to the positive and negative terminals of the batteries respectively with the switch on, the battery turn the DC motor, the DC motor drives the alternator and the alternator produces electricity having voltage up to 220V above and carries the load while charging the battery at the same time with the help of the electricity also supplied to the charger. The voltage meter shows a constant value of 240V for as long as the switch is on. The alternator has diode that gives polarity (+Ve and -Ve) to the battery and capacitor that stores electrical charges smoothen the electricity supplied by the alternator.

The generator using battery, gear and couplings consist majorly of five major units, which includes the following;

The power supply Unit.
Conversion Unit
Control Unit.
Output Unit.
Charging Unit

THE POWER SUPPLY UNIT

12 volts battery was used as source of power supply unit to the D.C motor in order to induce electromotive force (E.M.F). Lead acid battery is highly recommended for DC generating system. This serves as storage device for the direct current which is to be induced.

CONVERSION UNIT

This unit is the unit that distinguished the DC generator from the popular fuelled generating set. The unit makes use of DC motor, which will be responsible for all voltage, current and power conversion.

CONTROL UNIT

This unit performs the following work; converts direct current (DC) to alternating current (AC), removal of ripples, and rectification.

OUTPUT UNIT

The use of the control circuit unit will make it possible to provide output voltage within the range of 100V - 240V which is the standard voltage requirement for all appliances. The red wire on the alternator was used to supply the household and offices as the mains. They are produced in a variety of power and voltage levels and generally are always examined from many points of view, such as reliability, efficiency, dimensions weight and costs.

D.C MOTOR

Electric motors are electric generators reversed in function. They convert electrical energy into mechanical energy- the continual stresses between two electromagnetic field relatively moveable, just as generator convert into electromagnetic stresses, the mechanical energy applied to them (Aremu, 2009). Power from the electric motor is transmitted into the alternator via rotating shaft driven system. Electric motor used for this research work has the following configuration; 6000rpm (Speed), 12V, and 30A.

TESTING

In order to ascertain the workability, reliability, and operating characteristics of the self-sustained powered generator from a detach 1KVA Generator; tests were carried out severally on both unloaded and loaded conditions. The results of these tests were then use to validate the self-sustained power system with the already existing ones. Also tests were carried out on the individual components that make up the self-sustained power system in order to know their behavior under working condition.

OUTPUT EFFICIENCY.

For self-sustained powered Generator, Table 1, Table 2 and Table 3 shows the result of performance evaluation for the 1KVA self-sustained power generating set from a detached 1KVA generator. The load bank was connected to the generator in order to power the light bulbs on the bank, which was connected to the extension wire. Stop watch was used to record the time at interval of 60 minute for five different runs. While the multi-meter was used to read the voltage output in Volts with Current in Ampere and the mean voltage with current result was computed in the Table 1, Table 2 and Table 3 respectively.

Output efficiency was computed using the data obtained after testing, according to Institute of Electrical and Electronics Engineers (IEEE, 1997) reported by Sandia Inverter (2004) as shown below. Load capacity used for this research work ranges from 0 watt to 800 watts; that is from 0% to 100% loading. The speed of the motor used was 3000rpm while that of the alternator was 6000rpm. From the result, it is observed that as the

voltage reduces the current increases. This result support Ohm's law finding that states that, the higher the voltage in the circuit, the higher the current.

Application and possibilities.

There are many possible ways to exploit the energy from self-powered engine when fully operated. With each of the possibilities, it seems the self-sustained powered system will be very useful and dependable. The self-sustained power system can replace the diesel engines used in the vast majority of modern heavy road vehicles such as trucks, buses, long distance trains, large scale portable power engines and most farm and mining vehicles.

TESTING AND EFFICIENCY

Upon completion of the fabricated system, it was tested using a multi-meter and tachometer to measure the voltage produced and the speed at which the generator is producing that voltage respectively. It was found to produce a voltage of 180V and 12A at a speed of 4000 rpm. It was from this basis the output power was calculated and hence the overall efficiency of the system estimated 85%.

PERFORMANCE EVALUATION

With the use of a multi-meter as a measuring device, the input voltage, output voltage, output current, input current were determined.

Input Power = Input Voltage × Input Current ----i

Output Power = Out Voltage × Output Current ----ii

Efficiency = $\frac{\text{Output power}}{\text{Input power}} \times 100$ -----iii

INPUT, OUTPUT POWER AND EFFICIENCY OF SELF-POWERED GENERATOR

Time (m)	Load (w)	Input voltage (V)	Output voltage (V)	Input current (A)	Output current (A)	Input power (W)	Output power (W)	Efficiency (%)
60	0	12.69	220	0	0	0	0	0
120	0	12.65	225	0	0	0	0	0
180	0	12.64	230	0	0	0	0	0
240	0	12.63	225	0	0	0	0	0
300	0	12.65	230	0	0	0	0	0
1	0	12.55	220	0	0	0	0	0

Table 1, at 60 minute on zero load, the input and output voltage was measured with a multi-meter the input power, output power and efficiency was zero.

Time (m)	Load (w)	Input voltage (V)	Output voltage (V)	Input current (A)	Output current (A)	Input power (W)	Output power (W)	Efficiency (%)
60	200	12.55	220	7.34	0.37	92.12	81.4	88.36
120	200	12.65	225	7.20	0.35	91.08	78.75	86.63
180	200	12.65	215	7.38	0.41	93.34	88.15	94.44
240	200	12.55	220	7.34	0.41	92.12	90.2	97.79
300	200	12.50	210	7.44	0.36	93	75.6	81.30
							Average	89.70

Table 2, at 60 minutes,120, 180, 240 and 300 minutes interval a load of 200W was used, the input voltage, output voltage, input current, output current was measured with a multi-meter, result revealed an average efficiency of 89.70 percent.

Time (m)	Load (w)	Input voltage (V)	Output voltage (V)	Input current (A)	Output current (A)	Input power (W)	Output power (W)	Efficiency (%)
60	500	12.70	200.10	7.88	0.44	100.07	88.04	87.98
120	500	12.65	197.20	7.84	0.43	99.18	84.79	85.50
180	500	12.60	199.10	8.02	0.38	101.05	74.87	74.09
240	500	12.40	200.00	7.84	0.43	97.22	86.00	88.46
300	500	12.70	199.99	7.50	0.41	95.25	81.99	86.08
							Average	84.42

Table 3, at 60 minutes,120, 180, 240 and 300 minutes interval a load of 500w was used, the input voltage, output voltage, input current, output current was measured with a multi-meter, result revealed an average efficiency of 84.42 percent

CONCLUSION

The self-sustained generating set from a detached 1000W (1KVA) generator has been developed for use in homes and offices. Self-sustained power system is a renewable energy source with insignificant or no CO2 emissions. The following conclusions were drawn from the design, development of 1000W (1KVA) self-sustained power system; It can be deduced that the system had the peak efficiency of 90% at a load of 200W and the lowest efficiency of 84.42% at a load of 500W with voltage output of 200V. It was also revealed that there is a decrease in the output of the machine when there is a high increase in the load. After proper statistical analysis, the machine is said to have an average efficiency of 85%.

RECOMMENDATION

The system can be incorporated into automobile engine in order to have fuel less automobiles that would run without fuel. In order to obtain a good performance characteristic, a voltage well above 12V battery voltage should be used to power the system. D.C motors of higher capacity than 500hp are coupled to the alternator whose

capacities are lower than that of the D.C motors, then maximal output capacity of the alternator could be obtained.

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IMPACT ASSESSMENT OF AN ABANDONED DUMPSITE ON DRINKING WATER QUALITY IN NIGERIA

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Abstract

The study employed both statistical and geospatial techniques to assess the impacts of an abandoned dumpsite on the surrounding residents, within Osogbo metropolis, Nigeria, located between longitude 7°46'35''N - 7°47'45''N and latitude 4°29'14''E - 4°30'28''E. A total of 18 groundwater samples within the study area, to test for the suitability of drinking water sources of the residents, GPS coordinates of the collection points were also taken and plotted within the ArcGIS environment. Water samples were tested, and their mean values measured against the NSDWQ (2007) and WHO (2022) drinking water guidelines. Results show that from 50m to 500m of collection, all the water samples fell short of water quality standards, recording consistently levels of E. coli contamination in the water samples. Finally, plotting the mean values of E. coli against the NSDWQ and WHO standards, the water samples recorded high level contamination, and also did not perfectly decrease with distance from the dumpsite. This may be due to the effects in the variety in the frequency and styles of water treatments, as they differ between households. From the interview reports, it was deduced that some houses in closer proximity (50m and 100m) to the dumpsite, treated their water sources than those who were farther away from the dumpsite.

Keywords: water pollution, groundwater quality, contamination, dumpsite.

Introduction

Waste disposal is a global issue, particularly in developing nations, as populations rise, economies grow, cities and industries expand, and inefficient waste management methods persist. Many poor countries often have uncontrolled municipal solid waste disposal in un-engineered open dumps. In particular, insufficient solid waste

management is a serious environmental issue in Nigeria, where adequately built waste facilities do not exist (Oyelami *et al.*, 2013; Yakubu *et al.*, 2013, 2015a). Wastes are often deposited in non-engineered dumpsites, from which emanate leachates including dissolved organic matter inorganic chemicals. These leachates are made up of inorganic compounds such as sodium, sulphates, ammonium, etc., heavy metals such as zinc, nickel, as well as other forms of organic compounds, that have the abilities to penetrate deep into soils and contaminate both surface and groundwater. The severity of this hazard is determined by the concentration and toxicity of the pollutants, the type and depth of the water table, proximity to the waste dump and the direction of groundwater flow (Aderemi *et al.*, 2011).

Water is used in several ways to benefit mankind and his environment for domestic uses and growing of food crops, it is important for tourism and culture, as well as for the preservation of the earth's environment (Yakubu *et al.*, 2015b). Groundwater is one of the most often used freshwater sources for drinking. It is a key renewable resource with various benefits over surface water, including being less contaminated owing to its great self-cleaning ability and simplicity of treatment (Coker *et al.*, 2019). However, this valuable resource is vulnerable to pollution as a result of improper municipal solid waste management (Yakubu *et al.*, 2015b). Leachates from municipal solid waste dumpsites are a major source of groundwater pollution in cities (Aboyeji and Eigbokhan, 2016). A considerable number of organic, inorganic, and microbiological contaminants in groundwater have been identified in various studies throughout the world (Han *et al.*, 2014; Liu *et al.*, 2020), and significant resources have been invested in efforts to address the issues.

In Osogbo, hand-dug wells and drilling of boreholes are the major sources of water abstraction used for drinking and other domestic supplies. The increased demand for fresh water, along with a restricted supply of pipe-borne water, has caused urban people to rely on groundwater for drinking and other household reasons. It is believed that more than 70% of the population gets its water via hand-dug wells (Ashano and Dibal, 2016; Yakubu, 2018). The quality of groundwater in a given location is determined by its land use pattern (Osibanjo and Majolagbe, 2016), as well as the forms of pollutants to which the water resources are subjected. Research (Osibanjo and Majolagbe, 2016; Okoli *et al.*, 2017; Yakubu, 2013; Yakubu *et al.*, 2017) has various anthropogenic factors such as improper waste management. Furthermore, high level of population growth, and urbanization have impacted adherence to NESREA's recommendations for dumpsite proximities, as people now reside as close as within 50m distance from the dumpsite. The National Environmental Standards and Regulations Enforcement Agency (NESREA) have set the proximity standard in Nigeria, stating that dumpsites/landfills should be located within 1000m of settlement areas for hygienic reasons, 2000m from existing major roads, and at least 1000m from ground and surface water bodies to avoid contamination from leachates. It is required by NESREA, that 1000m, 500m, and 250m should fall within the buffer zones for built-up areas, major roads and water courses when siting a dumpsite (Geidam and Isa, 2019). This is because it takes a dumpsite about

450 years to fully decompose, (Geidam and Isa, 2019) hence decommissioned dumpsites may continue to impact the quality of environmental resources for as long as it is still decomposing. Every year, over two million people die worldwide from water-related ailments (Ayeni, 2021) due to poor sanitation and contaminated water, of which 90% are children (Okoli *et al.*, 2013).

This study assesses the impacts of an abandoned dumpsite on drinking water quality in Osogbo metropolis, Nigeria, using the Onibu-Eja dumpsite as case study. The objectives of the study were to: determine the current suitability of the residents' drinking water sources around Onibu-eja dumpsite, and to analyze the distribution of fecal contamination across varying distances from the dumpsite. The study area, Onibu-eja dumpsite is situated on the outskirts of Osogbo, along Iwo Road. Figure 1 shows that it is located between longitude 7°46'35"N - 7°47'45"N and latitude 4°29'14"E - 4°30'28"E. The location falls within the Ido Osun local government area in the Osogbo Metropolis, and is accessible via the Iwo-Osogbo main routes.



Figure 1. Study area

Literature Review

Rapid urbanization, population expansion, and development have led to overexploitation of both surface and groundwater. Osun State's urban regions are distinguished by a variety of water sources, the most prevalent of which being wells and boreholes. The primary water supply for more than 75% of the homes in this region is a well (Atoyekun, 2022). Akoteyon, (2022); Akinbile and Yusoff, (2021); Eshiet and Agunwamba, (2022); Longe and Balogun, (2020); have all recorded instances of landfill leachate contaminating groundwater. It was discovered that the groundwater in the Attics Region of Greece, next to the Anoliosia Landfill, was immobile and unfit for use as irrigation water (Fatta *et al.*, 2019). In New Castle County, Delaware, private wells 300 meters downstream from the Liangollu Landfill were severely contaminated and eventually abandoned (Chian and DeWalle, 2016).

Research conducted in Nigeria has also demonstrated that leachate penetration and outflow from landfills degrade the quality of groundwater (Longe and Enekwechi, 2017). According to Longe and Balogun's (2020) analytical findings, groundwater samples collected from wells close to the Solus Landfill site in Alimosho Local Government Area, Lagos State, Nigeria, had a mean pH of 6.13, indicating a moderate level of contamination. According to research done at landfills in Igando, Lagos, Nigeria, by Akoteyon (2022), heavy metal concentrations were high in groundwater samples taken from three landfills, indicating a significant influence on groundwater quality. About 23.3% of the groundwater pollution was caused by cadmium, compared to 19.3% by lead and 8.8% by copper. It was also discovered that iron, lead, zinc, and chromium were contaminating the groundwater close to a municipal dump in Akure, Ondo State, Nigeria (Akinbile and Yusoff, 2011). Additionally, it was discovered that the Avu dumpsite along the Owerri-Port Harcourt highway in Owerri, Imo State, Nigeria, significantly impacted the nearby soil and water ecosystem (Eshiet and Agunwamba, 2012).

Finally, insufficient solid waste management is a significant environmental issue, and Longe and Balogun (2010) claim that Nigeria lacks appropriately built solid waste facilities. Technical competence deficiencies as well as institutional and budgetary limitations are important causes. Hence the need to monitor the groundwater quality of the study area, regardless of the active nature of the dumpsite. Wastes that have been dumped there, may still have the potential to continue to threaten the quality of water around the communities, and by extension, human health.

Methods

The suitability of the drinking water of the study area was determined by a systematic collection of 18 groundwater samples in well-labelled, air-tight plastic containers at regular distance intervals within the host communities (Onibu-eja and Aduramigba) around the Onibu-eja dumpsite, and 1 control sample from 2km distance away from the dumpsite (based on NESREA's recommendations). Water quality test of the physical parameters (*turbidity and solids*); chemical parameters (*pH, lead, arsenic, zinc, iron, fluoride, copper, manganese,*) and biological parameters (*E. coli*) of the water samples were tested in the laboratory and their mean values were plotted against the WHO 2022 and NSDWQ 2007 water quality standards and graphically represented.

The mean values of *E. coli* concentration in the water at varying distances were calculated and plotted against the NSDWQ and WHO water quality permissible limits to analyze their distribution and relationship between distance of pollution source (dumpsite) and level of water contamination. The output of this analysis was represented using tables and charts as applicable.

Discussion

Water samples from the groundwater sources around the study area were collected at varying distances from the dumpsite (50m; 100m; 200m, 300m, 400m, and 500m), and at each point, 3 samples were collected for comparisons. These water samples were either

directly drawn from the wells, or collected through the tap outlets from the boreholes into sterilized air tight water gallons, and kept cool while taken to the laboratory for testing immediately after collection.

The water quality results of the all the water samples collected and tested are presented in Table 4.4 below. The mean values for each parameter were calculated per distance and presented for further discussion.

Parameters	Units	Distance in meters						C/P	NSDWQ (2007)	WHO Standard (2022)
		50m	100m	200m	300m	400m	500m	2000m		
pH	-	8.08	7.78	7.70	7.61	7.07	6.95	6.91	6.5 – 8.5	-
Turbidity	NTU	5.67	4.78	4.67	3.67	4	3.67	3	5	5
Total Dissolved Solids (TDS)	mg/L	643.33	616.67	540	483.33	450	383.33	200	500	600
Lead	mg/L	0.0027	0.0057	0.0002	0.0005	0.0008	0.0004	0.0011	0.01	0.01
Zinc	mg/L	2.98	4	2	2.48	2.07	1.42	0.21	3	3
Copper	mg/L	1.63	2.43	2.33	2.20	3.47	2.40	2.6	1	2
Manganese	mg/L	0.16	0.48	0.38	2.74	0.26	0.25	0.16	0.2	0.08
Arsenic	mg/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Iron	mg/L	0.27	0.53	0.51	0.38	0.26	0.25	0.15	0.3	0.1
Fluoride	mg/L	1.3	1.3	1.47	1.18	1.67	1.23	0.8	1.5	1.5
<i>E. coli</i>	cfu/100 mL	9	9.67	7.33	6.67	6.33	7.67	2	0	0

Table 1. Mean values of water quality results

pH

As presented in table 1 above, the World Health Organization's Guidelines for drinking water, (WHO, 2022), have no health-based guideline value proposed for pH parameter, when testing for drinking water quality. However, the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007) sets the permissible limit for pH at “6.5 – 8.5” because lower pH-water (approximately 7 or less) is likely to be corrosive. Although pH usually has no dirt impact on consumers, it is one of the most important operational water quality parameters.

As presented in figure 2 below, the mean values of the water samples from 50m through to 500m away from the dumpsite, were all within the permissible limits of the NSDWQ (2007). Although at 50m, the mean pH value was highest 8.08, with a continuous decline with distance away from the dumpsite, and at 500m the mean pH value was at 6.95. The pH value for the water sample taken at 2,000m away from the dumpsite to serve as control sample, had a pH of 6.91. This then suggests that the Onibu-eja dumpsite has not impaired the operational quality of drinking water within the communities, in terms of corrosivity, as all the samples, fell within the permissible limits.

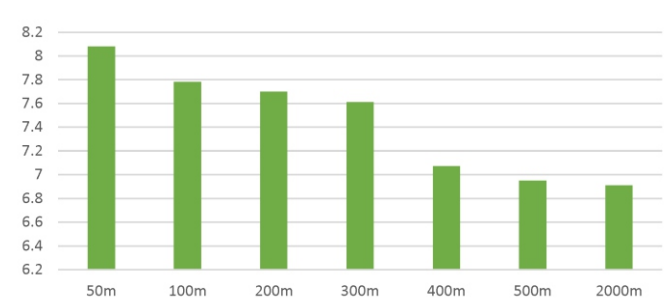


Figure 2. pH level of water samples

Turbidity

Turbidity, typically expressed as Nephelometric Turbidity Units (NTU), describes the cloudiness of water caused by suspended particles such as clay and silts, chemical precipitates such as manganese and iron, organic particles such as plant debris and organisms. According to the World Health Organization's Guidelines for drinking water, (WHO, 2022), and the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), the health-based guideline value proposed for turbidity is 5 NTU as presented in table 1 above, when testing for drinking water quality.

From the results presented in figure 3 below, all the water samples from 100m to 500m, including the sample at the control point, 2,000m away from the dumpsite were within the permissible limits, as recommended by NSDWQ (2007), and WHO (2022). However, the water samples taken within 50m from the dumpsite, exceeded the permissible limit, with a mean value of 5.67 NTU. This may suggest therefore, that at such close proximity from the dumpsite, the high turbidity level in the water samples may be caused by poor source water quality and poor treatment. According to WHO (2022), increasing turbidity reduces the clarity of water to transmitted light because of the visible particles present in them. Visible turbidity may therefore reduce the acceptability of drinking-water. Also, most particles that contribute to increasing turbidity may have significant impact on human health, depending on the hazard potential of the particles, and their quantity in the water. Hence, residents who source drinking water from sources that exceed the recommended limit, stand the risk of possible health hazard if the particles are hazardous.

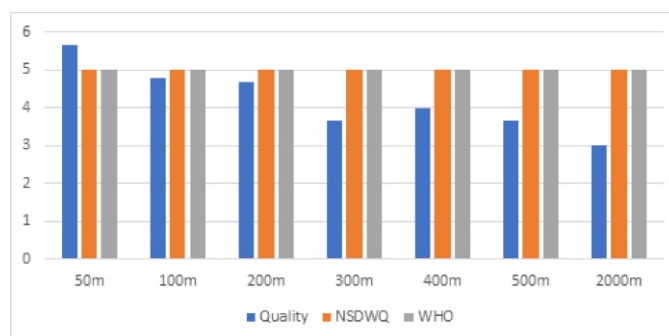


Figure 3. Turbidity level in water samples

Total Dissolved Solids (TDS)

Total dissolved solids (TDS) comprise inorganic salts (such as calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and small amounts of organic matter that are dissolved in water. According to the World Health Organization's Guidelines for drinking water, (WHO, 2022), the palatability of water with a total dissolved solids (TDS) level of less than about 600 mg/l is generally considered to be good; while the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), sets the limit at 500 mg/l.

As presented in figure 4 below, some of the mean values at closer proximity to the dumpsite have TDS values that exceed the permissible limits. At 50m distance from the dumpsite, the TDS values of the water samples exceed the health-based guidelines as recommended by WHO (2022) and NSDWQ (2007), with a mean value of 643.33 mg/l. At 100m distance from the dumpsite, the TDS values of the water samples still exceed the recommended permissible limits, with a mean value of 616.67 mg/l. At 200m from the dumpsite, the TDS values of the water samples exceed the permissible limit of the NSDWQ (2007), but stays within the threshold recommended by the WHO, (2022) with a mean value of 540 mg/l. With increasing radial distance from the dumpsite, there is a marked decline in the TDS values of the water samples, suggesting that, the water quality within the area measured by TDS, improves with distance from the dumpsite.

Although there are no reliable and available data on the health effects associated with ingested TDS in drinking water, however, drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than the permissible limits (WHO, 2022).

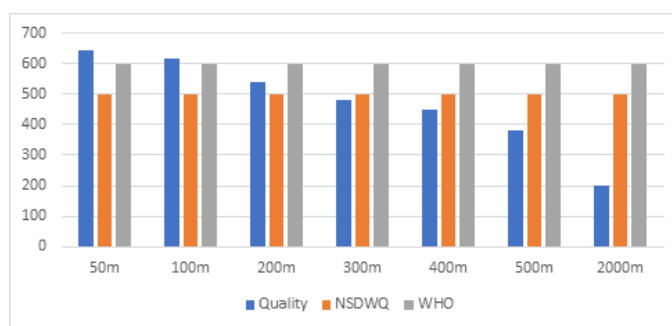


Figure 4. TDS contamination in water samples

Lead

Lead is used principally in the production of lead-acid batteries, solder and alloys, some of which may have been disposed in the Onibu-eja dumpsite during its active years (OWMA, 2023), hence its potential ability to contaminate drinking water sources around the area. According to the World Health Organization's Guidelines for drinking water, (WHO, 2022), and the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), the health-based guideline value proposed for lead is 0.01 mg/l, when testing for drinking water quality.

As presented in figure 5 below, the mean values of all the water samples collected and tested from a radial distance of 50m, through to 500m away from the dumpsite are well within the permissible limits of 0.01mg/l as recommended by NSDWQ and WHO, with the highest mean concentration at 100m being 0.0057 mg/l, and the lowest mean concentration at 200m being 0.0002 mg/l.

Lead is rarely present in tap water as a result of its dissolution from natural sources; rather, its presence is primarily from corrosive water effects on household plumbing systems containing lead in pipes, solder or fittings (including alloy fittings with high lead content), or from the service connections to homes (Noiki *et al.*, 2021). The amount of lead dissolved from the plumbing system depends on factors, such as pH. The low concentration of lead in the water samples may be due to the fact that the pH values of the water within the area are within the safe limits of the NSDWQ, that is they are less corrosive. Exposure to lead is associated with a wide range of effects, including various neurodevelopmental effects, mortality (mainly due to cardiovascular diseases), impaired renal function, hypertension, impaired fertility and adverse pregnancy outcomes, etc.

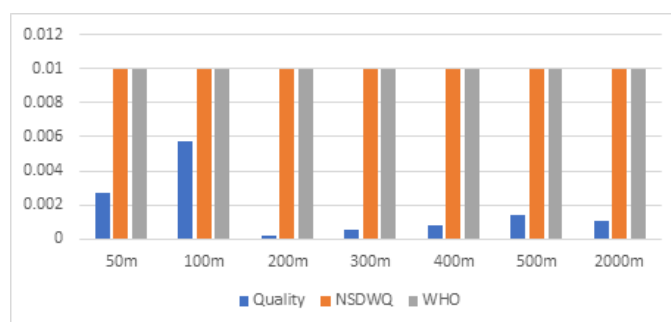


Figure 5. Lead contamination in water samples

Zinc

Zinc is an essential trace element found in virtually all food and potable water in the form of salts or organic complexes. According to the World Health Organization's Guidelines for drinking water, (WHO, 2022), and the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), the permissible limit proposed for zinc is 3 mg/l, when testing for drinking water quality.

As presented in figure 6 below, all the water samples collected and tested within the area, all contain considerable amount of zinc in them, except the control sample taken at 2000m away from the dumpsite. Although, there are appreciable levels of zinc concentration at radial distances from 50m through to 500m, they all are within the permissible limits recommended by NSDWQ and WHO. However, at 100m, from the dumpsite, the mean value of 4, towers above the limits. Although there may be no health hazard associated with this level of Zinc contamination in drinking water, increasing levels may affect its acceptability, hence rendering it unsuitable for drinking.

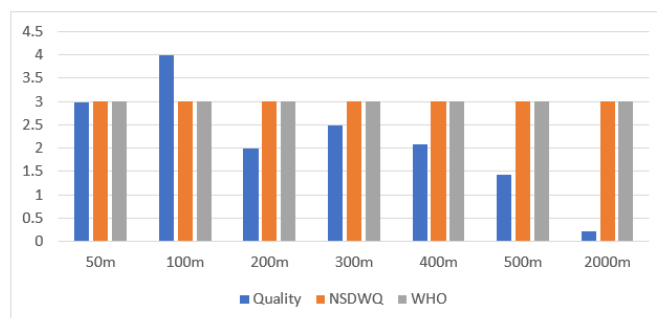


Figure 6. Zinc contamination in water samples

Copper

Copper is both an essential nutrient and a drinking-water contaminant. It is used to make pipes, valves and fittings and is present in alloys and coatings. According to the World Health Organization's Guidelines for drinking water, (WHO, 2022), the acceptable limits of copper concentration in drinking water is 2 mg/l; while the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), sets the limit at 1 mg/l.

Figure 7 below presents the level of contamination of copper in the water samples taken at radial distance around the dumpsite. Results show that all the mean values of the water samples from 50m through to 500m, and the control sample taken at 2000m away from the dumpsite, exceed the permissible limits of the NSDWQ which is set at 1 mg/l. However, only the mean value of copper contamination in the groundwater sources at 50m distance from the dumpsite falls within the WHO recommended limit. All other mean values from 100m through to 500m distances from the dumpsite, including the sample at the control point all exceed the WHO permissible limit, with the highest contamination mean value at 400m from the dumpsite. This then suggest that when measuring water quality around the area based on copper contamination, the quality falls far below the acceptable permissible limits of both NSDWQ and WHO. According to WHO (2022), guidelines for drinking water, the derivation of the permissible limits are to be protective against acute gastrointestinal effects of copper and provide an adequate margin of safety in populations with normal copper homeostasis. Additionally, at levels above 2.5 mg/l, copper may impart an undesirable bitter taste to water; at higher levels, the color of water is also impacted.

This result confirms the interviews report from the respondents who confirmed that some of their drinking water sources had undesirable taste, and caused health concerns such as stomach upset, infections and diarrhea. This then calls for attention, as the water quality within the area falls short of the standard, when measured against the acceptable limit of copper contamination.

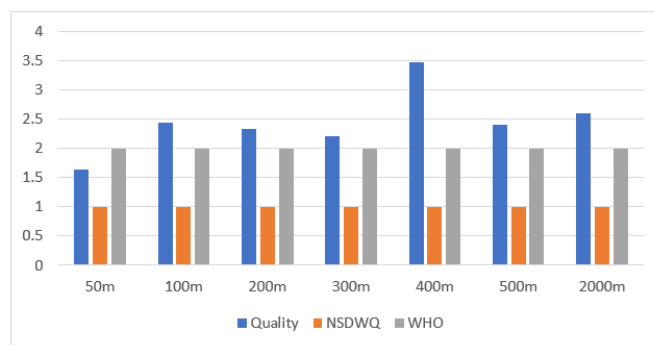


Figure 7. Copper contamination in water samples

Manganese

Manganese is one of the most abundant metals in Earth's crust, usually occurring with iron and it is one of the most important parameters when testing for water quality. According to the World Health Organization's Guidelines for drinking water, (WHO, 2022), the acceptable limits of manganese concentration in drinking water is 0.08 mg/l; while the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), sets the limit at 0.2 mg/l.

As shown in figure 8 below, only the mean values of manganese contamination at 50m from the dumpsite, and the control sample at 2000m away from the dumpsite, fall within the acceptable limit of the NSDWQ for manganese contamination, while the other distances, from 100m through to 500m, all exceed the threshold. Additionally, all the mean values of the water samples across the measured distances, including the sample at the control point, exceed the WHO's recommended limit, with the highest point towering with a mean value of 2.74 mg/l at 300m distance from the dumpsite. This is to say that the level of manganese contamination within the study area is very high and unsafe for consumption, which predisposes the residents to neurological effects in the most sensitive subpopulation; bottle-fed infants and consequently the general population.

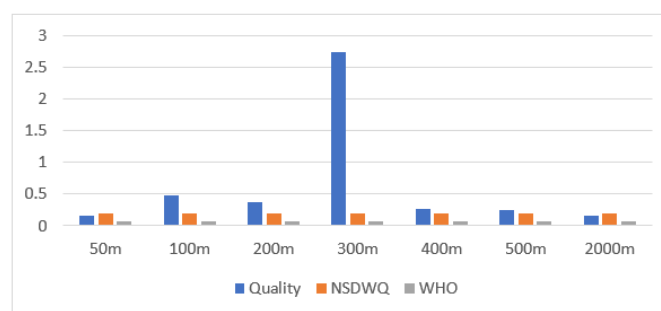


Figure 8. Manganese contamination in water samples

Arsenic

Arsenic is found widely in Earth's crust and one of the chemicals of greatest health concern in some natural waters. The most important routes of exposure to this harmful parameter are through food and drinking-water, including beverages that are made from contaminated drinking-water. According to the World Health Organization's Guidelines for drinking water, (WHO, 2022), and the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), the permissible limit proposed for arsenic is 0.01 mg/l, when testing for drinking water quality.

Figure 9 presents the laboratory results of the water samples taken around the Onibu-eja dumpsite. Results show that the mean values of across distances from 50m to 500m around the dumpsite, and the control sample at 2,000m do not contain any unsafe levels of arsenic contamination. This implies that the present of the abandoned dumpsite within the area does not predispose the surrounding residents to signs of chronic arsenicism, including dermal lesions such as hyperpigmentation and hypopigmentation, peripheral neuropathy, skin cancer, bladder and lung cancers and peripheral vascular disease, etc. which have all been observed in populations ingesting arsenic-contaminated drinking-water (WHO, 2022).

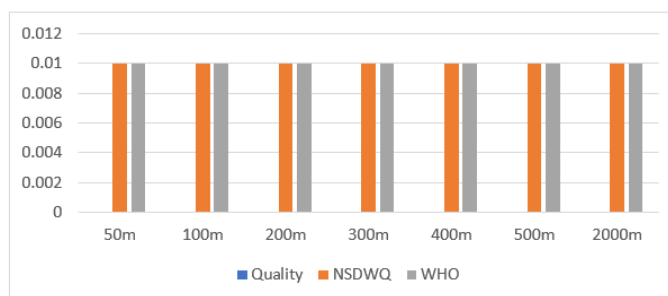


Figure 9. Arsenic contamination in water samples

Iron

Iron is one of the most abundant metals in Earth's crust and they are found in natural fresh waters at ranging levels. According to the World Health Organization's Guidelines for drinking water, (WHO, 2022), the acceptable limits of Iron concentration in drinking water is 0.1 mg/l; while the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), sets the limit at 0.3 mg/l.

Figure 10 below presents the level of contamination of Iron in the water samples taken at radial distance around the dumpsite. Results show that all the mean values of the water samples from 50m through to 500m, and the control sample taken at 2000m away from the dumpsite, exceed the permissible limits of the WHO which is set at 0.1 mg/l. However, at 100m, 200m and 300m, the mean values for Iron contamination exceed NSDWQ's limit, while distances at 50m, 400m, 500m and the control sample at 2,000m were within the limits. This then suggest that when measuring water quality around the area based on Iron contamination, the quality falls below the acceptable standard.

Although there may be no health hazard associated with this level of Iron contamination in drinking water, increasing levels may affect its acceptability (WHO, 2022).

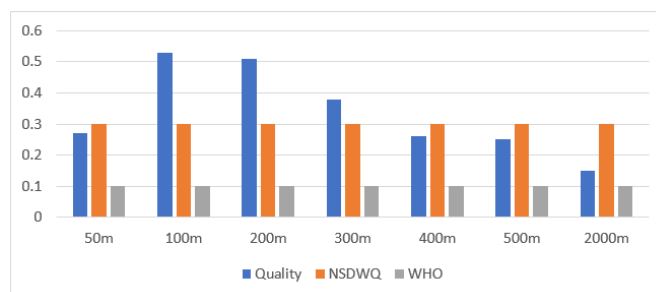


Figure 10. Iron contamination in water samples

Fluoride

Fluorine is a common element that is widely distributed in Earth's crust and exists in the form of fluorides in a number of minerals, such as fluorspar, cryolite and fluorapatite. Traces of fluorides are present in many waters, with a possibility of finding higher concentrations being in contaminated groundwaters. The World Health Organization's Guidelines for drinking water, (WHO, 2022), and the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), have set the permissible limit of fluoride contamination at 1.5 mg/l.

As presented in figure 11 below, at 50m, 100m, 200m, 300m, 500m and 2,000m from the dumpsite, the level of fluoride contamination in the water samples, all fall within the acceptable limits of the NSDWQ (2007), and the WHO (2022) drinking water guidelines; with the least concentration at the control point (2000m away from the dumpsite). However, at 400m distance from the dumpsite, fluoride concentration towers above the limits, with a mean value of 1.67.

Although fluoride may be an essential element for humans; however, essentiality has not been demonstrated unequivocally. Meanwhile, there is evidence of fluoride being a beneficial element with regard to the prevention of dental caries. To produce signs of acute fluoride intoxication, minimum oral doses of about 1 mg of fluoride per kilogram of body weight is required. Many epidemiological studies of possible adverse effects of the long-term ingestion of fluoride via drinking water show that concentrations above this value carry an increasing risk of dental fluorosis and that progressively higher concentrations lead to increasing risks of skeletal fluorosis. Hence, residents around the study area must be careful with their drinking water sources as a result of likely predisposition to possible health concerns.

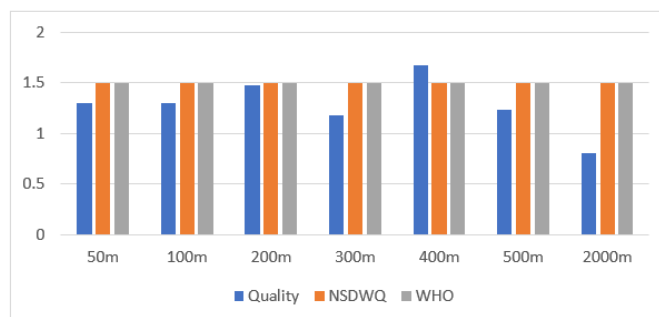


Figure 11. Fluoride contamination in water samples

Escherichia Coliform (E. Coli)

Waterborne transmission of pathogenic *E. coli* has been well documented for contaminated drinking-water. *E. coli* are enteric organisms, and humans are the major reservoir. The World Health Organization's Guidelines for drinking water, (WHO, 2022), and the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), have set the permissible limit of this bacterial contamination at 0 mg/l.

Figure 12 below shows that all the water samples tested within the area, from 50m through to 500m distances from the dumpsite, are heavily contaminated biologically. This may be due to the ongoing decomposition going on within and around the dumpsite. This level of contamination, predisposes surrounding residents to health hazards, as some *E. coli* serotypes cause diarrhea that ranges from mild and non-bloody to highly bloody, vomiting and fever in infants presenting with malnutrition, weight loss and growth retardation (Adekola, 2018). Between 2% and 7% of cases may also develop the potentially fatal haemolytic uraemic syndrome, which is characterized by acute renal failure and haemolytic anaemia. Children under 5 years of age are at most risk of developing haemolytic uraemic syndrome. Symptoms of *E. coli* infection include mild

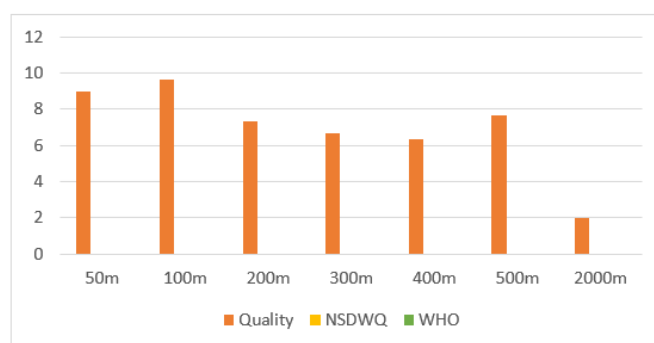


Figure 12. *E. coli* contamination in water samples

Distribution of Fecal Contamination Across Varying Distances from the Dumpsite

Although the water quality test results from the laboratory, reveal that some chemical contamination at varying distances, which makes the drinking water around the area

unsuitable for consumption, the results further reveal a consistency in the high levels of *E. coli* (fecal contamination) present in all the 18 samples that were collected and tested around the study area, which suggests a further downward slope of the drinking water quality within the area. The results show that bacterial contamination (*E. coli*) is the most common and consistent form of contamination within the area, capable of causing water borne diseases such as typhoid, cholera, skin irritations etc., (WHO, 2022). This result also confirms the interview responses who stated the most common forms of disease outbreaks within the study area.

The World Health Organization states that water is safe to drink if there are no *E. Coli* microbes present in every 100 ml. Table 2 below presents the mean values of the *E. coli* results were therefore taken at various distances and then plotted against the NSDWQ and WHO water quality acceptable limits as shown in figure 13 to show the distribution across the varying distances from the dumpsite. At 100m distance away from the dumpsite, mean value of *E. coli* pollution in the water sample was highest, and lowest at 400m. There were declines in the levels of contamination between 100m to 400m, and then a sharp increase at 500m. Results at 50m and 500m from the dumpsite, still confirms that NESREA's recommendation on dumpsite proximities should be strictly adhered to in order to secure public health.

The distribution of *E. coli* concentration at varying distances from the dumpsite does not independently justify that the levels of fecal contamination in the groundwater sources decrease with distance from the dumpsite, because of the various forms of water treatment used in each household. This confirms the report from the interview where respondents who lived in closer proximity (50m and 100m) to the dumpsite paid more attention to treating their water sources, than respondents who lived farther away (400m and 500m) from the dumpsite some people treat their water regularly. In essence, the attitude of the residents living closer to the dumpsite may have contributed to a lower presence of *E. coli* in their water despite their close proximity to the dumpsite, while some of the water sources, though farther from the dumpsite, have higher *E. coli* contents because no efforts have been made to treat their water sources.

Distance from Dumpsite	Mean Values of <i>E. coli</i>
50m	9
100m	9.6
200m	7.3
300m	6.6
400m	6.3
500m	7.6

Table 2: Mean values of fecal contamination

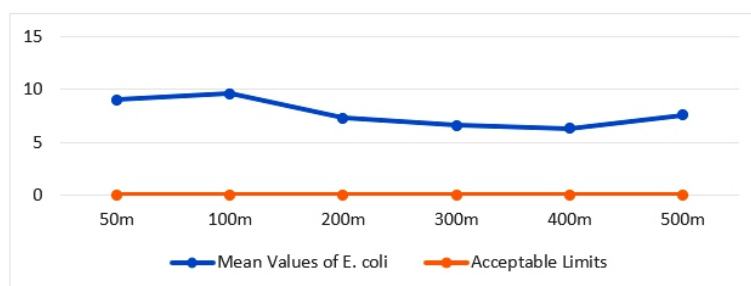


Figure 13. Distribution of fecal contamination across varying distances from the dumpsite

Recommendation and Conclusion

Waste management practices in developing countries such as Osogbo metropolis, continues to pose a challenge till this present day. The current situation of waste mismanagement at the Onibu-eja dumpsite, and its impacts on the environmental and health safety of people within its closest communities is not a menace that is peculiar to the study area alone. It is a reflection of what is happening in other parts of the country too, particularly in areas with larger populations. Regardless of the current status of a dumpsite, whether active or abandoned, wastes that have been deposited in unsanitary landfills, still have the potential of decomposing and forming leachates that sink into the ground, and impair water quality.

Water is central to human survival on earth; hence, water quality cannot be compromised if good health and wellbeing of humans and the environment is to be ensured. As revealed in this study, waste mismanagement poses great threat to water quality, and sustainable management of scarce water resource. Currently, Nigeria's estimated average waste generation rate per capital/per day is between 0.65kg - 0.95kg (Noiki *et al.*, 2021) and according to the Osun Waste Management Agency (2023), about 700 tons of solid waste is disposed on the dumpsite daily. This current waste generation rate is estimated to increase in the coming years generation due to increase in population growth and resource consumption, and if this projection proves true, it is then of immediate necessity that sustainable waste management practices in the country be encouraged.

The current reality of climate change gripping the world today, is impacting natural resources including water – surface and underground. This situation leaves so much in the hands of every stakeholder – the government, and the people in finding ways to adapt and mitigate the impacts of climate change on scarce freshwater resources. The risk and vulnerability of developing countries like Nigeria makes it more imperative for sustainable waste management practices to be carried out in the communities, so as to secure. Climate change has contributed to the rise in temperatures in the most recent years. Increased temperatures may contribute to an increase in the activities of some pathogens and microorganisms in water, thereby increasing the rate of disease outbreaks

within affected communities. Microbial contamination may have such negative effects on health that it is imperative that control over it is maintained at all times and never compromised.

Additionally, climate change also contributes to increase in rainfall. An increase in rainfall leads to an increase in percolation of contaminants/pollutants into groundwater resources, turbidity, chemical loading etc. (WHO, 2022). Therefore, if water quality within cities is to be assured, then concerted efforts must be put towards ensuring that wastes are efficiently and sustainably managed.

Recommendation

With regards to the findings and inferences made from this research, the following recommendations are proposed:

- i. In the first instance, people should not be allowed to reside closely to unsafe places such as dumpsites, mining sites etc. NESREA's recommendations for dumpsite proximities should be strictly adhered to. The National Environmental Standards and Regulations Enforcement Agency (NESREA) have set the proximity standard in Nigeria, stating that dumpsites/landfills should be located within 1000m of settlement areas for hygienic reasons, 2000m from existing major roads, and at least 1000m from ground and surface water bodies to avoid contamination from leachates. It is required by NESREA, that 1000m, 500m, and 250m should fall within the buffer zones for built-up areas, major roads and water courses when siting a dumpsite (Geidam and Isa, 2019).
- ii. The need for routine water resource surveillance and quality control both by public and private sectors.
- iii. The government should take responsibility for providing safe drinking water resource allocation within the state to residents in areas like Onibu-eja where water quality generally falls below the expected drinking water quality standard.
- iv. There is a need to care for the dumpsites and generally improve the structural qualities. Time is right to proceed to the use to begin to enforce sustainable waste management practices sanitary landfills, that reduce unsustainable practices such as burning, indiscriminate dumping etc.
- v. The need for guidance and support for households and individual consumers within the area on best water resource management practices, as well as preventive management of their water sources, so as to reduce the level of contamination through programs for community education and training.

Further Research

Having completed this study, there is need for a follow up study to assess the progression of impacts of the abandoned dumpsite on water quality within the study area, as the dumpsite continues to decompose.

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ANALYZING THE CORE DIAMETER AND INSULATION THICKNESS OF ELECTRICAL WIRES WITHIN DESIGNATED ZONES IN NIGERIA

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Abstract

The focus of this study was to examine the measurements of metal conductors and insulation thickness in copper cables sourced from both Nigerian and international brands. The primary aim was to gain insight into the causes of fire outbreaks resulting from overheating of electrical wires in residential and workplace environments. Cables of different cross-sectional areas (1.5mm², 2.5mm², 4mm², and 6mm²) were gathered from major markets and evaluated against established standards. The findings showed that certain commonly used sizes (1.5mm² and 2.5mm²) failed to meet the core diameter requirements specified by the Nigerian Industrial Standard, whereas 4mm² and 6mm² cables generally complied with these standards. Notably, all sampled cables exceeded the expected insulation thickness. To address deficiencies in core diameter, manufacturers compensated by adding extra insulation to meet the total cable diameter standards. As a result, reduced core diameters contribute to cable overheating and the frequent occurrence of fire outbreaks in Nigeria. Recommendations include intensified efforts by regulatory agencies and cable producers to combat piracy and mitigate these fire hazards.

Keywords: Copper cables, Overheating of electric wire, Core diameter, Fire outbreaks, House wiring.

INTRODUCTION

Electrical cables are essential elements in power transmission systems, enabling the smooth transfer of electricity from one location to another with efficiency. Understanding the electrical characteristics of different cable brands is necessary for ensuring optimal performance and reliability in various electrical applications. In Nigeria, locally manufactured electrical cables are highly esteemed by consumers, with manufacturers consistently positioning themselves as reputable entities within the industry. The issue of overheating, especially attributed to counterfeit cables imported from China with potentially lower copper content in their core, has been raised (Iroegbu

et al, 2014). Findings emphasize that a significant portion of substandard electrical materials in Nigeria originates from Asia, notably China and India, as highlighted by (Schneider Electric, 2015) research. It's noteworthy that while many of these materials are imported, there's also evidence suggesting local production of substandard electrical items within Nigeria. Additionally, there is a pressing need for regulatory bodies to strengthen their efforts against the use of substandard building materials in Nigeria, aiming to effectively mitigate potential risks. The extensive use of substandard construction materials has resulted in devastating consequences in the country, involving loss of thousands of lives and the destruction of properties, worth billions of Naira resulting from incidents like building collapses, electrocutions, and electrical fires. According to (Ugochukwu et al, 2014), the authors reported that substandard materials in building construction poses significant risks not only to the safety of individuals residing in these structures but also to the integrity of the properties themselves and the economic well-being of the affected people.

The key parameter used to assess the performance of cables is electrical resistance, which is a measure of the opposition to the flow of electric current within the cable (Dorf & Svoboda, 2010). In determining the overall performance of an electrical cable, the core diameter and insulation thickness are essential. Core diameter represents the size of the conductive material within the cable, affecting its ability to carry current without significant voltage drops or power losses. Additionally, insulation thickness acts as a protective barrier, preventing electrical leakage and ensuring the safety of electrical installations.

Amidst the plethora of cable brands available in the market, stakeholders face the challenge of selecting the most suitable cable brand that meets their specific project requirements while ensuring compliance with industry standards. These cables have been grouped into varying load-carrying capacity based on specific wiring applications. Consequently, the utilization of either oversized or undersized cables can result in economic inefficiency. Undersized cables hinder the smooth flow of current, leading to obstruction of electron passage and subsequent heat generation. Insulation serves to prevent current leakage, electrocution and also helps protect the conductor from environmental factors such as chemicals, moisture, and extremes temperature.

Despite the indispensable role of electrical cables in delivering electricity to homes, businesses, and institutions, concerns persist regarding the quality and adherence to standards of household electrical cable brands in Nigeria. Substandard cables present significant safety hazards, such as electrical fires and equipment damage. However, there remains a dearth of empirical data of the core diameter and insulation thickness of various cable brands available in the Nigerian market. This knowledge gap impedes efforts to ensure electrical safety and reliability, thereby jeopardizing both public safety and the integrity of Nigeria's electrical infrastructure. Consequently, there is an urgent imperative to conduct a systematic empirical analysis to evaluate the variability in core diameter and insulation thickness among household electrical cable brands in Nigeria

and to provide evidence-based recommendations for enhancing safety standards and regulatory practices. The aim of this study is to provide a comprehensive comparison of electrical resistance values among various cable brands for different cable sizes, while taking into consideration both the core diameter and insulation thickness. By analyzing and evaluating the resistance data alongside core diameter and insulation thickness, stakeholders can make informed decisions regarding cable selection based on specific project requirements and industry standards.

METHODOLOGY

The study focused on examining electrical cables sourced from prominent modern markets across major cities in Nigeria, including Onitsha, Abuja, Kano, Lagos, and Port Harcourt. These cables, originating from various brands and widely utilized, underwent thorough scrutiny to assess their core diameters and insulation thickness. The investigation encompassed a selection of commonly used cable sizes in household electrical wiring, such as 1.5mm², 2.5mm², 4mm², and 6mm², chosen due to their prevalence in residential electrical installations and relevance to typical household power requirements. These cables were sold by various traders, claiming to be products of both local and foreign manufacturers.

The primary objective was to evaluate the cables' adherence to established standards, following the protocols outlined by the Standard Organization of Nigeria. Each cable brand received a unique code corresponding to the store from which it was purchased. Core diameter and insulation thickness measurements were conducted using a digital vernier caliper. First, we gently removed the cable jacket to protect the insulation and measured the diameter of the insulated conductor (*DT*). Then, we measured the diameter of the conductor (*Dc*) after removing the insulation. The insulation thickness (*Di*) was calculated as the difference between these two measurements, as shown in equation 1.

$$DI = DT - Dc \quad (1)$$



Figure 1: Determining the Diameter of a Wire

RESEARCH METHOD

The research method employed in this study follows a quantitative approach, as advocated by (Creswell, 2003) This approach involves the analysis of numerical data, facilitating the use of statistical methods for a more precise and accurate depiction of

results. By focusing on quantitative research methods, the study aims to provide a robust analysis grounded in statistical evidence.

EXPERIMENTATION RESULTS

This study presents measurements core diameters and insulation thicknesses for 10 brands of electrical cables manufactured in Nigeria, as outlined in tables 1 and 2 and Figures 2 through 5. The data clearly indicates that the core diameters of certain cables with sizes 1.5mm², 2.5mm², 4mm², and 6mm² fall short of the established standards. However, all cables across these sizes conform to the insulation thickness standard specified in table 2.

According to the graph in Figure 2 below, just 10% (Sample E) of the cable brands for the 1.5mm² size displayed core diameters of 1.38mm, aligning with the expected benchmark set by SON for the minimum core diameter. In contrast, the remaining 90% of the brands (Sample(s): A, B, C, D, F, G, H, I, and J) failed to meet this minimum standard.

Figure 3 illustrates that 70% of the cable brands did not meet the minimum stipulation of 1.78mm for the 2.5mm² sizes. Conversely, Sample A, D, and E were the brands that surpassed the minimum requirement.

In Figure 4, it can be noted that 30% of the cable brands did not satisfy the minimum criterion of 2.25mm for the 4mm² sizes. Conversely, 70% of the brands conformed to this standard requirement.

In Figure 5, findings indicated that 40% of the cable brands complied with the prescribed minimum core diameter of 3.03mm for the 6mm² cable sizes. Conversely, the remaining brands did not adhere to this minimum standard.

Table 2 illustrates that all the cables analyzed possessed sufficient insulation, surpassing the expected thickness. Consequently, some manufacturers utilize additional insulation material to offset deficiencies in conductor diameter, ensuring compliance with insulated wire requirements. This strategy complicates the identification of such practices through visual inspection alone. Incorporating extra insulation may enlarge cable dimensions, posing challenges in space-restricted installations and potentially escalating material costs. Although extra insulation aids in limiting heat transfer, it might hinder heat dissipation from the conductors, leading to concentrated heating within the cable and possibly resulting in insulation deterioration over time. Excessive insulation thickness, particularly in environments with high temperatures, could lead to insulation degradation or damage, jeopardizing electrical safety and dependability.

The prevalence of this practice is particularly evident in 1.5mm² and 2.5mm² cables due to their high demand for household wiring. Specifically, 1.5mm² cables are typically used for low-voltage lighting and bulbs while 2.5mm² cables are commonly employed for lighting installations like low-voltage air conditioners and kitchen appliances. Moreover,

4mm² cables are chosen to supply power to 220-volt air conditioners, small water heaters, ovens etc. The extensive use of these cable sizes in Nigerian homes and workplaces significantly increases the risk of cable overheating during operation, which can lead to fire outbreaks. This risk is further compounded by the prevalent sourcing of most electrical cables directly from industrial markets.

As a result, any deficiency in these less commonly demanded cables becomes noticeable as they tend to remain in distributors' and retailers' warehouses for longer periods before being sold, unlike the more frequently used cable gauges. This observation corroborates with the findings of (Onafowokan, 2018), which highlighted the prevalence of substandard cables in electrical distribution lines. According to (Eze, 2017), the author reported that the Standards Organization of Nigeria recently seized warehouses holding electrical cables purportedly imported but repackaged as locally manufactured. This action clears our local cable producers of any involvement in such misconduct. However, it highlights the ongoing necessity for regulatory agencies to rigorously monitor their activities. Furthermore, indigenous manufacturers should proactively engage in self-examination to identify and eliminate any unscrupulous practices within their operations.

PRESENTATION OF DATA

Table 1: Core diameter of Solid Core Cables and Analysis of Core diameter of single core electrical cables

CABLE BRAND	CABLE BRAND										Minimum core diameter (SON)
	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Sample G	Sample H	Sample I	Sample J	
1.5(mm ²)	1.3	1.34	1.3	1.36	1.38	1.3	1.35	1.33	1.34	1.33	1.38
2.5(mm ²)	1.89	1.7	1.69	1.8	1.8	1.71	1.7	1.7	1.68	1.42	1.78
4(mm ²)	2.21	2.44	2.28	2.25	2.25	2.31	2.18	2.46	2.56	2.19	2.25
6(mm ²)	2.93	2.94	2.68	3.23	3.23	3	3.36	2.74	3.18	3.01	3.03

Table 2: Insulation Thickness of Solid Core Cables and Analysis of Core diameter of single core

Cable Sizes (mm ²)	CABLE BRAND										Minimum core diameter (SON)
	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F	Sample G	Sample H	Sample I	Sample J	
1.5	1.81	1.5	1.7	1.29	1.74	1.73	1.55	1.61	1.62	1.48	0.7
2.5	1.88	1.8	1.49	1.5	1.5	1.83	1.5	1.5	1.63	2.54	0.8
4	1.63	1.93	1.44	1.5	1.73	1.49	1.69	1.86	1.66	1.57	0.8
6	1.39	2.2	1.38	2.25	1.84	1.84	1.77	1.52	2.05	1.32	0.8

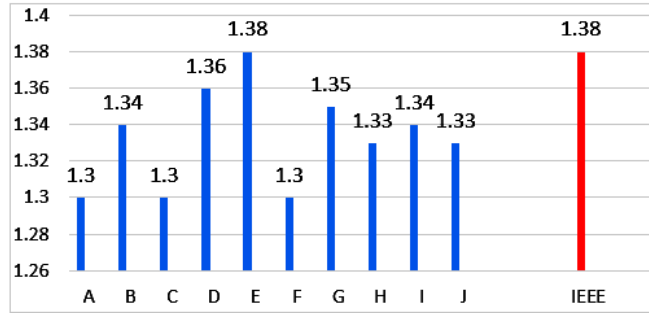
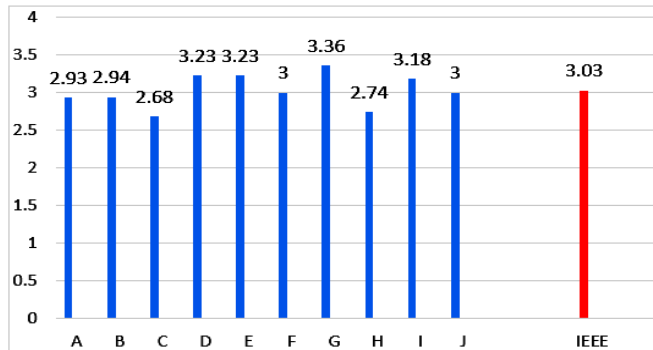
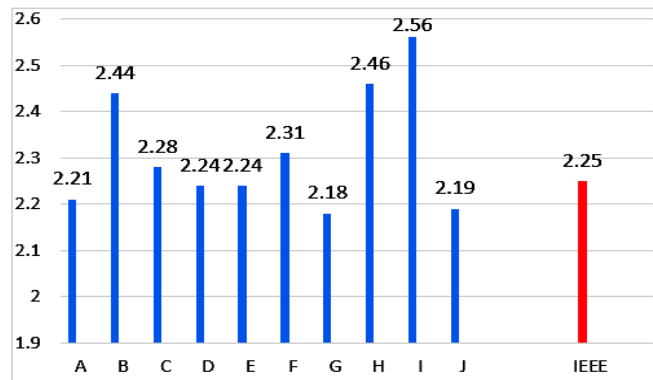
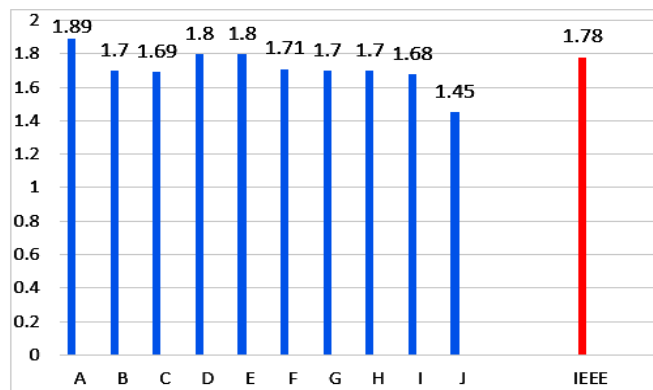


Figure 2: Core Diameter of 1.5mm²



CONCLUSION

This study has revealed deficiencies in core diameter among commonly used household cables sourced from major industrial markets in Nigeria, indicating non-compliance with Nigerian Industrial Standards (NIS). These findings highlight the substandard quality of core diameter, which significantly contributes to overheating issues in electrical wires, leading to frequent electrical fires in residential and commercial buildings. To address this issue, regulatory bodies such as the Standard Organization of Nigeria (SON) and cable manufacturers must enhance efforts to combat piracy in the industry. This would curb the proliferation of substandard products and mitigate the incidence of fire outbreaks and electrocution in Nigeria. Non-compliance with core diameter requirements outlined in NIS for electrical systems poses severe risks to electrical safety, increases fire hazards, invokes legal consequences, impacts insurance terms, and introduces health and environmental hazards. Therefore, strict adherence to these standards is imperative to ensure the reliability and safety of electrical installations and mitigate the risk of fire incidents. However, Regulatory agencies should enforcement measures and penalties for substandard cable production

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COMMUNICATION IN SCIENCE AND SCIENCE COMMUNICATION IN NIGERIAN INSTITUTIONS OF LEARNING-THE TREND THIS FAR

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Abstract

Throughout the globe, there is a general trend hitherto that every nation is becoming fervent in and adopting the tenets of science and its relational output to navigate their cultural, political, economic, security and creativity prowess. Effective public communication of science topics is needed for various reasons. This paper examined the means to: improving scientific literacy, overcoming public mistrust, discovering inaccurate styles of communication in science, identifying categories of communications in science, as well as presenting comparative studies within international cycle that show best science communication practices. Media materials and interaction with teachers and students provided the approach adopted to sieve opinions on an adapted teaching practice assessment template used as instrument whose reliability index gave .79 through scorer reliability test for data collection. Data obtained were analysed using mean and t-test statistics of which the results revealed similarities in the style adopted by science communicators in communicating science in schools and a correlation existed between science communication and communication in science in schools. Personal 'top tips' for ensuring success in science communication by science educators in Nigeria especially at the secondary school level were well proposed.

Key words: Communication, Literacy, Signal, Science, Sound waves.

Introduction

In nature, communication is triggered by a signal which arises in the form of sound, posture, movement, colour, scent, or facial expression all of which are sent and received through all of the human senses of sight, hearing, smell, touch, and taste. World Encyclopaedia 2004 edition has it that signals are used by animals to influence the behaviour of other animals and since they face a variety of social situations in which communication is needed, animals usually have several different signals each suited to a different situation. Animal signals have been shaped by natural selection so that they reach the intended receiver efficiently and stimulate a response. To ensure efficient

transmission, a signal must be able to travel through the environment from sender to receiver as well as being recognizable to the receiver, or it will not have any effect on behaviour. Vocal communication may be most developed among animal primates, but in humans, language develops at a very early age which is why infants begin to learn language by trial-and-error during the “babbling baby” phase of six-month childhood age. Infants afterwards pick out the sounds used by the people around them and repeat only those sounds while the other sound begins to drop away and are forgotten. Though children quickly and effortlessly learn a vocabulary of thousands of words, it is known that such ability to learn language rapidly seems to be genetically influenced. Studies have revealed that language is not the only form of human communication as evidences have suggested that odours and nonverbal signals (body language) may also be important (Johnson & Raven, 2004).

Signals in the form of sound is the sensation detected by the ear caused by the vibration of the air surrounding it. It is anything that can be heard and registered in the form of music, speech or indicator recorded on a tape, as part of a film or broadcast on radio or television. Serway and Beicher (2000) maintained that sound waves though slower than light is an important form of longitudinal waves that can travel through any material medium with a speed that depends on the properties of the medium. As the waves travel, the particles in the medium vibrate to produce changes in density and pressure along the direction of motion of the wave. The changes which result in a series of high and low-pressure regions do produce sinusoidal pressure vibrations if the sources of the sound waves vibrate sinusoidally. Serway et al (2000) have categorised sound waves into three based on frequency ranges as: audible waves which lie within the range of sensitivity of the human ear can be generated in a variety of ways, such as by musical instrument, human vocal cords, and loudspeakers; infrasonic waves which have frequencies below the audible range and particularly used by Elephants to communicate with each other, even when separated by many kilometres; and ultrasonic waves that have frequencies above the audible range which play significant role in medical imaging and as “silent” whistle to retrieve dogs although humans cannot detect it at all.

It is in the ears that the energy in sound waves becomes converted to electrical signals which are transmitted to and interpreted by the brain. Johnson and Raven (2004) have established that sound waves enter the ear through the ear canal and strike the tympanic membrane (eardrum) causing it to vibrate. Behind the eardrum, three small bones of the middle ear (the hammer, anvil, and stirrup) transfer the vibrations to a fluid-filled chamber –the cochlea, a coiled structure that contains mechanoreceptors called hair cells, within the inner ear. The hair cells rest on a membrane that vibrates when waves enter the cochlea. Serway et al (2000) have found that waves of different frequencies cause different parts of the membrane to vibrate and thus stimulate different hair cells. When hair cells are stimulated, they generate nerve impulses in the auditory nerve which travel to the brain stem through the auditory nerve. The thalamus then relays the information communicated to the temporal lobe of the cerebral cortex, where the auditory information is processed (Johnson, et al 2004).

Communication in science refers to the process through which scientific information is conveyed, shared, and interpreted as coded in sound waves. It includes the verbal or written, transfer of scientific concepts, ideas, findings, and theories among scientists and non-scientists alike. Science communication is the use of appropriate skills, media, activities and dialogue to produce awareness, enjoyment, interest, opinion-forming and understanding to science. It describes a variety of practices that transmit scientific principles, methods, knowledge and research to non-audiences in an accessible, understandable or useful way (Asworth, Bowater & Yeoman, 2013). Diviu-Miñarro and Cortiñas-Rovira (2020) have purported that dissemination of information about science has undergone a major upsurge in recent years. Whereas Côté and Darling (2018) maintained that communication of research has always been a fundamental part of academic work, the demand to convey results to the society has grown at an increasing pace, with calls for the scientific community to commit to and engage with society, and to facilitate the relationship between the scientific world and the world of laypeople (Anzivino, 2021).

To communicate in science, it is important to understand the different theories of mass communication which make one as an observer to be more conscious of how the media may affect one's disposition. Relevant theories worthy of consideration include: cultivation theory which according to Gerbner, Gross and Morgan(1986) was designed to unravel the enduring impacts of media assumption with a primary focus on television and a believe that social media can influence-and-skew-people's perceptions of reality; the spiral of silence theory that deals with human communication and public opinions and purports that people's willingness to express their opinions on controversial public issues is affected by their largely unconscious perception of those opinions as being either popular or unpopular. This could cause people to either change their willingness to express their opinion as a result of the fear of being socially isolated or sense the opinions on controversial topics of those around them and modify their public behaviour accordingly (Neelle-Neumann, 1974).

Ayesh, Saul and Olivia (2024) clarified the hypodermic needle theory as a linear communication theory which suggests that a media message is injected directly into the brain of a passive, homogenous audience. It assumes that media texts are closed and audiences are influenced in the same way. In this case, media consumers are uniformly controlled by their biologically based instincts and that they react more or less uniformly to whatever stimuli that come along. It is in the view of Authoritarian theory as conceived by Mark to be highly concentrated of and centralised by government's power and maintained by political repression and the exhibition of potential or supposed challengers by armed force (en.m.wikipedia.org>wiki>Author...). Anyone who adopts this model use the position of power to convey a message in a forceful and commanding manner by creating a sense of urgency and importance in the mind of the audience in such a manner to make people take the message more serious.

Yet the Libertarian theory by Robert in the 1970s is another political position that advocates a radical redistribution of power from the coercive state to voluntary associations of free individuals. It does not matter if the voluntary association takes the form of a free market or of communal cooperatives. This theory advocates for a government that has less control over the lives of its citizen but allows people to be responsible for themselves. While in opposition to government bureaucracy and tax, it promotes private charity, tolerate diverse lifestyles, supports the free market and defend liberties ([en.m.wikipedia.org>wiki>liberta...](https://en.m.wikipedia.org/wiki/liberta...)). To crown it up, the Soviet-communist theory embraces democratic and open discussion of policy issues within a party foremost and the requirement of total unity in upholding the agreed policies. Maxrxism-Leninism ([en.m.wikipedia.org>wiki>ideology...](https://en.m.wikipedia.org/wiki/ideology...)) maintained that even if the policies were unpopular, they were agreed to be correct because the party was enlightened. So also the social-responsibility theory according to Whimster (2018) requires that individuals are accountable for fulfilling their civic duties. It demands that the actions of an individual must benefit the whole of the society. It views communication as a process of anticipating stakeholders' expectations, and allows free press without any censorship although the content of the press would have to be discussed in public panel.

Statement of the Problem

Scientists have applied figure of speech globally over the years to convince the world that science is every person's enterprise so much so that all and sundry would need to be adequately informed in order to benefit concomitantly. It can never be a hyperbole to say that the best place to communicate science to learners effectively is in the school premises where a science role model is assigned to implement the objectives of science curriculum. Though other medium at home and in the society could also transmit scientific information, it is only those from the school that could be guided by a curriculum. Since it is possible for deviations to arise due to the present proliferation of information sources, learners may be prone to misleading information. This assumption prompted this study on the tendency of how science is being communicated in institutions of learning in Nigeria to this moment.

Objectives

This paper was to ascertain the trends assumed in science communication and communication in science in the context of Nigerian schools as regards:

- i. Identification of communication categories in science
- ii. Discovery of inaccuracies in communication
- iii. Improvement of scientific literacy
- iv. Overcoming public mistrust and
- v. Best ways to communicate science as we grow

Method

The study is a reviewed work on communication as practiced in science and analysis of same accordingly. Though this study cannot claim to have exhausted the work reviews on communication, an approach to examine the possible theories on communication was

carried out. This was followed by analysing the approaches for science communication and communication in science in schools through a bit of data obtained from media materials and the interactions between teachers and students with a sample of 40 science lessons from schools categorised into A and B based on locations (North and South of Kontagora) were assessed to ascertain the extent to which science communication by way of inclusion of media/information technology materials and communication in science by way of the utilization of curriculum contents and instructional aids featured in the course of teaching and learning science. An adapted teaching practice assessment template was used for data collection. The template which was structured to address a scope on categories of communication, inaccuracies, science literacy, trust for science and mechanisms to ensure success in science communication was tested for its reliability using scorer reliability test that yielded .79 index which assured the confidence in it to produce consistent measurement.

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
FSC	A-school	20	25.7000	.17885	.48720
	B-school	20	25.1500	.34849	.30153
ISC	A-school	20	18.4045	.87391	.19541
	B-school	20	19.8215	.98137	.21944
ISL	A-school	20	24.8500	.02600	.50945
	B-school	20	23.1000	.40236	.79229
OPM	A-school	20	15.3000	.61775	.58535
	B-school	20	16.3000	.47429	.26258
BWSC	A-school	20	22.4090	.85758	.19176
	B-school	20	24.0605	.91605	.20483

Source: Field work 2024

Table 1 shows

closeness in mean scores between the categories of schools on the aspects observed. This implied that similarities existed in the styles adopted for communication of science in all the lessons observed in the schools.

Table 2: Correlation of Science Communication and Communication in Science

	Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Pearson's R	.835	.060	9.339	.000 ^c
Ordinal by Spearman Ordinal Correlation	.793	.080	8.026	.000 ^c
N of Valid Cases	40			

Source: Field work 2024

Table 2 shows that a significant correlation existed between how teachers and students engaged themselves in science communication and communication in science ($r = .835$ or $.793$ at $p = .000$ based on normal approximation). Squaring $r = .835$ or $.793$ produces (r^2) = $.697225$ or $.628849$ and multiplying any of these squared r values by 100 gives 69.72 or 62.88. This invariably indicated that science communication either contributed 69.72% or 62.88% to communication in science in the schools selected for this study while other concealed factors could be responsible for the communication replicas adopted by teachers and students in science in the lessons examined in the sampled schools.

Forms of Science Communication (FSC)

By human nature, it is typical for scientists to exchange and thereby spread new ideas on scientific knowledge which might be communicated through informal and formal networks. Prospective scientists may informally communicate their experiments with other scientists who may spread the information further. Spreading new ideas in science was assumed to be done through informal STAN newsletters, computer networks, electronic journals, fax machines, and even telephone. Scientific information was best spread however through classroom interactions as an informal way to exchange ideas in the lessons in schools under this study. This enabled scientific theories, principles, facts and laws to be taught to a wider audience by exploring newspapers, magazines, media apps and radio and TV programmes.

The uses of publications to communicate science in the form of special magazines known as “scientific journal” were noticed. Such type of journals (like STAN Journal) enables scientists to announce formally the results of their works as they carried technical articles concerning research in a given field of study and were principally circulated to individuals working in that field. Every Journal is being expected to have a set of editors or reviewers do receive articles reporting scientific findings from which they selected for publication only those articles that reflected painstaking research. Reference publications known as indexes, abstracts, and digests also served as channels through which science was communicated.

Latest discoveries in science were found to be communicated through scientists' gatherings. Gatherings of this nature served as an avenue for scientists to meet other experts in their various fields. It has become a kind of tradition that scientists participated in gatherings of JETS clubs at primary and secondary school levels, while national and international conferences, seminars, workshops and conventions were evidence of practices in tertiary institutions. Whereas professional societies, business, and governments have set up research institutes where scientists also share information as they work together, some countries have as well jointly sponsored research institutes to minimise the cost of expensive laboratory equipment. Scientific discoveries spread further as scientists converged from around the world to work and study at these laboratories.

Inaccuracy in Science Communications (ISC)

When some scientific jargons were pronounced by science teachers in the classrooms but not written on the board, learners perceived or understood them partially with some pitfalls. Inaccurate conception of what was communicated further induced misleading communication in science by those to spread it. The use of jargons in relation to Piagetian developmental theory of accommodation and assimilation was another area in which authors and teachers were yet to address. The use of 'synthetic drugs' in science communication at primary school level in-text and in communication of science during teaching was considered to be beyond the developmental stages conceived by a theory for accommodation and assimilation. The complementary and compensating roles of human senses in science communication and communication in science with regards to the use of tangible materials and technology cannot be dissociated from government policy as far as supplies to schools and curriculum implementation is concerned.

As contained in the findings of Walter Lewin in a particular work based on demonstration of conservation of potential energy revealed in Randy (2009) and Miller (2008) that it can be difficult to captivately share good scientific thinking as well as scientifically perfect information. It was found in this study that Science communication in-text for the definition of habitat was stated as 'a place of abode' but found to be misleading to teachers during WAEC marking coordination (communication in science) and corrected as 'a place where organisms live' for simple. It was surprising that even popular Biology texts communicated the castoff definition. Another case hitherto in Mathematics class indicated teachers still communicated the concept of 'change of subject' using 'cross multiply' (a misleading short cut of steps) and the learners expressing a sign that placed 'multiplication' on 'equal to', which made the whole muddle-up of what was communicated since such expression does not exist anywhere or make any sense in science communication. Maintaining the normal steps of 'multiply both side by' or 'divide both side by' or 'square both sides' or 'square root both sides' is thus mandated for model communication. For this, Krulwich and Olson in Randy (2009) and Miller (2008) believed that scientists must rise to that challenge of using metaphor and storytelling.

Improvement of Science Literacy (ISL)

It is found in this paper that science literacy and science communication are two contending issues in science learning in secondary school. It is the study of teaching style that lay emphasis on 'what I see I remember, what I hear I forget and what I do I know' for teachers to justify how they impart knowledge on the learners. Both media items and teacher made instructional items applied in the course of lesson delivery played crucial roles in improving students' science literacy in both categories A and B schools. Science literacy was characterised of three components such as knowledge of science content; understanding science as a way of knowing; and understanding and conducting scientific inquiry (nap.nationalacademics.org>chapter). Bybee (1997) had suggested four levels of scientific literacy to include: interrelated features that involve an individual; scientific knowledge and use of that knowledge to identify questions;

acquisition of new knowledge; and explanation of scientific concepts, while Dani (2009) outlined four aspects of scientific literacy as: knowledge of science, investigative nature of science, science as a way of knowing and interaction of science, technology and society. In order to achieve scientific literacy, scientists were required to read and comprehend articles about scientific topics; explained various types of natural phenomena; determined the accuracy of scientific information by evaluating both the sources and the methodology used to acquire it (Online.sou.edu>education>msed). Equipped with these prerequisites then, it was possible to advance some formidable steps for the improvement of science literacy in schools through: making a framework explicit; modelling and critiquing explanation; providing a rationale for creating explanations; connecting scientific explanations to everyday explanation; and having assess and provide feedback to students (www.discoveryeducation.com>info).

Science communication as a practice of informing, educating, raising awareness of science-related topics, and increasing the sense of wonder about scientific discoveries and arguments connects Science communicators and audiences. Illingworth and Allen (2020) have emphasised that two types of science communication available in practice are outward-facing or science outreach in which science journalism and science museum find relevance (typically conducted by professional scientists to non-expert audiences) and inward-facing or science "in-reach" that embrace scholarly communication and publication in scientific journals (expert to expert communication from similar or different scientific backgrounds). With these, science communicators can use entertainment and persuasion including humour, storytelling and metaphors (Randy, 2009; Miller, 2008) or scientists can be trained in some of the techniques used by actors to improve their communication (Grushkin, 2010). Jensen and Gerber (2020) in a study maintained that continually evaluating science communication and engagement activities allows for designing of some planned activities that could be of possible resource efficient while also avoiding well known pitfalls.

Overcome Public Mistrust (OPM)

Science communication as a sphere of activity, consists of three sub-domains that include: scientific communication (professional communication); technical communication (semi-popular science communication) and popular science communication (public communication of science and technology). In each of these domains, principle of science communication is to be considered if the findings in science are to find dependability among the receivers. This is why such principles as: clarity (clearly written), accuracy (accurate data), simplicity (easily accessible reports of medical studies) and understandability are necessary tools for ensuring trust in science communication. Findings from the schools A and B types indicated that in addition to these, accuracy in texts and by teachers were essential for maintaining credibility, respect for the scientific evidence and informing the learners correctly. Controlling common pitfalls in science when telling stories about science such as: oversimplifying complex concepts, neglecting human element, presenting a misleading narrative for dramatic effect and cherry-picking data to fit a desired storyline, as well as change due to

technical jargon and specialized terminology (www.linkedin.com>advice) also added values that enabled the public assumed confidence in what science has to offer.

Gregory and Miller (1998) have observed that it is possible for science communication to generate support for scientific research or science education and inform decision making, including political and ethical thinking. It was considered that the science contained in the curriculum was to be communicated in a manner that it can serve as an effective mediator between the different groups and individuals that have a stake in public policy, industry, and civil society (Jensen & Gerber, 2020). Durant, Evans and Thomas (1989) agreed that science communication may explicitly exist to connect scientists with the rest of the society, but science communication may reinforce the boundary between the public and the experts. Fiske and Taylor (1991) viewed science communication just as one kind of attempt to reduce epistemic asymmetry between people who may know more and people who may know less about a certain subject.

Best Way of Science Communication

It is expedient these days that science practitioners upgrade their activities to reflect global view. Birke, Ockwell and Whitemarsh (2018) documented the practices in which science communication researchers and practitioners now often than not showcase their desires to attend to non-scientists as well as acknowledging an awareness of the fluid and complex nature of (post/late) modern social identities. As the editor of the scholarly journal *Public Understanding of Science* put it and presented by Howell (2011) in a special issue on publics:

"We have clearly moved from the old days of the deficit frame and thinking of publics as monolithic to viewing publics as active, knowledgeable, playing multiple roles, receiving as well as shaping science".

Evidence-based science communication is another discovery that combines the best available evidence from systematic research, underpinned by established theory, in which practitioners' acquired skills and expertise help reduce the double-disconnect between scholarship and practice (Canfield & Menezes, 2020). Jensen et al (2020) had argued that neither adequately taken into account the other side's priorities, needs and possible solutions, bridging the gap and fostering closer collaboration could allow for mutual learning, enhancing the overall advancements of science communication as a young field. The use of opinion leaders as intermediaries between scientists and the public has been described by Nisbet and Scheufele (2009) as a way to reach the public via trained individuals who are more closely engaged with their communities, such as "teachers, business leaders, attorneys, policymakers, neighbourhood leaders, students, and media professionals" (Aikenhead, 2001). The use of traditional journalism which embraces newspapers, magazines, television and radio provides opportunity of reaching large audiences. Society where traditional journalistic (a one-way) method of communication is adopted are aware that there can be no dialogue with the public, and science stories can often be reduced in scope so that there is a limited focus for a mainstream audience, who may not be able to comprehend the bigger picture from a

scientific perspective ("Science Gone Social", 2014). Schwartz (2014) however noted that this is not to rule out the new research now available on the role of newspapers and television channels in constituting "scientific public spheres" which enable participation of a wide range of actors in public deliberations.

Also in vogue is the live or face-to-face events, such as public lectures in museums or universities, (Tachibana, 2017); debates, science busking, (Collins, Shiffman & Rock, 2016); "sci-art" exhibits, (Milani, 2017) or Science Cafes and science festivals. Citizen science or crowd-sourced science – a scientific research conducted, in whole or in part, by amateur or nonprofessional scientists could be done with a face-to-face approach, online, or as a combination of the two to engage in science communication ("Science Gone Social", 2014). These days online interaction like websites, blogs, wikis and podcasts can be used for science communication, as can other social media since they have the potential to reach huge audiences, and can allow direct interaction between scientists and the public (Hara, Abbazio & Perkins, 2019) and the content is always accessible and can be somewhat controlled by the scientist. Online communication has now given rise to movements like open science, which advocates for making science more accessible. Torner, (2014) agreed accordingly that online communication of science can help boost scientists' reputation through increased citations, better circulation of articles, and establishment of new collaborations.

Art has been an increasingly used tool to attract the public to science as opined by Lesen et al (2016) and Short (2013). "Public Attitudes to Science 2011" Ipsos-MORI in deduced that either formally or in an informal context, an integration between artists and scientists could potentially raise awareness of the general public about current topics in the Science, Technology, Engineering and Mathematics (STEM). Bodmer (2010), discovered that arts have the power of creating emotional links between the public and a research topic and create a collaborative atmosphere that can "activate science" in a different way. Thus, learning through the affection domain, in contrast to the cognitive domain can increase motivation. Social media science communication is another means by which scientists navigate resources with ease. The use of Twitter by scientists and science communicators serve a great deal in discussing scientific topics with many types of audiences with various points of view (Viallon, 2019).

The use of mental shortcuts called heuristics that allow people who make an enormous number of decisions every day is gaining attention, since to approach all of them in a careful, methodical manner is impractical. To "Heuristics" such as representativeness, availability and anchoring and judgment are quick ways of types of heuristics to arrive at acceptable inferences. Inclusive science communication and cultural differences is twin bond that impart reasonably on how science is communicated. It seeks to build further methods for reaching marginalized groups that are often left out by typical top-down science communication. Brown (2015) could establish complementary methods for including diverse voices like the use of poetry, and others like participatory arts by Bultitude, (2011) film by Ipsos-MORI (2011) and games by McCartney (2016) all of which

could be used to engage various publics to monitor, deliberate, and respond to their attitudes toward science and scientific discourse.

Conclusion

Science students who lack motivating learning environment are prone to poor science communication as well as perform badly and consequently drop out of school. Findings reported in studies have shown that science students' success in their studies is directly related to their teachers' ability to communicate effectively.

The dissemination of information about science has undergone a major expansion in recent years through the Internet, which has served to overcome many of the technical and economic barriers. Many initiatives have assisted in this regards like the TED Talks website. One of the barriers to proper communication is the usage of a language that can be associated with self-promotion and aggrandizement which is destructive when incorporated into scientific writing. Similarly, any practice that oversells the novelty of research or fails to provide sufficient scholarship on the uniqueness of results can be ill-disposed to excellent science communication. It is important therefore for stake holders in science cycle to relate openly with one another to ensure updating of their knowledge day-in day-out.

Recommendations

1. Encouragement of teamwork to provide possible means where groups of learners' interactions would abolish competition among members but concentrate more on talking and working together to get the best results.
2. Provision of positive feedback by science educators to promote effective science communication in the classroom by students especially when they are assured that accomplishment on a given task can be more successful when they receive reinforcement anytime they elicit correct response.
3. Adoption of active listening exercises by science teachers who lend their ears to provide a useful means for promoting a supportive and caring environment would make learners to speak out their minds.
4. The inclusion of opinion leaders as intermediaries between scientists and the public when enforced would allow for wider spread of scientific information.
5. It is now time for science teachers to cultivate the habit of communicating science using metaphor and storytelling and develop an attempt to reduce epistemic irregularity between them who know more and the learners who know less.
6. Regular evaluation of science communication and engagement activities to pave way for resource efficiency and to help in overcoming communication pitfalls is required.

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DEVELOPMENT OF A PORTABLE MACHINE FOR DRYING VEGETABLE LEAVES FOR PRESERVATION

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Abstract

Vegetables are edible products of a plant and its leaves (edible and inedible) serve as vegetable nutrients when eaten raw or cooked (as the case may be). The importance of vegetables and their leaves cannot be over-emphasized, as they are rich in vitamins and minerals but low in calories thus, resistance to heart attack and high blood pressure. But because they (vegetable leaves) are prone to rot, they need to be well preserved in order to minimize pathogenic bacteria and kept at their best quality to avoid excess wastage when they are out of season. Here comes in the idea/ thought of developing a portable machine to preserve them through the process of drying. The machine was designed to be portable, containing two equal rectangular shaped cabinets, each having three equal squared tray plates. This study develops a portable machine for drying vegetable leaves for preservation; to work electrically, using a circuit box containing a switch, a contactor and a temperature controller. The source of heat was through a heating filament of capacity 1,800W. The developed machine also contained a 12V, 25W D.C motor and a propeller shaft which works to extract moisture from the drying materials being: fluted pumpkin leaf (*Telfaria accidentalis*), water leaf (*Talinum triangulare*) and bitter leaf (*Vernonia amygdalina*). The result of this study shows the mass of water removed during drying for the aforementioned three varieties of vegetable leaves as 3,500g, 4,387.5g and 3,850g respectively; amount of moisture extracted as: 72.9%, 75% and 73.3% in that order; total heat energy required to extract moisture as: 2,858.4kJ and the efficiency of the developed machine was evaluated to be 70.6%. This implies that the developed machine is capable of drying the three varieties of vegetable leaves used for this study thereby avoiding wastage, high price when out of season among other benefits.

Keywords: Portability, Drying, Vegetables Leaves and Preservation

Introduction

A portable machine is a machine designed to be easily and safely moved or carried from place to place with less or no external means of transportation. This is in line with the simple definition of portable devices by Margaret Rouse (2013) as devices that can easily

be carried which she also named handheld or mobile devices. A typical application and advantage of portability in engineering is the use of portable hand-drill in creating holes in wooden doors instead of transporting the drilling machine from the site to the final place of installation or taking a number of wooden doors to the site and then transporting them back to their final place of installation after appropriate machining operations have been carried on them. Another application of portable machines is in the repair work on large parts and considerably complex systems such as: aircrafts, ships, power stations, metal fabrication and heavy machinery (Krishna Dave *et al.* 2014). No doubt, the essence of portability in engineering design cannot be overemphasized, as it includes but not limited to the following: simplicity of mechanical works such as: cutting, drilling, sawing e.t.c, easy mobility from place to place, just to mention a few.

Every portable machine is designed for a/ some specific objective(s). The aim of this study is thus, centered on developing one for drying vegetable leaves. The development of this machine for drying vegetable leaves will be clearly distinguished from oven drying, as there will be no room for 'Case hardening' which would have occurred in oven drying if not tested for maintenance of relatively low temperature though being a precautionary measure thus, in this development, there will be proper drying in the interiors. The problem behind this study is such that in the production of engineering items, a significant challenge (considering: time, cost, flexibility, energy constrain among other logistical factors) is the difficulty in transporting such items from the site of their production to their final place of installation where various machining operations are required, hence, the need for portability. Meanwhile, a major problem in the food processing industry is the damage, decay or spoilage of raw food items when not used over a period of time bearing in mind that pumpkin leaves among other vegetable leaves are seasonal and highly perishable. Hence, the aim of this study is to develop a portable machine for drying vegetable leaves for preservation. This will be achieved through designing, fabricating and carrying out a performance evaluation, as stated objectives.

The study is thus, to provide a means of preserving vegetable leaves so as to avoid decay, damage or spoilage and general wastage thereby saving cost in this hard economic situation of Nigeria among other countries world-wide. This study is limited to the preservation of only vegetable leaves, using fluted pumpkin leaf, water leaf and bitter leaf as the selected vegetable variety.

LITERATURE REVIEW

From the result of an experiment carried out by Raji *et al.* (2016), after all step by step process of drying; starting from first principle down to slicing the fluted pumpkin leaves with a sharp knife, the maximum desired moisture content was 84.00%. In a similar experiment conducted by Ayo J.A *et al.* (2011), the moisture content of water leaf (*Talinum triangulare*) was found to be 49.34%. Again, in a research carried out by Fred Oboh *et al.* (2009) the maximum desired moisture content found in bitter leaf was 77.43%. I therefore hope to compare and contrast my results with these aforementioned literatures at the end of this study.

MATERIALS AND METHODS/METHODOLOGY/EXPERIMENTAL PROCEDURE

MATERIALS AND METHODS

The materials used for this development include the following:

Mild Steel Plate (for the inner and outer body of the machine, the door plate, the base/ seat of the machine, the circuit box and the propeller.

Mild Steel Pipe (for the body frame, door frame and base frame of the machine)

Mild Steel Angle Iron (for the inner tray seat and the legs of the machine)

Mild Steel Flat Bar (for the door handle and locker)

Stainless Steel plate (for the tray plates)

Galvanized plate (for the top of the support structure)

Fiber Glass (for the insulation)

Design Theories

Cabinet Design

The developed machine consists of the following design specifications:

Number of cabinets – 2

Number of trays for each cabinet – 3

The area and volume of the cabinets and the trays were determined using the equations below:

$l \times b$ and $l \times b \times h$ respectively.

$$A_c = 0.375m \times 0.3m$$

$$\text{Area of each cabinet} = 0.1125m^2$$

$$\begin{aligned} \text{But total area of the cabinets of the machine} &= 0.1125 \times 2 \\ &= 0.225m^2 \end{aligned}$$

On the other hand, volume of the cabinet $V_c = l \times b \times h$

$$V_c = A_c \times h$$

$$0.225 \times 0.35$$

$$V_c = 0.07875m^3$$

But total volume of the drying machine = drying capacity = $2 \times V_c$

$$2 \times 0.0787$$

$$0.158m^3$$

Determination of Area and Volume of Trays

The six (6) square shaped trays were of equal dimensions as shown below:

$$l = b = 30.4cm \text{ and } h = 1.9cm$$

$$\text{Area} = 0.0924m^2 \text{ and Volume} = 0.0018m^3$$

Frame Design

The frame of the vegetable leaf drying machine provides structural support and stability to the entire machine. The material used for the frame was of high resistance to withstand the smoke/ vapour during drying.

The dimensions of the frame are:

Mass of the Driving Shaft (m_s)

The mass of the shaft which connects to the 12V D.C motor and transmits rotational motion is

$$\rho = \frac{m}{V} \qquad m_s = \rho V_s$$

But $V_s = l \times b \times h$ And $b \times h = A$ $V_s = A_s l$

But $A = \frac{\pi d^2}{4}$ OR $\frac{1}{4} \pi d^2$

$$m_s = \rho V_s = \rho \frac{\pi d_s^2}{4} l_s \text{ OR } \frac{1}{4} \rho \pi d_s^2 l_s$$

Speed of Rotation of the Propeller Shaft

The speed of rotation of the shaft can be determined by the equation (2.9) as cited by (Khurmi and Gupta, 2005)

Expected Quantity/ Amount of Moisture to be Removed

The amount of moisture (A_m) to be removed was determined using the equation:

$$A_m = \frac{m_1 - m_2}{m_1} \times 100$$

Rate of Temperature Change

This refers to the ratio of the difference in temperature over a period of time, measured in 0_c/s.

RESULTS AND DISCUSSIONS

The rate of temperature change for each drying material was determined using various temperature differences and their respective time. The maximum drying temperature set on the temperature controller was 75°C. This was recorded as presented on the table below:

Table 3.1: Fluted Pumpkin Leaf (at initial temperature 31°C)

S/N	Temperature Readings (°C)	Δθ(°C)	Time (s)	$\frac{\Delta\theta}{t}$ (°C/s)
1.	31	0	0	0
2.	38	7	300	0.023
3.	41	3	60	0.05
4.	51	10	315	0.032
5.	61	10	615	0.016
6.	71	10	735	0.014
7.	75	4	225	0.018

Since change in temperature is certainly not constant, the average rate of temperature change was determined.

Average rate of temperature change = 0.022°C

Table 3.2 Water Leaf (at initial temperature 45°C)

S/N	Temperature Readings (°C)	Δθ(°C)	Time (s)	$\frac{\Delta\theta}{t}$ (°C/s)
1.	45	0	0	0
2.	50	5	90	0.056
3.	55	5	200	0.025
4.	60	5	330	0.015
5.	65	5	600	0.008
6.	70	5	920	0.005
7.	75	5	1,500	0.003

Average rate of temperature change = 0.016°C

The developed machine was used to conduct a test in order to determine the amount of moisture removed from each variety of vegetable leaves. The result is recorded as represented in the table below:

Table 3.3 Amount of moisture content (%) removed

Vegetable Leaves	m_b (g)	m_1 (g)	m_a (g)	m_2 (g)	m_w (g)
	$m_b - m_0$			$m_a - m_0$	$m_1 - m_2$
Pumpkin Leaf	5,100	4,800	1,600	1,300	3,500
Water Leaf	6,150	5,850	1,762.5	1,462.5	4,387.5
Bitter Leaf	5,550	5,250	1,650	1,400	3,850

Where $m_0 = 300g$ or $0.3kg$

Now applying equation (3.4) above:

$$A_m (\text{Pumpkin Leaf}) = \frac{3,500}{4,800} \times 100$$

$$A_m (\text{Pumpkin Leaf}) = 72.9\%$$

$$A_m (\text{Water Leaf}) = \frac{4,387.5}{5,850} \times 100$$

Parts/Parameters	Input Data	Calculation	Result
Area of Cabinet (m^2)	$l = 0.375m$ $w = 0.3m$	Area is $l \times b$	the area of the cabinet is $0.225m^2$
Volume of $w = 0.0035m$	$lh = 0.35cm$	Volume is $l \times b \times h$	the volume of Cabinet (m^3) the cabinet is $0.158m^3$
Area of Tray (m^2)	$l = w = 30.4cm$ $= 0.304m$	Area is l^2	the area of each tray is $0.0924m^2$
Volume of Tray (m^3)	Area = $0.0924m^2$ $h = 1.9cm$ $0.019m$	Volume is $A \times h$	the volume of each tray is $0.0018m^3$

Area of the (m^2)	$l_f = 83cm$ $= 0.83m$	$l \times b$	the area of the Frame <u>frame</u> is $0.307m^2$
	$b_f = 37cm = 0.37m$		
Volume of frame	$h_f = 90cm$ $= 0.9m$	$A \times h$	the volume of the frame the is $0.28m^3$
Mass of the Driving Shaft (kg)	$\rho = 7,850kgm^{-3}$ $\pi = \frac{22}{7}$ $d_s = 6mm$ $= 0.006m$ $l = 60mm$ $= 0.06m$	$\rho \frac{\pi d_s^2}{4} l_s$	the mass of the shaft is $0.013kg$
Rate of Temperature Change Δ^0C/s			the rate of temperature change is:
Pumpkin Leaf	$\Delta\theta = 44^0C$	$\frac{\Delta\theta}{t}$	0.022^0C
Water Leaf	$\Delta\theta = 30^0C$		0.016^0C
Speed of Rotation of the Shaft (m/s)	$d_s = 6mm$ $r.p.m = 2,500$	$\frac{diameter (mm)}{19,108} \times r.p.m$	the speed of rotation is $0.785m/s$
Amount of Moisture Removed from water (%)		$\frac{m_1 - m_2}{m_1} \times 100$	
Fluted Pumpkin leaf	$m_1 = 4.8kg$ $m_2 = 1.3kg$	$m_1 - m_2$	the mass of water removed is $3.5kg$ the amount of moisture removed is 72.9%
Water <u>leaf</u>	$m_1 = 5.85kg$ $m_2 = 1.46kg$	$m_1 - m_2$	the mass of water removed is $4.39kg$ $\frac{m_1 - m_2}{m_1} \times 100\%$ the amount of moisture removed is 75%
Bitter leaf	$m_1 = 5.25kg$ $m_2 = 1.4kg$	$m_1 - m_2$	the mass of water removed is $3.85kg$ $\frac{m_1 - m_2}{m_1} \times 100\%$ the amount of moisture removed is 73.3%
Heat Energy to Dry the leaf	$m = 4.8 kg$ $c_p = 5,174JkgK^{-1}$ $\Delta\theta = 44^0C$	$mc_p\Delta\theta$	the heat energy needed is $1,092.7kJ$

Heat Energy to	$m = 0.53kg$	$m_w \times (h_g - h_f)$	1,765.7kJ
Remove Moisturer (J)	$L = 504.49J/kg$		
Fluted Pumpkin leaf		$Q_1 + Q_2$	2,858.4kJ
Total Heat Needed			
Efficiency	$W_{output} = 2,858.4kJ$	$\frac{Work\ output}{work\ input} \times 100\%$	the efficiency of the
	$W_{input} = 4,050kJ$		machine is 75%

The findings from table 3.3 reveal that there was a significant loss in mass in the three varieties of leaves used for this study. However, this difference varies from material to material based on the level of water content present in them. Also, the moisture content varied for each leaf, as that of water leaf was found to have the highest moisture content being 75%. This is a clear significance that when any fresh vegetable leaf is purchased, it still contains a certain amount of water/ moisture content.

Also, the heat/ thermal energy needed to remove the moisture were in two phases: that needed to dry up the leaf and that needed to evaporate the moisture content from the leaf. This requires a high magnitude of thermal energy in total.

CONCLUSION

This study has not just reminded the world of the existing methods of preservation, but has also developed a machine for this very purpose. To this effect, I have been able to design, fabricate and develop a portable machine for drying vegetable leaves for preservation. In conclusion, this study has: designed, fabricated a portable machine used for drying vegetable leaves whose with two different varieties of vegetable leaves (Fluted Pumpkin leaf and Water leaf) and the working performance of the machine have been evaluated based on its efficiency as 70.6%.

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THE ROLE OF HISTORY AND HERITAGE STUDIES IN ADDRESSING AFRICA'S DEVELOPMENT CRISIS AMID EMERGING ISSUES IN THE 21ST CENTURY

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Abstract

Africa, a continent with enormous potential and incredible human resources, is facing various challenges that are changing its development trajectory. The pervasive effects of colonialism combined with the emerging problems of the 21st Century like uneven technological advancement and climate change, constitute the forces of decline with which the continent is grappling. In furtherance of the above, it is crucial to note that the despicable status of African tourism and tradition is part of the underlying challenges bedeviling Africa's developmental programmes. In this respect, the usefulness of historical and heritage research in grasping and addressing these challenges becomes undeniable. Based on the above issues, this research explores the origin and trends of the development crisis in Africa; examines the relevance of historical and heritage research to address retrospective and prospective issues hindering Africa's development; highlights the challenges that disrupt the roots of African history and heritage as the most viable solutions to Africa's challenges and highlights through case studies and examples, innovative successful initiatives that integrate history and heritage studies into development projects. Using historical research methods which entail primary and secondary sources, the information needed for this research was extracted through interviews with various stakeholders. In addition, books, magazines and articles were also used as complement to the primary source earlier stated. The research concludes by providing recommendations for policymakers, researchers and practitioners to advance history and heritage studies for sustainable development in Africa.

Keywords: Africa, Trajectory, Heritage, Ripple, Trend, Retrogression, Colonialism, Tourism

Introduction

It is common knowledge that the yardstick for development in the world is the white's level of development. This notion buoys the concept of monopoly in that one is aroused to ask if Europe and America which have large concentration of whites are unique continents; if their inhabitants are exceptional and if there are moves by other people / continent to surpass the white's exploits. It is on the aforementioned global quagmire

that the existence and essence of the blacks whose home and heritage is Africa becomes worthy of discussion. Based on the belief of the blacks and the perception of the whites, Africa is the most blessed continent in terms of incredible resources embedded and human resources domiciled. According to research, about 1.2 billion people inhabit Africa; more than 40% of world's gold, cobalt, manganese, crude oil and a host of other natural resources which are necessary for development are deposited in Africa. It thus beggars belief that despite the resources which abound, Africa is still grappling with growth and development.

The anomaly in Africa's development is the manifestation of age long and contemporary issues that were improperly addressed and that have snowballed into greater chaos. Starting from the 15th century when relations with Europe became more pronounced, the continent has been shortchanged through various phenomena like the Trans-Atlantic Slave Trade which decimated Africans' power, popularity and population; colonialism which disrupted and even destroyed African history and heritage and neocolonialism which is the most recent external agent of retrogression in Africa. African leaders are more than aroused to ascribe the sociopolitical and economic lapses of Africa to the Trans-Atlantic slave trade and colonialism. Scholars and pundits of Africa extraction majorly have also corroborated the one-sided view of African leaders which is that the Atlantic slave trade was responsible for Africa's socio-economic inertia, political ineptitude, technological backwardness and sundry dislocations. A one-time Nigerian leader, Nnamdi Azikiwe of Nigeria submitted that "slavery played its shameful role in depopulating Africa; capitalism denuded it of its wealth; colonialism deprived it of its birthright and imperialism emasculated its will to live as a human being [sic] and to enjoy its fair share of the bounties of the good earth."

At this juncture, it is imperative to note that aside from external players and factors which are also known as the "dependency theory", the scope and effect of internal causation can never be downplayed. Africa was under the shackles of colonialism for more than 4 decades but it is pertinent to note that freedom has been attained for more than 5 decades - many African countries gained independence in the 1960s and 1970s hence it is logical to expect development in Africa. Since Africa is still termed as underdeveloped after more than 50 years of autonomy, it is expedient and urgent to make a deft move from retrospective factors and focus on introspective factors which are arguably the best approach to examine Africa's developmental issue. It is imperative to note that this research does not seek to debunk the adverse effects of exogenous factors rather, one of its objectives is to highlight the endogenous agents of retrogression therefore, this research will serve as a critique. Having established the fact that the development issue of Africa is both internal and external, this paper shall be within the context.

A Historical Analysis of Africa's Developmental Crisis

The history of Africa is replete with different people, kingdoms, civilizations and even culture. Ancient and independent civilizations especially the Egyptian civilization

which is often dubbed as the basis of other civilizations emanated from Africa. Through the Egyptian civilization, the calendric system was engendered based on the inundation of the River Nile; farming was facilitated through extensive irrigation made possible by dams and dikes; medicine was revolutionized through the invention of surgery and mummification and writing was enhanced through the invention of papyrus and reed - without doubt, the Egyptian civilization ushered in an unprecedented era in the evolution of man. Aside from the Egyptian civilization, Ghana empire which remains perhaps the most ancient empire in Africa, Mali empire which is popular for its gold and the pilgrimage of one of its most outstanding emperors, Mansa Kanka Musa, Sokoto caliphate which had an extensive textile industry and was perhaps the largest empire in Africa at its peak, Songhai empire, Benin kingdom, Oyo empire, Kanem-Bornu empire, Moshoeshe empire and a host of others are evidence of development in Africa. In sum, Africans lived in complex and varied indigenous political systems where authority could be exerted by men and women alike.

However, the trajectory of Africa's development was altered through the influx of the whites. This began in the 15th century through the voyage of Bartholomew Diaz and Vasco Da Gama. Since then, African affairs have been at the dictate of the whites because their entry into Africa opened a floodgate of whites to Africa. The Europeans have steadfastly struggled to change African history to their sole input through their merchants, missionaries and explorers. The truth however is that Europe didn't discover Africa and that Africa remains an inalienable part of the globe that boasted of thriving kingdoms, ancient civilizations and illustrious people.

According to Walter Rodney, the level of development in Europe and Africa could be termed as commensurate, it was the industrial revolution, a brainchild of the Trans-Atlantic Slave Trade that altered this reality. In the economic aspect, despised and unsaleable products in Europe were sent to Africa, viable and vibrant men and women were transported to Europe to work as slaves on different plantations. The Trans-Atlantic Slave Trade is majorly the narrative that best describes the trade between Africans and Europeans in centuries before the advent of colonialism in the 19th century. Africans had been free from any form of slavery. This doesn't mean the concept of slavery does not exist in Africa, it simply implies that slavery was entirely on another basis. For example, slaves in Africa could buy their freedom or rise to an exalted position in their master's household. As a concept however, the Trans-Atlantic Slave Trade was distinct; it was an extremely barbaric event. According to research, the poorest countries in Africa today are countries that had the most slaves during the Trans-Atlantic Slave Trade. The trans-Atlantic slave trade began in the 15th century when slaves were shipped from West Africa, West Central Africa and Eastern Africa to the European colonies in the New World. Through the slave trade, approximately 12 million slaves were extracted from Africa.

A lot of Africans died during raids and while on voyage to Europe. Due to the excessive and mindless demand for slaves in Africa, state development in Africa was smothered,

political and social harmony was thwarted and African institutions were demoted. There are uncertainties as to the concept of the Trans-Atlantic Slave Trade in Africa but what remains unequivocal is the level of destruction and retrogression that it brought into Africa. In short, the Trans-Atlantic Slave Trade was in its totality a barbaric phenomenon in the annals of Africa.

After about four centuries, the Trans-Atlantic Slave Trade was abolished and Africans thought the time to rebuild and refire had come. However, this expectation was quickly discomfited by the industrial revolution which was spearheaded by Britain. One of the reasons for the abolition of slave trade was the industrial revolution which illuminated the weaknesses and inefficiency of man power compared to a machine. Before delving into the industrial revolution as a basis for Africa's development crisis, the woes of the Trans-Atlantic Slave Trade need to be articulated for a proper grasp. Among others, ethnic fractionalization became a normal concept as kings and kingdoms decided to launch onslaughts against neighbours and enemies for the sole aim of capturing and onward sale to the whites as slaves. Raids were carried out through increased intertribal warfare, conflict and banditry. Also, able bodied men and women were transported to Europe hence, the labour force of Africa was drastically reduced. Slave buyers preferred their victims between the ages of 15 and 35, and preferably in the early twenties; the sex ratio being about two men to one woman. Europeans often accepted younger African children, but rarely any older person. African economic activity was affected both directly and indirectly by population loss. Economic development during the 15th century to 18th century was stunted by the inability to engage the labour force which had become non-existent owing to the slave trade.

After the abolition of the Trans-Atlantic Slave Trade which led to the decline of slave trade and introduction of legitimate trade, Africans had thought they were free from the shackles of slavery and stagnation. However, the Europeans exacerbated Africa's woes through the industrial revolution that followed the abolition of slave trade as this facilitated the occupation of Africa as initiated and agreed at the Berlin Conference of 1884 / 1885. Through the industrial revolution, the necessity of raw materials and market for finished goods became apparent hence the Europeans earmarked Africa as the perfect place to meet their economic needs. Also, the industrial revolution led to massive unemployment as the labour force required in the industries was reduced while a lot of people were displaced. Emphasis must be laid on the fact that the high rate of unemployment in Europe aroused Europeans to search abroad for places to establish industries and resettle displaced and unemployed people. As the economy of the various European countries particularly Britain expanded and as more capital was accumulated as a result of the profit from trade with the Africans, there was the need for the investment of surplus capital. Africa served as the suitable place to invest in the exploitation of natural resources of the continent. In the Gold Coast for example, European mining companies and timber firms were established by the Europeans to exploit the natural resources of the area to serve European interest. Politically, in Europe of the nineteenth century, a country was considered powerful and great when that

country has a lot of territories both in Europe and outside Europe. Acquiring more territories also served as a form of national pride and superiority over others. This relationship later transformed into an unbalanced, parasitic affair, with Africa at the losing end of the rope. Ie. In Nigeria and other African countries, all the European industries employed mostly Europeans while the local employees were few.

It is logical to state that the industrial revolution precipitated the occupation of Africa by the Europeans based on the several needs that accompanied it. Hence, European nations drew boundary lines on a map of Africa, dividing up the continent and approving each other's claims to different African lands. After the conference, formal control was exerted over African territories. The Berlin Conference was a formal convergence of several European nations and the United States of America to discuss the division and occupation of Africa. There was no African representative in the meeting. The Europeans were successful in their colonial quest because of the strategic tactic of divide and rule employed. Due to this, Europeans became the architect of African borders. With little or no recourse to the future, borders were created and different systems were established.

African borders were not envisaged as real state boundaries but as administrative colonial limits hence several border disputes have characterized the geopolitical space of African countries. The developmental issues that colonialism had on Africa can never be downplayed. It encompassed and influenced every stratum of Africa. Now, colonialism has come and gone but its vestige is still evident. It has even been superseded by neocolonialism nowadays in Africa. Neocolonialism is more subtle and invented by monetary control and economic domination. Neocolonialism also initiates a consumerist culture, centered around western goods, where the foreign goods are more preferred to indigenous ones and therefore the indigenous ones are not encouraged. Despite the large acclaimed doses of supposed independence gotten by Africa since the mid to late 20th century from its colonial masters, there are still deliberate and continual display of colonizing traits in the systems and institutions that we relate on; subtle forms of economic infiltration and manipulation; legacies of subjugation to higher institutions. Neocolonialism is a detriment to colonial discontinuity. It is a modified version of colonialism for the continued exploitation of politically independent countries. It is a new avatar of the old evil. It is a threat to the vital interests of "newly" independent countries of Asia and Africa. Kwame Nkrumah, the first president of Ghana, defined neo colonialism thus: "The essence of neo-colonialism is that the state which is subject to it is, in theory, independent and has all the outward trappings of national sovereignty."

Impediments to Africa's Development

As mentioned earlier, the developmental crisis of Africa are products of internal and external phenomena that have been left unaddressed. For more than 50 years now, Africa has been grappling with sustaining democracy and development. This is because various countries in Africa have experimented both democratic and non-democratic system of government. Non-democratic systems adopted were justified on the basis of the

ineptitude and inertia nature of democratic governments who have constantly failed to make good the dividends of democracy and sustain development programmes. Despite the innate faults and lapses in democratic governments which the non-democratic governments have severally leveraged, the situation has always been the same and at times worst than it had been. The basis for Africa's developmental woes despite the evidence of abundant resources can be examined through a historical and holistic analysis. Hence, Africa's woes can be ascribed to historical colonial experience, political instability, large scale corruption, the monoculture nature of the national economy and the persistent lack of commitment to focused development strategies on the part of the political elites.

Neo colonialism

Neo colonialism could be dubbed as a remote factor in that its direct influence is inconspicuous except from a vantage view. Be that as it may, it remains one of the underlying factors which scholars believe if it is non-existent, Africa would have made giant stride in development. Through neocolonialism, structural deficiencies have become pervasive as it isn't just exploiting African people, it has also plunged them into vulnerable positions which has made development intricate and evasive. As a result of bonds with colonial masters, West African countries are still subject to political subjugation and economic exploitation therefore, they are often influenced on matters pertaining to them. It is arguable that one of the reasons for the slow economic integration in West Africa is the fear of West African leaders to propose and pursue viable and brave economic policies due to the fear of opposition from foreign donors. It is safe to posit that West African countries are not sovereign states because their policies and pursuits are influenced and controlled by foreign powers. For example, the control of inherent natural resources in West Africa by foreign powers as in the case of Nigeria wherein petroleum is exported abroad at a cheap price to be refined and imported back to Nigeria at a higher price. In the political realm, West African countries have been plunged into conflicts, crises and at times wars by foreign powers in their bid to oust West African leaders who are resentful of foreign influence. Latent and at times lucid foreign hands are mostly responsible for the deplorable and unfortunate political misunderstanding in West Africa as responsible governments that oppose them are deposed while puppets are installed. Ie. The assassination of Thomas Sankara of Burkina Faso by a high profile conspiracy orchestrated by France, the removal of Kwame Nkrumah through a coup d'etat bankrolled by the US etc.

Mismanagement and Corruption

Aside from the detrimental contribution of colonialism, blatant mismanagement of the country by those who should have orchestrated its development cannot be downplayed. African leaders lack the required capability and attitude to institute the needed social and economic transformation in the continent. Rather than work for development, African political leaders have actually compounded Africa's developmental challenges and as such institute apathy, instability, a torrid of criminal activities and cynicism on the part of the citizenry. The rate and influence of poverty and underdevelopment in

Africa are heart-rending and underscore the dangerous state of African economy and politics. Corruption constitutes one of the fundamental causes of Africa's development woes. In one of the analysis of the Commission of Africa to address Africa's developmental woes, the political elites were indicted and earmarked as one of the factors slowing down Africa's development. An extract from the analysis goes thus; Africa has suffered from governments that have looted the resources of the state; that could not or would not deliver services to their people; that in many cases were predatory, corruptly extracting their countries' resources, that maintain control through violence and bribery; and that have squandered and stolen aid (monies)". Corruption and development are incompatible hence corruption dislocates the economy, diverts public funds to private pockets, depletes resources and plunges people into poverty, illiteracy and misery. Instead of building infrastructure, developing the economy, funding researches to power and fuel technology, innovation and modernization, most African leaders, as Moses Mungo said, "have turned themselves into thieves in government houses". Africa is estimated to be losing more than \$50 billion on an annual basis via illicit financial flows of which "bribery and theft by corrupt government official form a substantial portion". The amount lost annually by Africa through illicit financial flows is therefore likely to exceed \$50 billion by a significant amount". Massive treasury looting have been ascribed to African leaders such as General Sani Abacha who allegedly embezzled \$20 billion, President H. Boigny of Ivory Coast who allegedly embezzled \$6 billion, President Paul Biya of Cameroun who allegedly embezzled \$70 million, President Haite Mariam of Ethiopia who allegedly embezzled \$30 million and a host of others. More than 400 million Africans live on less than \$1.25 a day yet a significant portion of state resources have been diverted into private pockets and as such there is egregious poverty amid enormous wealth.

Insecurity

Closely related to corruption is the issue of insecurity which is the outgrowth of various levels of ethnic crisis and political tension. Insecurity has become a continental phenomenon and sadly at an unprecedented level. Banditry, kidnapping, insurgency, militancy, ethnic conflicts and a host of other forms of violence and crisis have made development evasive because local and international investors are skeptical about making investments of great magnitude in volatile environments such as Africans'. The issue of insecurity stems from marginalisation and inequalities, dichotomy between the rich and the poor, ethno-religious conflicts, political tension, loss of sociocultural value system, weak security system, large scale unemployment, poverty and lack of institutional capacity resulting in government's failure. The continent is imbued in tension and uncertainty as citizens are overwhelmed with the fear that anarchy and chaos might engulf the continent. In Nigeria, the issue of kidnappings, banditry, herdsman - farmers' conflicts among others have become a great challenge to developmental stride.

Multinational Corporations

Another inalienable underlying factor that truncates Africa's development is the

presence of Multinational Corporations. Multinational corporations which own and control the production of goods and services in countries other than their home country have found green pastures in Africa. Many of the tools or instruments of neo-colonialism are economic and are aimed at economic exploitation. Multinational Corporations are well-known agents of neo-colonialism. They operate across their national frontiers through subsidiary firms and exercise control over several markets. Multinational Corporations enter Sub Saharan African countries with the consent of the government of the host country and offer better quality products to earn maximum profit. Of course, there are a lot of advantages that accompanies Multinational Corporations but yet, the adverse impact of multinational corporations is far more than their advantages. These giant corporations are "the most powerful human organizations yet devised for colonizing the future. In fact, they have been largely compared to "absentee landlords" who are concerned only with increasing profits. Companies like Coca-Cola and Nestle Plc have become underlying agents of underdevelopment in Nigeria, a country in Africa - their presence has stifled local industries and impeded economic dynamism. Thus, multinational corporations have become one of the latent instruments of underdevelopment in Africa.

Loans and Foreign Assistance

Aside from the presence and pervasion of Multinational Corporations, loans and assistance from foreign developed countries and the International Monetary Fund constitute one of the developmental barriers of Africa. Oftentimes, loans are given on high rate of interest and are mostly used for non- productive sector. Consequently, African countries are left with no alternative but to seek fresh loan from other countries to pay back the earlier loan or at least pay interests on those loans. They often get into the debt trap. The World Bank and International Monetary Fund are largely financed by the United States and other Western countries. Therefore, when African countries seek economic assistance or loan from these institutions, they impose those functionalities which suit the Capitalist countries, and the African countries are forced to obey the Western countries in the management of economy. Devaluation, reduction of budget deficit, restrictions on domestic credit and cuts in subsidiaries are some of the measures that needy African countries have to take. Much of the continent's export earnings of Africa now go to paying off these debts: African governments spend twice as much money on debt service as on health and education, even while they curtail investments in social and economic development. Their economies are thus controlled by Western countries, International agencies and the MNCs. Western countries, Arab nations and Asian countries especially China are often the lenders. Nigeria, Ghana, Niger and a host of other countries in Africa are captured in the web of foreign loans to the extent that their budgets are dependent on such.

Political Instability and Internal Conflicts

The partition of Africa by the Europeans during the scramble for Africa created greater fissures in the differences among Africans and thus, heightened cultural disunity and political instability in Africa. Many West African countries have been plunged into

political crises like civil wars, coup d'états, violent protests among others. This is because of high profile conspiracy and at times, ethnic tension which is a latent inheritance bequeathed to colonies by colonists in West Africa. Political crises are deeply rooted in West Africa and are even threatening the existence and continuity of the region. Also, the tendency of West African leaders to make political seats their exclusive possession has aggravated the turmoils that are evident in West Africa as those who make peaceful change impossible make violent change inevitable. The manifestations of political instability and internal conflicts often result in displacement of people, destruction of properties, breakdown of law and order and even anarchy. The attendant uncertainty which often accompanies political turmoil has frustrated and foiled investment plans in West Africa because local and foreign investors are always afraid of the vulnerable political situation inherent and thus, West Africa is steeped in underdevelopment. State fragility and conflict have become popular in the annals of Africa over the past six decades and such have been frequently manifested through civil wars as in Nigeria (1967 - 1970) among other political and ethnic-based crisis.

Lack of durable infrastructures

West African countries are fraught with abysmal infrastructures. Infrastructures are part of the backbone of any economy and it is unfortunate that West African countries are devoid of good and durable infrastructures like roads, water supply systems, electricity and telecommunications. Lack of good infrastructures has had adverse effects on economic development, social welfare and human development. This is evident through limited economic opportunities as there are several difficulties in transporting goods and services and such has led to transportation costs and limited trade. Also, epileptic power supply, scarcity of good water, lack of basic health care facilities, substandard communication equipments and even poor education have smothered socioeconomic growth. The inadequacy or absence of durable infrastructures has made cordial economic interactions among West African countries complex and development elusive. In Nigeria, most of the roads are death traps, electricity is unstable, basic health care facilities are mere mirage and potable water is scare even in developed cities. Many companies rely on alternatives to electricity like generator and as such Nigeria purchases goods from abroad and technically abandons its local economic growth. This is applicable to other African countries.

Poverty

The presence and prevalence of poverty in West Africa can never be downplayed. Most of the inhabitants of West Africa are plagued with impoverishment which stems from unemployment, low salary structure among other retrogressive elements. Africa has even dubbed as "the lowest income region in the world". One of the reasons poverties has become a popular theme in Africa is due to over reliance on natural resources and this has led to a monolithic economy which is vulnerable and susceptible to global economic shock. Due to lack of dynamism in the economy, West African countries are subject to the whims and caprices of foreign forces whose aim is to explore and exploit the region. For example, Nigeria, a West African country is heavily dependent on

petroleum and in refining it, she exports crude oil at a cheap rate while she imports refined oil at an exorbitant price. This has led to economic stagnation and frustration. The situation is not peculiar to Nigeria. Also, the plague of unemployment is bedeviling Africa in that many graduates are roaming the streets in search of tangible jobs. Aside from unemployment, a lot of people are doing jobs that are not really profitable in terms of remuneration, imposts and incentives. Every African nation is economically dependent on natural resources and that has made economic growth difficult because such is highly volatile.

The Essence of History and Heritage Studies in Africa's Development

Having established the fact that Africa is grappling with developmental issues, it becomes plausible to search for solutions and it is in this regard that the role of history and heritage studies needs to be emphasized and applied. History which has been defined as the culmination of human experiences overtime up to the present has a lot to do in resolving Africa's problems. More often than not, if history is given its rightful position in Africa, salient measures that ignite developmental agenda and that can thwart the antics and tactics of detractors will be engendered and attained. It is thus on this basis that it is pertinent to note that developmental issues in Africa have become exacerbated through its disjointed history mainly induced by European historical fallacy. It was this diluted history that was propagated till the middle of the 20th century when Afrocentric history became prominent through the emergence of Afrocentric scholars. Such scholars were Kenneth Dike, Tekena Tamuno, Saburi Biobaku, J.F.A. Ajayi, Obairo Ikime and a host of others. They fought with vigour through writing the prejudice expressed by Europeans towards Africa. The past of Africa which was considered dead and insignificant was thus resuscitated by African scholars.

By virtue of arrogance in ignorance, Europeans paraded and propelled historical parochialism and subjectivity in Africa and it was for this reason that their writings about Africa were fraught with misinformation, misrepresentation and manipulations. Eurocentric scholars had wrongly believed and disseminated that Africa had no history until the contact with the whites. Such a despicable sentiment was echoed by Eurocentric scholars like Hegel, Prof. Hugh Trevor-Roper, Prof. A.P. Newton among others. Through the establishment of educational institutions, emergence of Afrocentric scholars and the rise of nationalists, African history became objectively documented. The Afrocentric history of Africa was made possible by several historical outlets mainly hinged on oral tradition and transcription into textbooks and writings by African scholars especially in the academics. It is thus on the basis of history that Africa's pasts like ancient civilizations, monuments and people were illuminated.

Oral tradition was the most crucial mechanism to transmit African history. This was made feasible by African proverbs, myths, legends among others. Through the existence of oral tradition, the authenticity of African history was established. In making simple and understandable the foregoing, various forms of oral tradition which is the major mechanism to reconstruct African history shall be highlighted hereunder. Among

others, verbal account constituted one of the major techniques used in passing African history. Although this was evasive during the African historical revolution of the mid-20th century, it was crucial in affirming Africans' stake to a rich and relishing past majorly evinced via second hand account which implies the transmission of history from generation to generation. Therefore, the content and concept of the past were brought to life through the reconstruction and transcription of testimonies given by people who had witnessed past events or those that were told past events. A Yoruba adage lends credence to the above submission and it goes thus: "Bi omode o ba ba itan, yo ba aroba" that is, if a child doesn't know the story of a particular event, he would be told about it".

Of great significance are myths and legends. Myths could be defined as a cultural story about origin, the undefinable past that is ancient times, the evolution of man and even natural occurrences that exceed human volition and contributions. In Africa, there are myths about the creation of the world, the evolution of man and other natural and at times supernatural phenomena. Yoruba myth about creation is a tenable example in this regard. Aside from myths, legends which are synonymous to myths embody an indispensable part of African history. It encompasses the exploits of men that one way or another influenced or revolutionized their society. Examples abound like that of Moremi and Inikpi among others who had exceptional and undeniable qualities and contributions which make them credible parts of African history. As such, legends include credible and incredible activities of humans that had lived in a relatable past. Songs and chants to appraise gods also form crucial parts of African history which African intellectuals earmarked in the reconstruction of African history.

History and Heritage Studies play a huge role in addressing Africa's development crisis through various ways. One of such is that they provide valuable lessons from past experiences and development especially the successes and setbacks recorded. The ignominious legacy of colonialism has been articulated through history. According to Professor A.J. Temu, it is only through the study of history that one can come to terms with the objective conditions of the peoples of Africa as they grapple with the problems of development, hunger and deprivation. Through history, the hunger, insecurity, intimidation, discrimination, deprivation and other evils that colonialism entrenched in Africa have been articulated. Without doubt, history and heritage studies have liberated Africans from the shackles of outright suppression and falsification of events by the Europeans. Even after the demise of colonialism, neocolonial policies which have been packaged as exclusive gestures of good will and benefits from the Europeans have been debunked and discomfited. It is history that unearths the entire realities that interplayed overtime to produce the current state of affairs as presently being experienced in Africa. As weapons of alienation policies, imperialist intellectuals sought to block the possibility of solidarity on the part of the colonized by using ideas such as the radical element to demonstrate that Africans had no history. Their henchmen and other ignorant African leaders have followed this dangerous path of depriving Africans of their history by historically eroding history as a subject from the national curriculum until recently.

Walter Rodney argues that history can be a powerful tool for intellectual liberation hence, by teaching and understanding history, oppressed African classes can be empowered to protest against the exploitation and corruption of post-colonial leaders. History as a tool of nation building identifies with the oppressed by delving into the historical roots of the current hardships plaguing Africa. Only a thorough understanding of the root causes of a problem can ensure a full understanding of the problem and the ways to reduce it. History has shown that Europe's development is intertwined with Africa's underdevelopment; the affairs between Africa and Europe is a dialectical and symbiotic one based on economic exploitation, slave trade, colonial conquest, unequal trade relations and other unhealthy commitments under the guise of today's globalization. In the search for solutions to Africa's challenges, only a deliberate and conscious reliance on history can liberate the country by exposing the real problems and from that repair the damage done to the continent.

Africans as the Solution of Africa

Going by the occurrence and success of the French revolution and the Russian revolution, it is logical to address the challenges bedeviling Africa in an African way. Colonial historiography has brainwashed Africans and since the denial and dilution of history was instrumental in this regard, it is logical to use indigenous mechanisms to address Africa's developmental woes. To the Europeans, Africa was not a historical entity that is worthy of study. Based on their shallow notion, one can through the words of E.J. Alagoa - "Their perceptions and misrepresentation of Africa from antiquity were fundamentally premised on ignorance, prejudice, ethnocentrism, cultural chauvinism and arrogance" say the Europeans were narrow-minded, biased and racism-inclined. In an African way, African scholars from different countries and historical roots initiated and championed the cause of African history by debunking the diluted history of the Europeans as it relates to Africa. Their barbaric propositions and submissions about Africa were swiftly dismissed through oral tradition.

Among others, one of the ways Africa can institute development is through the institutionalization of indigenous educational systems and processes. This is logical based on the exploits of African scholars like Kenneth Dike, Obaro Ikime, Atanda, Akinjogbin among others who fought for the documentation and acceptance of African history globally with vigour and vision. Their effort led to the establishment of Ibadan School of History in 1948 which presented a new perspective of the history of the peoples of Africa in contrast to what the Europeans and their apologists had written. To these revered historians, the histories of Africa must be the histories of African peoples and not merely the activities of invaders. History should be a tool for emancipation from the shackles of western control. The establishment of the Zaria School of History in 1962 was an impetus to the reconstruction of African history that had been spearheaded by African scholars from the Ibadan School of History. Radical scholars like Bala Usman, Mahmud Tukur, Abdullahi Mahadi and George Kwanashie among others revolutionized the study and practice of history as predicated on deep research and teaching. Nigeria, Africa and World histories were researched, interrogated and taught

in a manner that dispelled the Eurocentric perceptions that Africans were incapable of anything good.

Furthermore, identity and social cohesion which will dispel the peril of disunity can only be attained through history and heritage studies. Africa is incredibly diverse, with numerous ethnicities, languages, and cultures. History and heritage studies can help foster a sense of shared identity and social cohesion by uncovering common historical experiences, cultural practices, and traditions. Understanding and celebrating this diversity can contribute to building stronger communities and nations, reducing inter-ethnic tensions, and promoting unity. For example, the political and cultural brouhaha in Nigeria can be properly addressed by instilling the spirit of identity and social cohesion. The incorporation of history into the educational curriculum aligns with this. By teaching young people about their history, heritage, and cultural identity, education systems can empower them to become active citizens and contribute to their communities. Additionally, history education can promote critical thinking skills, empathy, and a deeper understanding of complex issues, laying the foundation for informed decision-making and lifelong learning.

Without mincing words, the resolution of conflicts and peacebuilding which have become a mirage in Africa can become feasible by exploring and addressing historical factors, including colonial legacies, ethnic rivalries, and resource disputes. History and heritage studies can provide valuable insights into the historical context of conflicts, helping to identify underlying grievances and pathways to reconciliation. By promoting dialogue, understanding, and forgiveness, history and heritage studies can contribute to peacebuilding efforts and conflict resolution. When there are tangible conflict resolution mechanisms, peace can be established and investors can invest without any fear of the unknown. This will also aid local industries to thrive.

The impact of cultural preservation and tourism development can never be downplayed. Africa has a rich and relishing cultural heritage, including ancient civilizations, archaeological sites, and traditional practices, holds significant economic potential. History and heritage studies can contribute to the preservation, documentation, and promotion of this heritage, fostering cultural tourism and generating revenue for local communities. By revitalizing cultural industries and heritage sites, history and heritage studies can create opportunities for economic development and job creation. Countries like Greece, Italy, Saudi Arabia, Israel, Egypt and Maldives enjoy a lot of economic and political gains and significance based on tourism and cultural visitations. Muslims go to Saudi Arabia on pilgrimage, Christians go to Israel on pilgrimage, Greece, Italy and a host of other countries receive a lot of tourists frequently due to the preservation and extollation of their cultural and historical values. In like manner, Africa can attain development through cultural and historical values as Africa is replete with cultural sites and monuments which are even more embellished and exquisite than those outside Africa. Such cultural and historical values and monuments include Esie Museum in Kwara State, Nigeria, Osun-Osogbo Sacred

Groove in Osun State in Nigeria, Mount Kilimanjaro in Tanzania, Ancient Thebes in Egypt, Victoria Falls in Zimbabwe, Old towns of Djenne in Mali, Meroe Pyramids in Sudan, Fort Jesus in Kenya, Robben Island in South Africa, Suleja Dam in Niger State, Nigeria, Mambilla Plateau in Taraba State, Nigeria, Gurara Waterfalls in Niger State, Nigeria, Obudu Mountain Resort in Cross River State, Nigeria, Almat Farms in Abuja, Nigeria and a host others. Aside from the aforementioned, climate change which is of global concern can be addressed in Africa via indigenous knowledge systems and traditional practices which contain valuable insights into sustainable resource management and environmental conservation. History and heritage studies can help revive and integrate these practices into modern conservation efforts, promoting ecosystem resilience and biodiversity conservation. Additionally, understanding historical patterns of land use and environmental change can inform sustainable development strategies and adaptation to climate change.

Conclusion

Based on the foregoing, the role of History and Heritage Studies in addressing Africa's development crisis amid emerging issues in the 21st century is not only pivotal but transformative. By embracing the continent's rich cultural heritage and complex history, Africa can break free from the shackles of colonialism, neoliberalism, and Eurocentrism, and forge a new path towards sustainable development, self-determination, and cultural renaissance. If Africans delve into the depths of Africa's past, they can uncover the resilience and ingenuity of their ancestors, who built mighty empires, harnessed the power of the Nile, and crafted masterpieces of art and literature. The secrets of African innovation, from the pyramids to the untold stories of resistance and liberation are unravelled through history. Standing at the crossroads of the 21st century, Africans can choose to toe the path of dependency and underdevelopment or to forge a new trajectory, guided by the power of their collective cultural history and heritage.

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HUMAN RESOURCE OUTSOURCING AND INNOVATIVENESS OF MANUFACTURING FIRMS IN NORTH CENTRAL, NIGERIA

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Abstract

Organizations have embarked on human resource outsourcing strategies over the years but many still suffer in terms of their goal achievement; some have experienced low productivity both in terms of quality and quantity, their profitability has not been stable, and their capacities are grossly underutilized. This research work determined the effect of outsourcing human resource activities including recruiting process, training and development, also, payroll management on the innovativeness of manufacturing firms in north central Nigeria. Survey research design was adopted with a population of 1151 staff of 10 selected manufacturing firms and a sample of 289 selected using Taro Yamane's formula and distributed among the 10 firms. The variables were statistically analyzed using ordinal logistic regression (OLR) statistic. The study found that; outsourced recruitment process, outsourced training and development, and outsourced payroll management has no significant effect on manufacturing firm's innovativeness. The study therefore recommends that; manufacturing firms should embark more on outsourcing of recruitment process, training and development and payroll management to reap innovativeness. Also, follow up steps through effective communication and monitoring should be employed. In addition, manufacturing firms should ensure that, the cost of managing the outsourcing process is lesser than the benefits generated by the outsourcing program.

Keywords: *Human Resource Outsourcing; outsourced recruitment; outsourced training and development; outsourced payroll management; Innovativeness; Manufacturing firms.*

Introduction

The success of an organization is measured by the level at which it attains its set goals. Hence, the most important objective of the organization is the wise & effective utilization

of its available resources pursuant to the achievement of its goals (Alzhrani, 2020). Today's business environment is however, severely dynamic (Jae, Minh, Kwok and Shih, 2000). Rapidly changing and increasingly complex business issues are creating key shifts in organizations and the manner in which they do business (Agburu, Anza & Iortsuun 2017). To ensure the competitiveness, success and indeed survival of the organizations, concerned managers need to accept innovation as a key element for the organization (Maier, Brad, Nicoară & Maier, 2014). One of the major drivers for innovation is Human Resource (HR) and for innovation to be successful managers need to plan for, support, and nurture an innovation culture in HR. Towards this end, managers keep track of existing HR capacity to innovate and possibilities to develop this capacity in order to improve the organization's innovative capacity, thus increasing their chances of success in the competitive business environment (Maier, Brad, Nicoară & Maier, 2014). To achieve its set goals in the presence of technological advancement, sophistication of business processes, knowledge explosion and need for constant growth, an organization looks out for strategies to enhance performance. It therefore reflects on the capabilities of its workers (staff), its technological knowhow, business processes and so on, and answers the question of whether it can achieve its goals with what it already has on ground or look out for ways to complement (Dominguez, 2006). To meet the demands of customers and shareholders, an organization may look out for ways that it has a comparative advantage. It therefore focuses on core competences and seeks to reduce operational cost which presents outsourcing as the right strategy. The rise of globalization has also, transformed outsourcing into one of the broadly adopted business strategies towards supplying exceptional services to consumers (Alzhrani, 2020)

Outsourcing is one management tool that has gained relevance among managers in addressing today's business dynamics (Jae, Minh, Kwok and Shih, 2000). It entails contracting out of a business function (Isaksson and Lantz, 2015). It is a method of staff augmentation without adding to headcount (Agburu, Anza & Iortsuun 2017). It is the replacing of in-house provided activities by subcontracting it out to external agents. Consequently, the management and development of innovations in outsourced activities become the responsibility of an agent external to the firm (Dominguez, 2006). Isaksson and Lantz (2015) assert that with the global market becoming increasingly competitive, manufacturing firms will pick up the trend set by their predecessors and outsource some of the key functions. Outsourcing avails organizations the opportunity to concentrate her core competencies on definable preeminence business area and provide a unique value for customers (Behara, Gundersen, & Capozzoli, 1995). Also worthy of note is the fact that present day outsourcing is no more limited to peripheral activities such as cleaning, catering and security. As noted by Jennings (1997:85), outsourcing also includes critical areas such as design, manufacturing, marketing, distribution, information system etc.

Today, firms are striving to create or expand business activities by adopting outsourcing strategies. Functions or services majorly outsourced by firms include information

technology; human resource and facility management (Dominguez, 2006). Cooperatives also outsource various services. These entities adopted outsourcing strategies with the intent of reducing cost, improving delivery and reliability of services, in addition to accessing and making use of resources lacking in the organization.

Human resource outsourcing (HRO) is the procurement of HR services from a third-party provider by an organization which they would normally provide themselves otherwise (Agburu, Anza & Iortsuun 2017). It entails the transfer of components of the HRM function or activities of a corporation to an administrator outside the corporation itself (Dominguez, 2006). HR outsourcing entails turning all or part of an organization's HR functions such as recruiting process, training and development, compensation and salary surveys, design and development, human resources information system, others, to external providers (Alzhrani, 2020). Greer, Youngblood, & Gray (1999) advocate an economic HR strategy to outsource the HR function. In fact, several organizations outsource all or some HR activities, since they are unable to allow talent in all sectors of the operations of the organization, either part-time or full-time, (Greer, Youngblood, & Gray, 1999). Some outsourced human resources activities include recruitment and selection, compensation, relationships with the industry, and occupational safety and health (Tom Kosnik, 2006). Despite evidence that there are both advantages and disadvantages to outsourcing HR practice the popularity of outsourcing for HR has grown quickly during the last decades, with many organizations choosing to outsource all or some of their HR activities (Agburu, Anza & Iortsuun 2017).

It is pertinent to submit here that, all forms of organizations engage in one form of outsourcing or another regardless of their size (whether small or large) (Isaksson & Lantz, 2015). Be it manufacturing, services, information technology, management services, product engineering, and research process or marketing services (Suraju & Hamed, 2013). Most firms outsource their major accounting operations to external accounting firms instead of employing accountants. They most at times have one or few accountants whose job is to record transactions and then acquire the services of external accountants who do the computation and preparation of sophisticated accounts and also audit their operations (Isaksson and Lantz, 2015). Other areas of outsourcing by firms as noted by Akewushola and Elegbede, (2013) are training of staff, advertising and other supporting activities. Human resource Outsourcing (HRO) generally, entails the outsourcing of recruitment, payroll, benefits, Human Resource Management Information System (HRIS) and training (Abdul-Halim & Che-Ha, 2011).

Organizational Performance is the output of the organization. Kotabe, Murray, and Javalagi, (1998) identifies three types of performance measures as necessary components in any outsourcing performance measurement system: strategic measures; financial measures; and quality measures. Other studies use additional dimensions of market performance such as costs savings, cycle time, customer satisfaction, and productivity to measure the effectiveness of outsourcing strategy (Goldstein, 1999). Agburu, Anza and Iortsuun (2017) posit that, organizational performance can be measured in terms of cost

savings, focus on core business (thus increasing efficiency), reduction in money spent on fixed assets (cost restructuring), reduction in tax paid (tax benefit) and increase turnover (sales). Organizational performance is seen as the output of the organization measured in terms of profitability, increase turnover, productivity, operational efficiency and organizational effectiveness (Agburu, Anza and Iortsuun, 2017).

In tracing the relevance of HR outsourcing to firm performance there has been consistency of findings that outsourcing, when well-managed, has positive effect on performance. Agburu, Anza & Iortsuun (2017) submit that, outsourcing improves organizational performance. Human resources development through outsourcing leads to increased knowledge, skills, and capacities of the people in an organization and/or the society. It accumulates human capital and its effective investment in the development of an economy (Silva, 1997). HRO plays a significant role in fostering innovation. It is no secret that business success today revolves largely around people (Agburu, Anza and Iortsuun, 2017). For innovation to take place, firms may leverage external human capital to develop organisational expertise for creating new products and services (Chen & Huang 2009). There is no limit to the areas of innovation in HR. There is increasing importance of HR to the success of other organizations' resources. This has caused many studies to give recognition to the importance of HR in firms (Akinbola, Ogunnaike, & Ojo, 2013; Awolusi, 2012; Gilley, Greer & Rasheed, 2004; Hornsby & Kuratko, 1990; Boselie et al., 2001; Chen, Huang 2007; Sung & Choi, 2014; Agburu, Anza and Iortsuun, 2017).

Over the years, human resource outsourcing has been empirically proven to be a sure way to enhanced firm performance. Management continually works towards utilization of outsourced (external) professional firms' expertise. Successful implementation of human resource outsourcing paves way for organizations' concentration on their core competencies leading to enhanced effectiveness and efficiency through cost savings, lower innovation costs, improved capacity, increased productivity, higher profitability, reduced capital investment within the firm, improved responsiveness to changes in the business environment, ensuring higher quality goods and services in the future, reduced risk of changing technology, and improved organizational competitiveness. In line with the above established merits of outsourcing, several organizations have ventured into HR outsourcing.

The benefits of an ideal outsourcing are glaring. Firms that do not outsource their human resource functions have experienced low productivity both in terms of quality and quantity, their profitability have not been stable, and their capacities are grossly underutilized. The consequence of not addressing the highlighted problems is the inability to build the needed innovative capabilities, to boost productivity and profitability in the manufacturing organizations. This would manifest in high dependency of the country on other nations for goods and services. However, the study focuses on human resource outsourcing and performance of manufacturing firms in North central, Nigeria. The study discussed human resource outsourcing, outsourcing of

recruitment process, outsourcing of training and development, outsourcing of payroll management, firm's innovativeness. The main objective of this study is on human resource outsourcing and innovativeness of manufacturing firms in north central Nigeria. The specific objectives are to:

- i. Determine the effect of outsourced recruiting process on firm's innovativeness.
- ii. Assess the effect of outsourced training and development on firm's innovativeness.
- iii. Ascertain the effect of outsourced payroll management on innovativeness.

Conceptual Framework

Human Resource Outsourcing (HRO)

Outsourcing is the process of subcontracting operations and services to other firms that specialize in such operations and services that can do them cheaper or better (or both) (Yalokwu 2006). It is also seen as the practice of hiring functional experts to handle business units that are outside of a firm's core business. She describes it as a method of staff augmentation without adding to headcount (Dominguez 2006).

HR outsourcing can be seen as the contracting of HR operations and services that are outside of a firm's core business to other firm(s) that specializes in it and can do it better or cheaper (or both). This definition supports the fact that organizations have their areas of specializations. An organization that performs its administrative and business services and operations may not perform all of them efficiently (Agburu, Anza & Iortsuun 2017).

Human resource outsourcing is described as a third-party supplier's procurement of HR services (CIPD, 2009). It is "the procurement from a third-party provider by an organization of ongoing HR services which they would normally provide themselves otherwise" (Gilley & Rasheed, 2004). Human Resource Outsourcing is the transfer of components of the HRM function or activities of a corporation to an administrator outside the corporation itself (Diaka, Anza & Isichei, 2017). In fact, several organizations outsource all or some HR activities, since they are unable to allow talent in all sectors of the operations of the organization, either part-time or full-time, (Greer, Youngblood, & Gray, 1999). Other outsourced human resources activities include recruitment and selection, compensation, relationships with the industry, and occupational safety and health (Armstrong, 2006).

Despite evidence that there are both advantages and disadvantages of outsourcing HR practice (Kosnik, Ji & Hoover, 2006; Stopper, 2005) the popularity of outsourcing for HR has grown quickly during the last decades, with many organizations choosing to outsource all or some of their HR activities. The design and management of HR functions in prevailing business environments needs thorough-depth planning that mostly includes considerable effort and. This assumption has demonstrated that the HR function has turned out to be the most common outsourcing function (Hansen, Youngblood, & Gray, 1999); Armstrong, 2006). Specific processes covered by any outsourcing arrangement vary from organization to organization. Although some

companies can outsource almost any HR system, others choose specific components such as payroll and assets (Akewushola & Elegbede, 2013).

The existing HR services offered by external service companies are increasingly standardized and effective, and are characterized by; a transparent process which provides easy access to information, usually e-enabled, both for HR system managers and employee users; processes that are connected across the entire range of HR services by the ability to apply an event-based approach where the employee provides detailed and non-friendly responses to all applicable HR responses; an incorporated service delivery method for HR programs so that all HR responses to a working-life event can be seen; the idea of an integrated software "single platform" that results in end-to-end data management and processing from many sources (Awolusi, 2012).

Inside today's companies, several factors drive HR outsourcing. Companies must provide quality and service products at competitive prices in order to remain competitive, and that means that organizations, always at the proper time, have the right sort of people. Such types of people are vital to corporate efficiency and sustainability, wherever they may be found (Igbinomwanhia et al., 2013). The reasons behind HR outsourcing are often tactical or logistical (Kang, Wu, & Hong, 2009; Houtzagers & Janssen, 2008).

Outsourcing Human Resource Functions

HR functions are outsourced to external service providers in the entire or part of the HR role of a company. Initially, this pattern indicates that outsourcing involves small segments of the HR structure, especially non-core activities such as the administration of salaries and benefits (Adler 2003).

However, many other facets of the work of HR have been added to this, including key tasks such as HR planning and design (Saha, 2005). Other outsourcing practices include education, hiring, relocation and HR information systems (Gilley et al. 2004). Whatever HR activities are outsourced, as long as they are able to have good relations with their service providers, the company will gain the maximum from those activities. Those working hard to partner the external provider were more successful than those who saw outsourcing as a way to dump transaction work on an external party. One of the most important assets of an organization is the function of human resources. The degree to which the organization can achieve its goals largely depends on its ability to attract the right quality and amount of human resource (HR) capital, grow it, retain it and sustain it (Igbinomwanhia et al., 2013).

The HR role is to ensure that, when and where required in the organization, the needed quality and number of employees is available. The general aim is primarily to encourage the company to achieve its goals through programs and assistance on all issues affecting its employees (Armstrong, 2001). This role involves creating a healthy working atmosphere in which the capacity of the workforce is fully exploited for both the

workforce and the organization. Given these critical roles, there was a continuing debate about not abolishing the HR feature (Igbinomwanhia et al., 2013). HR outsourcing in line with the works of Gitiye and Omondi (2018) and Alzhrani (2020) is measured in terms of the outsourced recruiting process, outsourced training and development, outsourced payroll management, outsourced accounting and finance management, outsourced management information systems.

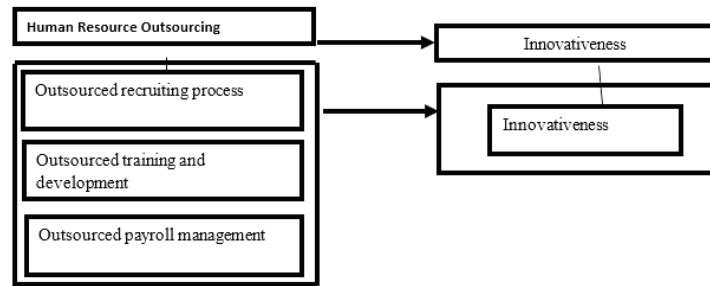


Figure 1 Conceptual Model of Human Resource Outsourcing and Innovativeness

Source: The Researcher, 2024

Outsourced Recruiting Process and Innovativeness

Outsourcing the recruitment process is a longstanding and rapidly increasing process. Recruitment process outsourcing is a form of business process outsourcing (BPO) where an employer transfer all or part of its recruitment processes to an external service providers. Recruiting Process Outsourcing (RPO) has matured in terms of size, scope and duration of contracts. RPO taps into two core reasons for outsourcing; gaining needed expertise and lowering costs (Agburu, Anza & Iortsuun 2017). Recruiting and selection activities include placing employment ads, accepting and screening resumes, initial contact interviews, referral of applicants to managers, and background/reference checks. The demand for these services can be highly variable and unpredictable making subcontracting or outsourcing a necessity during periods of rapid growth.

A global shortage of skilled professionals is driving the demand for recruitment outsourcing. Recruitment outsourcing providers offer expertise on demand by having retained teams of professional and seasoned recruiters combined with a solid track record of sourcing a multitude of professional positions, and advances in recruitment process engineering. Recruitment outsourcing began in the higher volume staffing of non-exempt employees, where specific investments in technology and standardized processes provided an advantage over in-house delivery. The market now is solidly a part of exempt, midlevel professional hiring. Nearly 90 percent of new recruitment outsourcing relationships includes professionals (Kinyua & Kwasira, 2009). This is an area where the buyer mindset has evolved from outsourcing non-core recruiting functions to absolute critical recruiting activities.

It is more common for organizations to outsource the entire recruiting function and implement centralized hubs to drive optimal performance. Recruitment outsourcing

providers know the business well enough to increase the number of contractual performance-based service level agreements, which place their fees at risk in the case of bad hires or missed hiring goals. Many organizations outsource only some functions within the recruitment process; while others are selecting a vendor to manage the entire recruiting process from end to end (Kinyua & Kwasira, 2009).

Recruitment process outsourcing (RPO) lets Talent Acquisition easily scale recruiting capacity to meet demand, better understand recruitment costs, and resolve the tensions associated with peak, valley, and even equilibrium requisition demand cycles. RPO also provides fast-changing organizations with a scalable, more cost-effective way to manage recruitment resources (Prater, 2014). Many are of the opinion that Outsourcing Recruitment process is mainly used to increase the efficiency of the organization through managerial time saving along with the cost (Corbett, 2014)

As a result of the rising competition that manufacturing firms are facing, a growing number are turning to recruitment process outsourcing to improve the quality of their hires, to elevate the success rate of the employee training programs and to increase employee retention rates. Partnering with a provider with proven expertise can enable firms to reach new heights of enterprise innovativeness (Prater, 2014). Without forgetting that recruitment specialists have more advanced techniques, including multiple sourcing channels, web-sites and recruitment software which can easily find thousands of applicants thereby increasing the probability that the best person for the job would be found (Maidment, 2014). By moving the recruitment process to a recruitment agency, a lot of time is saved by the managers for more efficient planning and innovativeness (Mansen, 2015)

Outsourced Training and Development and Innovativeness

Training is one of the most multidisciplinary functions in corporations. Corporate training is a complex and difficult operation. A small group of people are expected to build, deliver and manage a wide range of training – covering topics from field repair, sales skills, IT technology, new manager training, new hire training, all the way to executive education. Outsourcing of many functions is mandatory to deal with the wide range of training demands. Sometimes, a company needs to roll out a large program quickly and needs skilled trainers to deliver existing programs. Frequently, these functions are outsourced to seasoned training companies. This broad and constantly changing set of content forces training managers to constantly look for outsource providers for courses, seminars and events. While training is outsourced by companies for a long time, the level of outsourcing is rapidly increasing. The number of training projects and the nature of these projects have increased as more firms partner for training and development activities (Friedman, 2005).

Training outsourcing is a constant transfer of the organization and implementation of some or entire training processes to external services provider. Training outsourcing is of two types: Selective training outsourcing where selected training activities are

outsourced and Comprehensive total training where the entire training function is outsourced. The level of outsourcing is increasing rapidly nowadays based on the facts that training boosts organizational competitive advantage, and outside training and increase an organization's innovativeness (Gainey & Klass 2014).

Outsourced Payroll Management and Employee Innovativeness

Payroll activities are not strategic and are transactional rather than relational but they must be performed well because service failures can have strong negative effects on employee morale. As Lepak and Snell (1998) have noted, there is increased emphasis on making HR more cost-efficient and outsourcing has been used to reduce costs of peripheral HR functions such as payroll services. Indeed, an industry of HR service providers has evolved in part to provide lower transaction costs for activities such as payroll processing, benefits administration, and workforce development (Çiçek & Özer, 2011).

In addition, because payroll activities are transactional rather than relational, vendors can perform them with little loss of value to the organization. They also have low task and social interaction requirements and can be performed in relative isolation from other organizational activities with only limited amounts of information and coordination from other organizational units. Thus, according to the guidance provided by the Lepak and Snell (1998) model, the Speaker typology (Greer, 2001), and the Baron and Kreps (1999) model, firms should outsource payroll activities to increase firm performance, because these activities are of low strategic value, are transactional in nature, are non-unique, and do not provide a source of competitive advantage.

In order for a company to run steadily and implement ambitious HR strategies, paying everyone in the organization and on time is a basic requirement. Payroll can prove to be costly and complex which requires companies to assess payroll-related processes in order to decide on the most relevant strategy and keep this critical function under control. Payroll processing involves perhaps the most transactional, routine activity involving HR and is the most frequently outsourced HRM activity (Norman, 2016).

Rapid change in internet technology and its availability has enabled complex processes such as payroll to be outsourced because the organization and the vendor are in touch. It was established that Payroll is one of the most vital activities for a company. An employee's salary is his single largest connect to an organization and a foundation of employee motivation. Payroll information is critical and highly sensitive. Any seasoned HR person knows that it can make or break an employee's relationship with his employer. Given this scenario, the time effort needed to maintain payroll administration and data security, many corporations worldwide outsource payroll to specialists (Agburu, Anza & Iortsuun 2017).

In addition, as a result of outsourcing, HR departments may be able to obtain better service and lower costs from vendors than from in-house sources, because payroll service providers have the advantages of scale, expertise, and up-to-date technology as well as more in-depth process knowledge that may enable them to provide better service as well as lower costs (Jarvis, 1999).

Firm's Innovativeness

Innovativeness is the novelty applied to something which already exists. The change may be new to the market in general or only to a particular company (Välimäki, Niskanen, Tervonen & Laurula, 2004). Innovation is rooted in notion of novelty in global terms (Frascati Manual, 2002). These novelties are assessed indirectly by the level of various educational attainment statistics (EIS, 2005) and patent counts (Grilliches, 1990). Facilitating innovation in organizations falls into two streams. One stream looks at introducing and managing processes that might lead to innovation, while the other examines specific factors that may enhance or impede the innovativeness of an organization. Among those innovativeness factors one could further distinguish between factors that affect the development of particular products and those that operate on the organization as a whole.

Innovativeness entails success factors, strategies, and trends such good internal and external communication, effective linkages with external sources of know-how, treating innovation as a company-wide task, high quality production, careful planning and control systems, strong market orientation, top management commitment, and long-term commitment to major projects among other critical elements (Rothwell, 1994)

Human Resource Outsourcing and Firm Innovativeness

Outsourcing firm's human resource and business processes can improve firm's innovativeness. It improves competitive edge. The reason behind this is that outsourcing reduces business costs. Organizations may choose to outsource with certain business aims in mind. The aim might be the need to improve on financial performance. Most times, such organizations are aware that outsourcing firms may offer them an opportunity to work cheaply through efficient technology and economies of scale. By minimizing costs, organizations can achieve their economic related goals and this enhances their organizational performance. Consequently, the extra amount that would have been passed to the consumers in the form of higher prices for the goods and services now becomes irrelevant as consumers pay less for their commodities. This allows businesses to compete favorably based on price thus giving them a competitive edge (Isaksson and Lantz, 2015).

Organizations that do everything on their own may be exposed to greater levels of risk than those who outsource their business functions. Most time, the former mentioned organizations may face difficulties trying to balance between choosing the right alternatives, training their employees in that area of interest, increasing reliability, and maximizing efficiency. By doing everything on its own, an organization may have a difficult time trying to eliminate risks, and usually run the risk of spending too much on infrastructural capital. Consequently, this eats into their profitability and reduces their chances of growing their organization's businesses. However, through outsourcing, organizations can minimize their risks with regard to huge infrastructural expenditures and the overall result of this issue is that more investors will be attracted to such organizations (Agburu, Anza & Iortsuun, 2017).

Outsourcing is good for business because there are certain situations that can be avoided through it. For instance, organizations that perform all their business functions may have to spend huge amounts on replacing obsolete technology. However, when that business function is outsourced, then organizations will not even feel the pinch. Frayer, Scannell and Thomas (2000) suggest that companies are increasingly viewing outsourcing strategies as a means of reducing costs, increasing quality, and enhancing a firm's overall competitive position.

This means that organizations can dedicate their resources to productive activities alone and thus enhance their effectiveness and efficiency (Frayer et al., 2000). Successful implementation of an outsourcing strategy leading to innovativeness has been credited with helping to cut cost (Gupta and Zeheuder, 1994; Greer et al., 1999), increase capacity, improve capacity, improve quality (Lau and Hurley, 1997; Kotabe et al., 1998), increase profitability and productivity, improve financial performance (Crane, 1999), lower innovation costs and risks (Quinn, 2000), and improve organizational competitiveness (Lever, 1997; Sharpe, 1997; Steensma and Corley, 2000). Nevertheless, outsourcing does generate some problems, as outsourcing usually reduces an organization's control over how certain services are delivered, which in turn may raise the organization's liability exposure.

Sink and Langley (1997) posit that, several companies are working to analyze their goals and focus their resources on a relatively small number of preferred tasks and procedures within the context of modern market trends. As a result, organizations have been increasingly willing to outsource designated activities including human resource. They incorporate the dimensions of organizational success in categories including innovativeness.

Theoretical Framework

Researchers have introduced several theoretical models to explain outsourcing phenomena and guide the decision-making of outsourcing. Among the well-known theories are the resource-based theory, the resource-dependency theory, the transaction cost theory, the agent-cost theory, the power-political theory and the social exchange theory. This study stems from the resource-based theory. The Resource-based theory (RBT) can be traced to the earlier research of Penrose (1959) among other researchers. The theory is an inside-out process of strategy formulation by looking at the resources available and assessing its potential for value generation. It ends by determining a strategy to generate maximum value in a sustainable way (Grant 1996). This theory consists of five stages: analyze resources, appraise capabilities, analyze competitive advantage, select strategy, and identify resource gaps. This process uses capabilities and resources as a basic thing for a firm's long-term strategy because it shows the flow for firm strategy and become as a primary source to generate profit to firm. Capabilities are determined as the quantity for a group or team of resource to perform some activity or task. Resources are explained as the inputs including the skill of employees and items of capital equipment into the production process. Similarly, the resource-based theory is

demonstrated to be the difference between resources and capabilities of entire firms (Barney, 1996).

The competitive advantage can be created when resource and capabilities are deployed and mixed in a proper way. The Resource-based view opines that, a firm can seek for an external provider in order to overcome its weakness. Busi and McIvor (2008) suggested that firms develop resource-based advantages by developing or acquiring a set of firm-specific resources and capabilities that are valuable, rare and imperfectly imitable and for which there are no commonly available substitutes. The resource-based theory views internal organizational factors as the determinants of business strategy and performance (Busi and McIvor, 2008; Penrose, 1959; Richardson, 1972; Williamson, 1985).

Due to the nature and scarce resource base of manufacturing firms, especially in developing countries like Nigeria, such organizations turn to source for knowledge and expertise of outsiders who are not on their payroll to carry out human resource activities such as recruitment, training and development and payroll management systems. This therefore points to the relevance of the resource-based theory in explaining the HR outsourcing decisions of manufacturing firms.

Empirical Review

Nnabuife, Ndubuisi and Obiakonwa (2020) conducted research on human resource outsourcing and performance of selected banks in Delta State. The specific objective was to determine the extent of relationship between staff Outsourcing and financial performance. The study adopted Pearson product moment correlation method. The finding revealed that staff outsourcing has positive effect on financial performance. The study recommended that firms could not do every business; therefore, non-core functions should be outsourced to vendors with good track records and revisit cost components of their business.

Imbolo (2019) conducted research on impact of human resource outsourcing on organizational performance, the case of MTN, Douala, Cameroon. The specific objective was to determine the effect of recruitment outsourcing on employee performance. The study adopted the ex-post factor research design. The finding revealed that recruitment outsourcing had positive effect on employee performance. The study recommended that organizations may outsource the service if it has no capacity to do it by itself but should prioritize outsourcing of top-notch firms.

Ko (2019) conducted research on exploring the performance effects of human Resource out-sourcing in the hotel industry using survey research design and found that, outsourced training has a positive effect on both innovation and stakeholder performance. In addition, payroll outsourcing was found to positively influence innovativeness. The study therefore recommended that, practitioners should invest more in outsourcing training and payroll activities as such investment is justifiable.

Gitiye and Omondi (2018) Carried out research to investigate the effects of outsourcing employee recruitment services on performance and outsourcing of training on firm performance using case study research design and analyzed data using correlation and multiple regression techniques. Outsourcing employee recruitment services was found to result to a negative slope on firm performance, Outsourcing employee training is positively associated with employee competence, hence improving firm performance. The study recommended that, Manufacturing firms should consider assigning recruitment functions to insider management or involve them fully in case of outsourcing.

Agburu, Anza and Iyortsuun (2017) carried out a research to determine the effect of outsourcing strategies (back-office activities, primary activities, accounting activities and supporting activities) on the performance of Small and Medium Scale Enterprises (SMEs) using survey research design and found that, outsourcing of back-office activities; outsourcing of primary activities; outsourcing of Supporting activities has a significant effect on organizational profitability of SMEs outsourcing of accounting activities has no significant effect on performance of SMEs. The research recommended that, SMEs should embark more on outsourcing strategies to attain the benefits of cost savings/restructuring which results in better customer service at profit; also, outsourcing process management through follow up steps like effective communication and monitoring should be employed and taken seriously to better reap the benefits of this maintenance/growth strategy.

Jepkogei and Kiprotich (2016) conducted research on effect of outsourcing human resource activities on employee engagement at rural electrification authority, Kenya. The specific objectives were to assess the effect of recruitment outsourcing on employee engagement at Rural Electrification Authority; also, to ascertain the effect of training outsourcing on employee engagement at Rural Electrification Authority. The study adopted the survey research design and data were analyzed using regression technique. The study found that, outsourcing of recruitment services had negative effect on employee engagement. Also, outsourcing of training services had negative effect on employee engagement. The study recommended that organizations should minimize the level of outsourcing of both recruitment services and training services as means of enhancing employee engagement.

Jirawuttinunt (2015) conducted research to ascertain the effect of human resource management outsourcing on performance of multinational firms in Thailand. The specific objective was to ascertain the effect of outsourcing recruitment on organizational performance. The study adopted the survey research designed OLS regression was used for data analysis. The study found that, recruitment outsourcing had a positive effect on organizational performance. The study recommended that; firms should focus on HR outsourcing as a strategy putting more emphasis on factors of HR outsourcing that aligns with strategic goal to increase organizational performance.

Kiptum (2014) conducted research on the effect of outsourcing on organization productivity in selected parastatals in Kenya. The specific objectives were to assess the effect of recruitment outsourcing on operational cost; to determine the effect of training outsourcing on employee productivity. The study adopted the descriptive research design. The study found that recruitment outsourcing resulted in reduced operational costs, innovation and productivity. Also, outsourcing training services resulted in reduced operational costs, innovation and productivity. The study recommended that, organizations should assess current modes of outsourcing and promote the adoption of other forms of outsourcing. Also, organizations should come up with employee motivation techniques and proper communication of outsourced services

Kinyua and Kwasira (2014) conducted research on assessment of the effect of recruitment outsourcing on performance of flower firms in Nakuru County, Kenya. The specific objective was to assess the effect of recruitment outsourcing on the performance of flower firms. The study adopted descriptive research design. Data were collected from flower firms in Rongai Sub-County. The finding revealed that, recruitment outsourcing had positive effect on the performance of the flower firms. The study recommended that flower firms should enhance their outsourcing activities whilst balancing its effects on in-house employee motivation.

Gilley, Greer and Rasheed (2004) conducted research on human resource outsourcing and organizational performance in manufacturing firms in the United States. The specific objectives were to determine the effect of outsourcing of payroll on firm's performance and to determine the effect of outsourcing of training on firm performance. The study adopted the survey research design. The finding revealed that outsourcing training had positive effect on firm's performance. Also, outsourcing payroll had positive effect on firm's performance. The study recommended that organizations should venture into outsourcing of training and payroll services for enhanced performance.

Research Gap and Statement of Hypotheses

The review of empirical studies revealed a compelling necessity to determine the effect of outsourcing human resource activities on areas of improved performance in the manufacturing sector particularly innovativeness of manufacturing firms in North central Nigeria. This is because of the following reasons. Firstly, most studies on outsourced human resource activities and firm performance are conducted outside the scope of Nigeria and hence will be inappropriate in suggesting prescriptive policy recommendations to improve manufacturing firms' performance in Nigeria.

Secondly, few studies conducted in Nigeria are mostly domiciled in States rather than geo-political zones, which would present a better understanding of the link between outsourced human resource activities and firm's innovativeness. A study that investigated the link between outsourced human resource activities and firm's innovativeness in more than one state in Nigeria would better illuminate the

phenomenon, which provides additional justification for why this study was carried out.

Thirdly, most of the works reviewed focused on human resource outsourcing and firm performance using aggregate dimension of human resource outsourcing covering the entire country, thereby ignoring completely the peculiarities that exist for regions. Also, in the existing studies, there is noticeable gap as some of the works presented various levels of effect of outsourcing some human resource activities and some areas of improved performance while others revealed no or negative relationships between human resource outsourcing and performance. Again, with the passage of time for most works, such results may be considered obsolete for meaningful policy formulation and implementation.

Most studies reviewed employed global measures of human resource outsourcing and firm performance (Imbolo, 2019; Ko, 2019; Gitiye & Omondi, 2018; Jepakogei & Kiprotich, 2016; Jirawuttinunt, 2015; Kiptum, 2014; Kinyua & Kwasira, 2014; Gilley, Greer and Rasheed (2004) neglecting a multi-dimensional approach, which has been employed in this study. This study therefore, used three proxies or dimensions of human resource outsourcing as outsourced recruiting process, outsourced training and development, outsourced payroll management. Also, specific performance measure - innovativeness. It is evidently clear that no attempt to the best knowledge of the researcher has been made to examine the effect of outsourcing human resource activities on areas of performance in the manufacturing sector of the North central Nigeria.

It is also worthy of note that, most of the works reviewed were from other sectors of the economy; only few studies were from the manufacturing sector. This further study is done involving more manufacturing firms in a developing economy of Nigeria to establish the underlying reasons why firms continue to outsource HR processes despite the mixed results found by the researchers.

With genuine considerations to the economic and business building process in the North central region and the need for enhanced business performance for maximized public benefit, the choice of this work is long overdue and hereby justified. To the best of our knowledge, we are not aware of any similar study conducted in the manufacturing sector in north central Nigeria. This study is found to be unique. It has relevant data that can close the existing gap in literature and contribute to knowledge. The study therefore proposes the following hypotheses:

- Ha₁: Outsourced recruiting process has a positive effect on firm's innovativeness.
- Ha₂: Outsourced training and development positively affect firm's innovativeness.
- Ha₃: Outsourced payroll management has a positive effect on innovativeness.

Methodology

For the purpose of this research, data was collected through the use of questionnaire. Ten

(10) manufacturing firms within the North-central region of Nigeria were purposively selected. The study was conducted in the selected manufacturing firms in six states of north central Nigeria. The states are Benue, Nasarawa, Plateau, Kwara, Kogi and Niger. The selected manufacturing firms are; Mikap Nigeria Ltd, Makurdi, Benue state; Nagari Farms, Keffi, Nasarawa state; Integrated Dairies Limited (IDL), Vom, Plateau state; Olak Roofing Nigeria Limited, Ilorin West Asa Ada, Kwara; Samad Paper Converting and Stationery Company, Ilorin West Asa Ada, Kwara; Royal Ceramic Tiles Ltd Ajaokuta, Kogi State; Crest Agro Products Limited, Kogi state and Leyjay Nig. Ltd., Niger State. The time scope for the study is 2013 to 2023.

The choice of the firms is carefully made to ensure that, only viable manufacturing firms which have been in operation beyond the past five years are involved. The target population for this study comprises the top and middle level managers of each of the ten selected manufacturing firms. The functional areas in the organizations are marketing, finance, production, store/warehouse, security, transport, human resources, Cleaning and sanitation, technical, Compliance/Quality assurances and procurement. Top managers in all the eleven areas are selected. The selection of the middle level managers is however, based on the labour force strength of assistant or deputy functional managers. These categories of staff are expected to have experience and knowledge about the outsourcing practice of their firms. The population size of the study is 1151 staff from the selected manufacturing firms.

Table 1: Population Distribution

S/n	Name of firm	Top Level Managers	Middle level Managers	Total
1	Mikap Nigeria Ltd	11	30	41
2	Nagari Farms	11	70	81
3	Integrated Dairies Limited (IDL)	11	130	141
4	Olak Roofing Nigeria Limited	11	147	158
5	Samad Paper Converting and Stationery Company	11	128	139
6	Royal Ceramic Tiles Ltd	11	134	145
7	Crest Agro Products Limited	11	98	109
8	Afro Foods and Spices Limited	11	102	113
9	Leyjay Nig. Ltd	11	116	127
10	Habib Industries Limited (HIL)	11	86	97
	Total	110	1041	1151

$$n = \frac{z^2 pq + e^2}{e^2 + (z^2 pq / N)} \quad (\text{Bartlett, Kotrlik \& Higgins, 2001})$$

Where:

- n = sample size
- z = standard error of the mean (usually 95% corresponding to 1.96 in the z-distribution table).
- p = proportion of the population likely to be included in the sample (50% or 0.5 is assumed).
- q = $\frac{1-z \text{ value}}{z \text{ value}}$ (1.96)
- e = level of significance (assumed to be 5% or 0.05)

N = Population size

N = 1151, e = 5% (or 0.05), z = 1.96, p = 0.5, q = 0.5; to substitute these into the formula;

$$n = \frac{1.96^2(0.5 \times 0.5) + 0.05^2}{0.05^2 + ((1.96^2 \times 0.5 \times 0.5) / 1151)}$$

$$n = \frac{3.8416(0.25) + 0.0025}{0.0025 + ((3.8416 \times 0.0025) / 1151)}$$

$$n = \frac{0.9604 + 0.0025}{0.0025 + (0.9604 / 1151)}$$

$$n = \frac{0.9629}{0.0025 + (0.9604 / 1151)}$$

$$n = \frac{0.9629}{0.0025 + 0.0008344}$$

$$n = \frac{0.9629}{0.003334}$$

$$n = 288.812$$

$$n = 289$$

From the above computation, the sample size for the study was 289.

The researcher stratified the sample size of 289 among different manufacturing firms using proportionate sampling based on the population of each firm using the proportional allocation of Bowley 1994 population allocation formula in Nzeribe and Ilogu (1999; 201) which states:

$$nS = \frac{n(NS)}{N}$$

Where: nS = sample size per firm

n = total sample size

NS = Total number of firms in the area of operation

N = Total population size

Table 2. Allocation of the Sample Size

S/n	Name of firm	Population	Sample
1	Mikap Nigeria Ltd	41	10
2	Nagari Farms	81	20
3	Integrated Dairies Limited (IDL)	141	35
4	Olak Roofing Nigeria Limited	158	40
5	Samad Paper Converting and Stationery Company	139	35
6	Royal Ceramic Tiles Ltd	145	36
7	Crest Agro Products Limited	109	27
8	Afro Foods and Spices Limited	113	29
9	Leyjay Nig. Ltd	127	32
10	Habib Industries Limited (HIL)	97	25
	Total	1151	289

The instrument for data collection was structured questionnaire. The questionnaire is designed based on the research objectives and in strict adherence to the research questions. This research instrument is made up of two sections (Section A and B). Five-point likert scale format is used to design the questionnaire. There are 5 demographic questions and 40 questions based on the research questions in the questionnaire and 289 copies of the questionnaire are to be distributed to the top and middle level managers of the ten selected manufacturing firms in North-central Nigeria.

The collected data was presented in tables and the corresponding values in percentages. Hypotheses was tested using ordinal logistic regression (OLR) which is a non-parametric statistic that uses ordinal data. The inferential analysis (OLR) was carried out using SPSS, 20.

$$\ln \left(\frac{\text{prob (event)}}{1-\text{prob (event)}} \right) = B_0 + B_1X_1 + B_2X_2 + \dots + B_kX_k$$

Where:

\ln = the link function or the logit (Odds that an event occurs)

$B_1 \dots B_k$ = the regression coefficient

$X_1 \dots X_k$ = the predictor (independent) variables

k = the number of predictors

To check for validity, the instrument was subjected to face and content validity. To measure face and content validity, the instrument is given to experts from the academia and the industry. Also, design of the questionnaire was made easy for the respondents to tick their preferred choice from the options provided as it has been established that the longer the length of the questionnaire, the lower the response rate. Response validity was ensured by re-contacting individuals whose response appears unusual or inconsistent.

Reliability of a measure concerns its ability to produce similar results when repeated measurements are made under the same condition. To ascertain that the instrument is reliable, a test-re-test method was adopted in which copies of the questionnaire were distributed to ten (10) manufacturing firms under study. The outcome was subjected to

reliability test using the Cronbach Alpha reliability test tool on statistical Package for Social Sciences (SPSS) version 20. Referring to the questionnaire, the items are grouped into ten principal components, reflecting five outsourced human resource functions and five performance measures. The Cronbach's alpha result is presented in table 3.

Table 3. A Table Showing Questionnaire Reliability (Cronbach's Alpha Results)

S/ N	Scale	Number of Items	Cronbach's Alpha
1	Outsourced recruiting process	4	.761
2	Outsourced training and development	4	.892
3	Outsourced payroll management	4	.701
4	Firm's innovativeness	4	.742
5	Overall Cronbach Alpha	20	.929

Source: SPSS, Version, 20.0

In testing the hypotheses, the study compares the calculated value of the test statistic with critical (table) value of the statistic. The critical value is a ceiling for rejecting or accepting the hypotheses. Therefore, the decision rule in this research is to accept the alternate hypothesis if the calculated value is $\leq 5\%$ (0.05) significance level, otherwise reject.

Result and Discussion of finding

Out of the total 289 questionnaires that were distributed, 233 were retrieved while 56 were lost. Of the 233 retrieved, 20 questionnaires were wrongly filled and therefore, were discarded leaving a final sample of 213 questionnaires that were used for further analysis. This represents a response rate of 73.3 percent which is adequate.

Responses to Questionnaire Items

This section presents the responses to the questions that captured the variables of the study, which are outsourced recruiting process, outsourced training and development, outsourced payroll management, as dimensions of human resource management. The responses will also capture the dimension of performance proxied as firm innovativeness.

Outsourced Recruiting Process

Table 4: Responses to Questions on Outsourced Recruiting Process

Outsourced Recruiting Process	S D	D	N	A	SA	Total
Our firm uses recruitment agencies to fill vacancies when the workload is high and/or when the core employees are not able to handle it	10	21	16	72	94	213
Our firm acquires the services of outsourced firms to conduct job analysis and announcement of vacancies (posting, descriptions, etc.) to outside experts	7	23	30	77	76	213
Our firm contracts interviews (group interviews, assessment centres etc.) to outside experts	3	15	24	106	65	213
Our firm contracts final applicant evaluation and Post-Hire (Contracts, onboarding, legal issues, communication to IT/security/etc.) to outside professionals	7	37	43	68	58	213

Source: *Survey Data, 2023.*

Table 4 shows the respondent's views about outsourced recruiting process. For the question of whether the firm uses recruitment agencies to fill vacancies when the workload is high and/or when the core employees are not able to handle it, out of the 213 respondents, 10 representing 4.7% respondents strongly disagreed, 21 representing 9.9% respondents disagreed, 16 representing 7.5% stood undecided, while 72 representing 33.8% agreed and 94 representing 44.1% respondents strongly agreed.

For the question of whether the firm acquires the services of outsourced firms to conduct job analysis and announcement of vacancies (posting, descriptions, etc.) to outside experts, out of the 213 respondents, 7 representing 3.2% respondents strongly disagreed, 23 representing 10.8% respondents disagreed, 30 representing 14.1% stood undecided, while 77 representing 36.2% agreed and 76 representing 35.7% respondents strongly agreed.

For the question of whether the firm contracts interviews (group interviews, assessment centres etc.) to outside experts, out of the 213 respondents, 3 representing 1.4% respondents strongly disagreed, 15 representing 7% respondents disagreed, 24 representing 11.3% stood undecided, while 106 representing 49.8 % agreed and 65 representing 3.5% respondents strongly agreed.

For the question of whether the firm contracts final applicant evaluation and Post-Hire (Contracts, onboarding, legal issues, communication to IT/security/etc.) to outside professionals, out of the 213 respondents, 7 representing 3.3% respondents strongly disagreed, 37 representing 17.4% respondents disagreed, 43 representing 20.2% stood undecided, while 68 representing 31.9% agreed and 58 representing 27.2% respondents strongly agreed.

These results show that, not all manufacturing firms outsource their recruitment process but a major percentage does.

Outsourced Training and Development

Table 5: Responses to Questions on Outsourced Training and Development

Outsourced Training and Development	S	D	N	A	SA	Total
Our firm outsource training and development services to outside experts	1	6	19	89	98	213
Our firm outsource the services of outside professionals to identify training needs and training objectives	3	4	14	114	78	213
Our firm outsources the services of outside professionals to develop training content based on identified training needs.	1	22	18	97	75	213
Our firm outsources training services instead of keeping technical experts within the organization.	7	4	12	88	102	213

Source: *Survey Data, 2023.*

Table 5 shows the respondent's views about outsourced training and development. For the question of whether the firm outsources training and development services to outside experts, out of the 213 respondents, 1 representing 0.5% respondents strongly disagreed, 6 representing 2.8% respondents disagreed, 19 representing 8.9% stood undecided, while 89 representing 41.8% agreed and 98 representing 46.0% respondents strongly agreed.

For the question of whether the firm outsources the services of outside professionals to identify training needs and training objectives, out of the 213 respondents, 3 representing 1.4% respondents strongly disagreed, 4 representing 1.9% respondents disagreed, 14 representing 6.6% stood undecided, while 114 representing 53.5% agreed and 78 representing 36.6% respondents strongly agreed.

For the question of whether the firm outsources the services of outside professionals to develop training content based on identified training needs, out of the 213 respondents, 1 representing 0.5% respondents strongly disagreed, 22 representing 10.3% respondents disagreed, 18 representing 8.5% stood undecided, while 97 representing 45.5% agreed and 75 representing 35.2% respondents strongly agreed.

For the question of whether the firm outsources training services instead of keeping technical experts within the organization 213 respondents, 7 representing 3.3% respondents strongly disagreed, 4 representing 1.9% respondents disagreed, 12 representing 5.6% stood undecided, while 88 representing 41.3% agreed and 102 representing 47.9% respondents strongly agreed.

These results show that, not all manufacturing firms outsource their training and development but a major percentage does.

Outsourced Payroll Management

Table 6: Responses to Questions on Outsourced Payroll Management

Outsourced payroll management	S D	D	N	A	SA	Total
Our firm outsources payroll services from outsourced firms	2	5	15	83	108	213
Our firm outsources our firm's employee compensation to outside vendors	4	7	13	89	100	213
Outsourced firms come up with pay systems on behalf of our organization	26	28	39	81	38	212
Pay structures are determined by consultants engaged by our firm with the guide of collective bargaining agreement	33	51	44	67	18	213

Source: *Survey Data, 2023.*

Table 7 shows the respondent's views about outsourced payroll management. For the question of whether the firm outsources payroll services from outsourced firms, out of the 213 respondents, 2 representing 0.9% respondents strongly disagreed, 5 representing 2.3% respondents disagreed, 15 representing 7.0% stood undecided, while 83 representing 39.0% agreed and 108 representing 50.7% respondents strongly agreed.

For the question of whether the firm outsources our firm's employee compensation to outside vendors, out of the 213 respondents, 4 representing 1.9% respondents strongly disagreed, 7 representing 3.3% respondents disagreed, 13 representing 6.1% stood undecided, while 89 representing 41.8% agreed and 100 representing 46.9% respondents strongly agreed.

For the question of whether outsourced firms come up with pay systems on behalf of our organization, out of the 213 respondents, 26 representing 12.2% respondents strongly disagreed, 28 representing 13.1% respondents disagreed, 39 representing 18.3% stood undecided, while 81 representing 38.0% agreed and 38 representing 17.8% respondents strongly agreed.

For the question of whether the firm's pay structures are determined by consultants engaged by our firm with the guide of collective bargaining agreement, out of the 213 respondents, 33 representing 15.5% respondents strongly disagreed, 51 representing 23.9% respondents disagreed, 44 representing 20.7% stood undecided, while 67 representing 31.5% agreed and 18 representing 8.5% respondents strongly agreed.

These results show that, not all manufacturing firms outsource their payroll management but a major percentage does.

Table 8. Responses to Questions on Firm Innovativeness

Firm's Innovativeness	S D	D	N	A	SA	Total
Our firm's outsourcing over the years has led to enhanced systems or technologies	1	0	7	106	99	213
Our firm's outsourcing over the years enables the newest HR technology to be approached and applied by the organization	2	6	17	102	81	208
Our firm's outsourcing over the years has led to accurate staff data collection and utilization	77	69	16	33	18	213
Our firm's outsourcing over the years has led to real time access to latest human resource information system technologies	67	60	31	35	19	212

Table 8 shows the respondent's views about firm's innovativeness.

For the question of whether firm's outsourcing over the years has led to enhanced systems or technologies, out of the 213 respondents, 1 representing 0.5% respondents strongly disagreed, 7 representing 3.3% stood undecided, while 106 representing 49.8% agreed and 99 representing 46.5% respondents strongly agreed.

For the question of whether the firm's outsourcing over the years enables the newest HR technology to be approached and applied by the organization, out of the 208 respondents, 2 representing 0.9% respondents strongly disagreed, 6 representing 2.8% respondents disagreed, 17 representing 8.0% stood undecided, while 102 representing 47.9% agreed and 81 representing 38.0% respondents strongly agreed.

For the question of whether firm's outsourcing over the years has led to accurate staff data collection and utilization, out of the 213 respondents, 77 representing 36.2% respondents strongly disagreed, 69 representing 32.4% respondents disagreed, 16 representing 7.5% stood undecided, while 33 representing 15.5% agreed and 18 representing 8.9% respondents strongly agreed.

For the question of whether the firm's outsourcing over the years has led to real time access to latest human resource information system technologies, out of the 212 respondents, 67 representing 31.5% respondents strongly disagreed, 60 representing 28.2% disagreed, 31 (14.6%) stood undecided, while 35 representing 16.4% agreed and 19 representing 8.9% respondents strongly agreed.

These results show that, not all manufacturing firms believe that their human resource outsourcing leads to innovativeness but many do.

Mean, Standard Deviation and Correlation of Independent Variables

This study also evaluated the mean, standard deviation and correlation of the

independent variable to test whether they are highly correlated; a condition that if violated impacts on the ordinal logistic regression result.

Table 9: Mean, SD and Correlation of Independent Variables

	Mean	SD	ORP	OT&D	OPM
ORP	4.57	.584	1.000		
OT&D	4.22	.606	.259***	1.000	
OPM	2.58	1.322	-.046	-.175**	1.000

Note: ***p = 0.000; **p = 0.01; *p = 0.05

ORP = Outsourced recruitment process; **OT&D** = outsourced training and development; **OPM** = outsourced payroll management.

The Table 9 captures the correlation among the independent variables. ORP correlates significantly with OT&D (R = 0.259, p = 0.000) but fails to correlate with OPM (R = -0.046, p = 0.505). OT&D on the other hand correlates significantly with OPM (R = -0.175, p = 0.011). All the significant correlations among the independent variables did not indicate high correlations suggesting that multicollinearity is not an issue in this study, a necessary condition for the testing of the hypotheses using ordinal logistic regression analysis. For the mean and SD, the result shows as follows: ORP (Mean = 4.57; SD = .584); OT&D (Mean = 4.22; SD = .606); OPM (Mean = 2.58; SD = 1.322).

Ordinal Logistic Regression Model

Model 1 evaluated whether outsourced recruiting process predicted the likelihood of manufacturing firms to achieve innovativeness; Model 2 evaluated whether outsourced training and development predicted the likelihood of manufacturing firm's innovativeness; also, in Model 3, outsourced payroll management predicted the likelihood of manufacturing firm's achieving innovativeness.

Overall Model Fit of Ordinal Logistic Regression Model

Prior to testing the hypotheses, the model fit of the ordinal logistic regression model is evaluated. Two fit indices are evaluated: the model fit information (see Table 10) and the Goodness-of-Fit (see Table 11). While the model fit information tests the full model using -2 Log Likelihood Chi-Square against the intercept-only model to determine whether there is an improvement with a p-value < 0.05 indicating model fit, the Goodness-of-fit index shows a good fit when the p-value > 0.05 using the Pearson Chi-Square. As Table 9 and Table 10 shows, the model fit information and the Goodness-of-fit all satisfy the criteria indicating that the five (5) ordinal logistics regression models demonstrate adequate model fit, a necessary condition prior to testing the hypotheses.

In Table 10, the model fit information for Model 1 [$\chi^2(1) = 7.076, p = 0.008$], Model 2 [$\chi^2(1) = 8.839, p = 0.003$], Model 3 [$\chi^2(1) = .304, p = 0.581$] all satisfy the p-value < 0.05 criteria except for Model 3. For Model 3, the model fitting information reveals that there is no

statistically significant difference between the intercept-only model and the final-model with the predictor variable.

Table 10: Model Fitting Information for Model 1 – Model 3

		-2 Log Likelihood	Chi-Square	Df	Sig.
Model 1	Intercept Only	37.748			
	Final	30.672	7.076	1	.008
Model 2	Intercept Only	53.402			
	Final	44.563	8.839	1	.003
Model 3	Intercept Only	96.730			
	Final	96.425	.304	1	.581

Link function: Logit.

Source: Author Computations (2023)

On the other hand, the Goodness-of-fit indices, which is the Pearson Chi-Square value for Model 1 [$\chi^2(8) = 8.573, p = 0.380$], Model 2 [$\chi^2(11) = 16.710, p = 0.117$], Model 3 [$\chi^2(15) = 45.033, p = 0.000$] is also captured in Table 4. All the models demonstrated model fit as indicated by p-value > 0.05 except for Model 3 respectively.

Table 11: Goodness-of-Fit for Model 1 – Model 3

		Chi-Square	Df	Sig.
Model 1	Pearson	8.573	8	.380
	Deviance	8.561	8	.381
Model 2	Pearson	16.710	11	.117
	Deviance	13.157	11	.283
Model 3	Pearson	45.033	15	.000
	Deviance	41.496	15	.000

Link function: Logit.

Source: Author Computations (2023).

Test of Hypotheses

As earlier indicated, three ordinal logistic regression models were evaluated in this study. Model 1, 2 and 3 were used to test Hypotheses 1, 2 and 3 respectively. To evaluate the significance of the path coefficient, the B-values tested with the Wald chi-square statistic was used. The B-values are the logistic regression coefficients with negative B-values indicating a negative relationship (the likelihood of falling in the lower category of the dependent variable for an increase in the independent variable) while positive B-values indicate positive relationship (the likelihood of falling in the higher category of the dependent variable for an increase in the independent variable).

Hypothesis One (Ha₁)

Hypothesis one was stated that outsourced recruiting process has a positive effect on firm's innovativeness. Based on the result of the ordinal logistic regression as shown in Table 7, the hypothesis is accepted based on the following information: B = 0.633, Wald

$\chi^2(1) = 6.973, p = 0.008$. This indicates that outsourced recruiting process has a significant positive effect on firm innovativeness of manufacturing companies in North Central Nigeria. The pseudo R^2 statistic, which captures the variation in the dependent variable measured as firm's innovativeness is assessed using the Cox and Snell R-Square and the Nagelkerke R-Square statistics. Going by the result, the variation in firm innovativeness from outsourced recruiting process range from 0.033 to 0.040 (3.3% to 4.0%) respectively.

Table 7: Test of Hypothesis One

	Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Threshold [f_INN = 1]	-2.539	1.445	3.086	1	.079	-5.371	.294
[f_INN = 2]	-.423	1.110	.145	1	.703	-2.597	1.752
[f_INN = 3]	2.958	1.108	7.133	1	.008	.787	5.129
Location oRP	.633	.240	6.973	1	.008	.163	1.102

Link function: Logit.

Note: oRP = outsourced recruiting process; f_INN = firm innovativeness

Source: Author Computations (2024)

Hypothesis Two (Ha₂)

Outsourced training and development was stated as having a significant positive effect on firm's innovativeness. This hypothesis was accepted which indicates that outsourced training and development has a significant positive effect on innovativeness of manufacturing companies in North Central Nigeria. This decision is based on the result as shown in Table 8 as follows: $B = .691, Wald \chi^2(1) = 9.480, p = 0.002$. The variation in firm's innovativeness from outsourced training and development based on the Cox and Snell R-Square and the Nagelkerke R-Square statistics ranges from 0.041 to 0.047 (4.1% to 4.7%) respectively.

Table 8: Test of Hypothesis Two

	Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Threshold [f_INN = 1]	-1.329	1.109	1.436	1	.231	-3.502	.845
[f_INN = 2]	-.440	1.020	.186	1	.666	-2.438	1.558
[f_INN = 3]	.772	.981	.619	1	.431	-1.152	2.696
Location oT&D	.691	.224	9.480	1	.002	.251	1.131

Link function: Logit

Note: oT&D = outsourced training and development; f_INN = firm innovativeness

Source: Author Computations (2024)

Hypothesis Three (Ha₃)

Hypothesis three was stated that outsourced payroll management has a positive effect on firm's employee motivation. Based on the result of the ordinal logistic regression as shown in Table 9, the hypothesis is rejected based on the following information: B = 0.054, Wald $\chi^2(1) = 0.321$, p = 0.571. This indicates that outsourced payroll management has no significant positive effect on the innovativeness of manufacturing companies in North Central Nigeria. The variation in innovativeness from outsourced payroll management based on the Cox and Snell R-Square and the Nagelkerke R-Square statistics is minimal with a range from 0.001 to 0.002 (0.1% to 0.2%) respectively.

Table 9: Test of Hypothesis Three

		Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[f_INN = 1]	-2.265	.325	48.609	1	.000	-2.901	-1.628
	[f_INN = 2]	-1.442	.279	26.707	1	.000	-1.989	-.895
	[f_INN = 3]	-.772	.262	8.706	1	.003	-1.285	-.259
Location	oPM	.054	.095	.321	1	.571	-.132	.240

Link function: Logit.

Note: oPM = outsourced payroll management; INN = firm innovativeness

Source: Author Computations (2024)

Discussions of Findings

In this study, the effect of human resource outsourcing on the innovativeness of manufacturing companies in North Central Nigeria was evaluated. Three hypotheses were tested which were evaluated using three ordinal logistic regression models. While Model 1 evaluated hypothesis 1, Models 2 and 3 evaluated Hypotheses 2 and 3 respectively. In this section, the discussion of the results will be presented.

Hypothesis One (Ha₁): Outsourced recruiting process has a positive effect on firm's innovativeness.

Hypothesis one was stated that outsourced recruiting process has a significant positive effect on the innovativeness of manufacturing companies in North Central Nigeria. The result as shown supports this hypothesis indicating that outsourced recruiting process has a significant positive effect on innovativeness. The implication is that for every unit increase in outsourced recruiting process, there is an increasing probability that manufacturing companies in North Central Nigeria will improve their innovativeness. This research finding agrees with the studies by Imbolo (2019) who found that recruitment outsourcing had positive effect on employee performance; Jirawuttinunt (2015) who found that, recruitment outsourcing had a significant impact on organizational performance; Kiptum (2014) who found that, recruitment outsourcing resulted in reduced operational costs, innovation and productivity; Kinyua and Kwasira (2014) who found that recruitment outsourcing had effect on the performance of flower

firms. The researches by Ibolo (2019), Jirawuttinunt (2015), Kiptum (2014) and Kwasira (2014) among others are consistent with the findings of this research. This research has therefore been affirmed by the earlier researches and have taken a step ahead to emphasize the effect of outsourcing recruitment process on specific area of performance improvement which is innovativeness.

The research however, opposes the studies of Gitiye and Omondi (2018) who found that, outsourcing employee recruitment services resulted to a negative slope on firm performance; Jepkogei and Kiprotich (2016) who found that, outsourcing of recruitment services had negative influence on employee engagement. The research by Gitiye and Omodi (2018) was carried out at Capwell industries limited Kiambu county, a manufacturing company in Kenya; the research by Jepkogei was also done in Kenya at the rural electrification authority, Kenya. Both researches considered performance as a generic variable and resulted in finding a negative effect. Our research took a step ahead to assess a specific area of performance improvement which is innovativeness and has resulted in an updated finding that, recruitment process outsourcing lead to enhance performance inform of innovativeness.

Hypothesis Two (Ha₂): Outsourced training and development positively effects firm's innovativeness.

Hypothesis two was stated that outsourced training and development has a significant positive effect on manufacturing companies' innovativeness in North Central Nigeria. Based on the ordinal logistic regression result, this hypothesis is supported which shows that outsourced training and development has a significant positive effect on firm innovativeness. The implication is that for every unit increase in outsourced training and development, there is an increasing probability that the innovativeness of manufacturing companies in North Central Nigeria will increase proportionately.

This research finding agrees with the studies by Ko (2019) who found that Outsourced training has a positive effect on both innovation and stakeholder performance; Gitiye and Omondi (2018) who found that, outsourcing employee training is positively associated with innovativeness, hence improving firm performance; Jirawuttinunt (2015) who found that, training administration has a significant impact on organizational performance; Kiptum (2014) who found that, outsourcing training services resulted in reduced operational costs, innovation and productivity; Gilley, Greer and Rasheed (2004), outsourcing training had effect on firm's innovation. The researches by Ko (2019), Gitiye and Omondi (2018), Jirawuttinunt (2015), Kiptum (2014) and Gilley, Greer and Rasheed (2004) among others are consistent with the findings of this research. This research is therefore been affirmed by the earlier researches and have taken a step ahead to emphasize the effect of outsourcing training and development on specific area of performance improvement which is innovativeness.

The research however, opposes the study of Jepkogei and Kiprotich (2016) who found that, outsourcing of training services had negative influence on employee engagement.

The research by Jepkogei and Kiprotich (2016) was done in Kenya at the rural electrification authority, Kenya. The research considered performance as a generic variable and resulted in finding a negative effect. Our research took a step ahead to assess a specific area of performance improvement which is competitiveness and has resulted in an updated finding that, outsourcing training and development leads to enhance performance inform of firm's competitiveness.

Hypothesis Three (Ha₃): Outsourced payroll management has a positive effect on innovativeness.

Hypothesis three was stated that outsourced payroll management has a significant positive effect on firm innovativeness of manufacturing companies in North Central Nigeria. The evidence did not support this hypothesis and was therefore rejected in favor of the null hypothesis that outsourced payroll management has no significant positive effect on innovativeness of manufacturing companies in Nigeria.

This research finding disagrees with earlier studies which established the positive role of outsourced payroll management on performance. For instance, Jirawuttinunt (2015) found that payroll management has a significant impact on organizational performance; also, Gilley, Greer and Rasheed (2004) found that, outsourcing payroll had positive effect on stakeholder performance of firms.

This research however, took a step ahead to assess a specific area of performance improvement which is firm innovativeness and has resulted in an updated finding that, outsourcing payroll management does not enhance performance inform of firm's employee motivation.

Conclusion

Based on the above findings, this research concludes that, just like other forms of organization, manufacturing firms outsource. They have over the years embarked on outsourcing of activities such as recruiting process, training and development and payroll management. The outsourcing of recruiting process and training and development activities have over the years led to their increase in innovativeness. There is however, negative effect of payroll outsourcing on employee innovativeness.

Recommendations

Based on the findings above, the following recommendations are made;

- i. Manufacturing firms should embark more on outsourcing of recruitment process for it results in innovativeness.
- ii. Manufacturing firms should also, embark on outsourcing of training and development which results in innovativeness.
- iii. Manufacturing firms should avoid the outsourcing of payroll management role to avoid the negative effect it has on innovativeness.

Limitations of the study

Aside the common but less strong limitations to research such as time pressure for the work, lack of resource materials, financial constraint, others, this research is constrained by;

- i. Lack of records: Ordinarily one would have preferred to present and analyze financial records of all these organizations to arrive at the implication of their outsourcing practices but due to the presence of insufficiently and so skeletal records, this research has depended on the responses of the management staff of manufacturing firms to arrive at the financial implication of their outsourcing practices. This is a threat to this research as a common error or misinformation by the respondents can mar the truism of its findings.
- ii. Limited scope: This study is limited by its small sample across a wide range of business sectors and organizations. Here, only 233 management staff across 10 firms are sampled among the almost uncountable manufacturing firms in Nigeria.

Suggestions for Further Studies

Earlier researches on human resource outsourcing and firm performance, including those of Imbolo, 2019; Ko, 2019; Gitiye & Omondi, 2018; Jepkoge & Kiprotich, 2016; Jirawuttinunt, 2015; Kiptum, 2014; Kinyua & Kwasira, 2014; Gilley, Greer and Rasheed (2004) employed global measures of human resource outsourcing and performance thereby neglecting a multi-dimensional approach. Their researches have resulted in mixed findings with some finding no or negative relationship while most found a positive relationship between human resource outsourcing and performance.

This research took a step further to replicate their researches here in Nigeria with more specificity using three dimensions of human resource outsourcing as outsourced recruiting process, outsourced training and development and outsourced payroll management. Also, a specific performance measure, innovativeness. These recent researches and ours notwithstanding, there is need for research to ascertain effects of these human resource outsourcing strategies on the specific areas of performance in other sectors such as those in the service industry and Small and Medium scale enterprises.

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LANGUAGE EDUCATION AND THE FUTURE

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Abstract

What will the language education of the future look like? This is the big question which this paper sets out to answer. While forced at home because of COVID 19, we have already seen a sneak peak. According to UNESCO data, School closure in March 2020 affected about 80% of the student population in the world, as during the pandemic, the only tool to allow the continuation of education has been online teaching both in formal and informal education. The pandemic has no doubt accelerated deep transformations in teaching and learning. Online learning will not replace educational institutions as we have come to know them, but it is destined to increasingly shape the future of the education industry. The paper concludes that considering all the potential benefits of a fully developed virtual classroom, a positive vision of the future of language learning and teaching will be more authentic, decentralized, distributed, democratized and accessible to all.

Introduction

Language can be described as the tool of significant expression since it provide individuals with the much needed tools for the expression of their thoughts and the exploitation of their own environment. (Onah 2013). Thus language which is commonly referred to as a medium of communication is a vehicle of people's culture, a mirror of their identity; it is the people's soul and power, which enables them to effectively participate in community activities, Bloroditsky (2001) affirms that language shapes the thoughts and emotions, determining one's perception of reality. Above all, language fosters peace, mutual understanding and the development of a democratic culture (Grin and Dalftary, 2003). No wonder then that the Federal Government of Nigeria emphasizes the need for the effective teaching and learning of language across the disciplines in Nigerian institutions of learning an encapsulated in the National Policy on Education (2004:5) thus:

Government appreciates the importance of language as a menas of promoting social interaction and national cohesion and preserving cultures. Thus every child shall learn the language of the immediate environment. Furthermore, in the interest of national unity it is expected that every child shall be required to learn one of the three Nigerian languages: Hausa, Igbo, Yoruba.

Language Education in Nigeria

In Nigeria's philosophy of education, education is described as an instrument for National development. To this end, the formulation of ideas, their integration for national development, and the interaction of persons and ideas are all aspects of education. FRN (1998) equally acknowledges that for the philosophy to be in harmony with Nigeria's national goals, education has to be geared towards self-realization, better human relationships, individual and national unity as well as towards social cultural, economic political scientific and technological progress. The national educational goals which derive from the philosophy are therefore the inculcation of the right type of values and attitudes for the survival of the individual and the Nigerian society. From the foregoing, it is clear that the National Policy on Education appreciates the importance of language and education as a means of promoting social interaction, national cohesion and preserving our cultural values.

Language Education in Africa

Obanya (1998) states that the choice of languages for education in Africa has been based on a number of factors among which.

- i. The historical experience of colonialism.
- ii. Political evolution after the attainment of independence.
- iii. The socio-linguistic contours of each country, and
- iv. The strength of linguistic and educational lobbies in various countries.

This paper looks at the colonial experience as key to understanding the topic under discussion. Most African countries were colonized from about the middle of the 19th century to the 1960s. Each colonial master (power) imposed its own language on the African countries it colonized. Countries colonized by the French taught the French language at all levels, and from the first day in school; Countries colonized by the Spanish and the Portuguese had a practice very similar to that of the French; Countries colonized by the British taught English to all levels, but always made sure that the first years of formal education were conducted in the first language of the learners or in the language of their immediate environment.

As a result of their colonial past African children are still educated predominantly through the medium of a foreign languages. Since the foreign languages are major international languages, they help in the transfer of science and technology. But they are foreign and are therefore limited as media of education, in their capacity to serve many of the personal, local and national objectives of the educational system. This has hindered the potentials of the indigenous languages from being fully exploited. Being that education through the medium of mother tongue ensures that a child's educational development is rooted in his own cultural heritage. This notwithstanding, the foreign languages have become prerequisite for acquiring science and technology. Thus western education, scholarships, business and science and technology were rendered impossible without acquiring these languages. Besides, foreign languages are viewed as symbols of

powers and means of securing good, secure jobs. (Criper and Widdowson, 1975, quoted in tappes-comax 1990-94, and Fafunwa (ed) 1970-78)

What Will Language Learning Look Like in The Future?

Traditionally, formal language lessons took place in a classroom with students at their desks and a teacher at the front. Almost all speaking and listening practices took place in this format, and students were given grammatical and vocabulary-based tasks to complete in their own time. This typical model has already changed or is being changed a great deal as more and more language schools/classrooms have embraced the virtual classroom and many have taken their teaching online. Educational softwares, particularly learning management system (LMS) have made managing these processes for easier.

The Internet

The internet has provided countless opportunities for learners and language users to access teaching online via websites, apps and learning softwares. However, there is still a great deal of benefits to be gained from working with a real teacher, whether through in-person contact or via a virtual classroom.

Many Language schools are already offering a blended learning model to their students. This means that learners get all the benefits of working with experience teachers, but they are also able to access resources, activities and assessments on demand from the cloud. This can be hugely effective and its highly likely that this teaching method will become the educational standard of the future.

The Language Class Can Hold Anytime Anywhere

We are moving ever closer to a twenty four hour society. More and more people will be able to access the language learning resources they need whenever they want no longer will students be happy with static courses that run at fixed time each week. Instead, they will want to be able to access the virtual classroom at a time that suits them. This implies that language schools will have to invest in (LMS) softwares to enable them to meet these requirements.

Learning Will Be Done on Handled Devices

Learning has moved from the classroom, through teaching online and into handheld devices such as tablets and smartphones. Language learning apps have quickly become very popular. Thus in the future we believe that students will no longer be satisfied with solely activity based mobile learning. Instead they will want to access all the traditional benefits of learning from a teacher; but they will want it from a virtual classroom on their mobile device.

Feed Back Will Be Instant

The days of waiting for a week or more to receive grades and feedback on projects work are very likely to soon become a thing of the past. Learning management soft wares

(LMS) is making the assessment process far more efficient. Presently most examining bodies like JAMB and even most colleges and universities have adopted computer-based exams where results are released to the candidates without delay unlike in the past when it takes a longer time before candidates could get their results. With this, language learners are now able to receive instant feedback on digital activities including revision, vocabulary practice, pronunciation techniques and assessments. When schools provide teaching online, this assessment automation is often one of the biggest benefit.

Virtual Campuses Will Be A Necessity

Digital learning spaces are becoming more and more ubiquitous. They are beneficial for students who are learning at a distance and are unable to access in-person facilities. However, they are also very popular with students who don't have geographical constraints. The virtual classroom and the wider virtual campus gives students the freedom to access learning resources from wherever they are. This could be the other side of the world, or it could just be from the comfort of their own homes a few streets away from the language school.

Learning Will Be More Flexible

One of the major benefits of the growth of the digital world is that it has given in for greater flexibility. This flexibility allows to have far more control over the space of their own learning. They are able to use a virtual classroom within a learning management software (LMS) to access learning materials and facilities on demand. This means that they are able to work through materials as quick or as slowly as they choose. They can also gravitate towards the types of learning content they know works best for them, switching between revision activities and live teaching online whenever they want.

Advantages of The Virtual Classes to Language Schools

Increase student volume while saving costs.

Virtual classes are exceedingly efficient and helpful for language schools as it allows schools to increase the volume of students they enroll each year while at the same time saving them costs. Hosting virtual classes for many students is easy with right virtual classroom software and that means language schools can offer courses to more students, without ever having to increase in physical structure. Students can sit through live or recorded virtual classes from the comfort of their own homes or offices and language schools can focus on delivering the best quality language training available. They also save in time and resources needed to attend face to face classes – no transportation costs e.t.c

Virtual Classes increase profitability:

More students plus saved costs equals increased profitability. There is a huge economic drive for language schools to support virtual classes because it effortlessly increases their profit margins. They can broadcast a live class via one single virtual classroom to hundreds of students around the world and turn a profit from it. Provide a flexible learning environment.

Provide a flexible learning environment:

Tailored to the new generation learners who are also attracted by technological development, allowing them the power to attend and actually learn from virtual classes. If a language school can provide a learning environment that is flexible, adaptable, easy to use and rich in interesting content, then students will not only achieve success, but they will tell everyone what they know about how great their language school is.

Reduce Student Abandonment

As earlier stated, virtual classes create a highly flexible and adaptable learning environment for administrators, teachers and students. As a result, students feel happier with their training and there is a decrease in the amount of students that abandon the course before completing it. They are also more likely to recommend courses to friends and family members they know would also benefit from this system of learning.

Virtual Classrooms integrated with web access:

Offering a consistent learning environment is almost as important as offering a flexible one. Students become unmotivated when e learning courses become complicated with too many username and passwords or login websites. That is why it is important for language schools to have virtual classes that are built into the same LMS platform where they access their courses to virtual classrooms with the click of a button under one single website. Administrator can manage virtual classes, student enrollment, hire classes recordings, student evaluation and more, all from one single sign only that simplifies their administrative tasks.

Virtual classes provide access to native speaking teachers in other geographical areas:

Some language schools are in geographical areas that make it difficult to hire native language teachers for their school. Virtual classes can help them provide native language instruction to their students that they would otherwise not have access to. This makes the students feel more confident in their language instruction and are likely to develop strong language skills as a result.

Conclusion

To conclude, the answer to the question “what will the language education of the future look like?” We can confidently say, online and virtual learning numbers will continue to grow rapidly. There are some exiting developments in the virtual space involving language education and it will be fascinating to watch how that develops in the near future. The way language learners expect to digest education content will also continue to drive change, and platforms such as Futurelearn are an excellent way for educators to deliver flexible options. Finally, considering all the potential benefits of a fully developed virtual classroom, a positive vision of the future of language learning and teaching will be more authentic, decentralized, distributed, democratized and accessible to all.

Recommendations

Because e learning is inevitable in the current dispersion every language school should

aim at providing their staff, students and teachers with the best available environment possible. We think the best way to plan for the future of education is to embrace the most advanced and up to date technology now. Language schools who aren't already offering virtual classrooms to their students may want to look into the software options that are available to them. The future language learning has a great deal to get excited about. The virtual classroom, provided by a learning management system (LMS) is going to play a huge role. Students will be able to get access all the resources they need from one virtual environment. As educational platforms are cloud based students will be able to get the access without having to download or purchase any software of their own.

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EFFECT OF FIRMS ATTRIBUTES ON EARNINGS MANAGEMENT OF LISTED INDUSTRIAL GOODS COMPANIES IN NIGERIA

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Abstract

The purpose of this study is to examine the effect of corporate attributes on earning management of listed industrial goods companies in Nigeria for the period of five (5) year, from 2016 to 2020. The population of the study is all the seventeen (17) listed industrial goods companies from where the twelve (12) constitute the working population of the study. Secondary data was extracted from the sampled institution's published annual audit report and CBN's annual reports for the five years under review. This study used descriptive statistics, correlation and multiple regressions to analyze the data. Earning management was measured using discretionary accruals (DAC) while corporate attributes was measured by firm size, leverage and liquidity. The results revealed that firm size and liquidity have significant effect on discretionary accruals (DAC). However, leverage has insignificant effect on discretionary accruals (DAC). This shows that corporate attributes significantly affects earning management of listed industrial goods companies in Nigeria. The study concluded that bigger firms tend to maintain their reputation in the market, thereby involving more discretionary accruals. Evidence from the study further reveals that a significant positive relationship exists between firm attributes and discretionary accruals (earnings management). This result appear to corroborate the suggestion that firm attributes is a variable that tends to influence a firm's tendency to manage earnings and might affect the magnitude of earnings. Recommendations made include: that firm should control their debt level in order to reduce the manipulation in accrual management. As companies capitalized on the size of the firm enhances the manipulation of financial statement by management for the purpose of increasing the company's profitability position.

Keywords: Firm Size, Leverage, Liquidity and Discretionary Accruals.

Introduction

Earnings management is a decision taken by managers in manipulating financial reports for the benefit of a handful of people. The level of earnings management practices that occur in a company can reflect good or bad management in a company. The level of earnings management practice can be high or low depending on several factors, such as company control factors. Control and monitoring carried out by the company will certainly affect the decisions taken by the managers of a company. A good company will certainly maintain that there are no earnings management practices that occur in the company because when there is such a practice it can harm some parties related to the company and benefit a handful of parties who have certain goals (Khanh & Thu, 2019).

However, questions are raised as to how the practice of earnings management is continuing to accelerate despite the amount of regulations and standards governing the reporting process (Zafar, Naveeda, Munawar & Muhammad, 2020). It has been noted that financial managers tend to window dress their figures in order to increase their compensation and job security, avoid breaching contracts with lenders, reduce regulatory costs or increase regulatory benefits (Supardi & Eka, 2018). The practice of earnings management is not only experienced in developed nations, it is also common in the emerging markets. In India, companies have become notorious for practicing earnings management for various reasons such as performance based incentives, personal gain of management and to achieve certain earnings targets. Earnings management and leverage has taken different turn. Quiet numbers of literature agree that managers engage in earnings management practices to avoid debt covenants violation. Thus, leverage has positive relationship with earnings management. Others assumed that leverage is a way to reduce agency conflicts between shareowners and managers and to reduce the information asymmetry cost. Closer monitoring by debtors could discourage managers from manipulating their profit (Muhammad, Ahmad, Khan, & Khan, 2018). Leverage consists of various financial instrument or borrowed capital such as margin used to increase the potential return of an investment of a firm. It is that amount of debt used to finance a firm's assets (Ayu, Zuraida & Mulia, 2018). Leverage can be obtained by comparing the level of a firm's total debt to the total book value of the firm's assets (Mahawyahrti & Budiasih, 2017).

According to Agustia and Suryani (2018), it is explained that leverage is a ratio used in assessing the amount of company assets that are financed using debt. Where companies that have many assets that are financed from the use of debt tend to carry out activities to increase the amount of profit, where this occurs because of the result of high interest expenses. If it is referred to from the theoretical understanding above regarding leverage, logically if a company has a little debt then it is considered that the company is in good condition and vice versa. It is possible for managers to manipulate financial statements in order to maintain the condition and image of the company in the eyes of investors. Leverage is debt used by the company to finance its assets in order to carry out its operational activities. The greater the company's debt the greater the risk faced by the

owner so that the owner will ask for higher profit levels so that the company is not threatened in liquidation.

Liquidity is the term used to describe how easy it is to convert assets to cash. The most liquid asset, and what everything else is compared to, is cash. This is because it can always be used easily and immediately. Liquid assets are important to have in times of crisis or emergency because they are so easily converted into cash. Without liquidity, money can become tied up in systems that are difficult to cash out of and even more difficult to assess for actual cash value. During times of emergency, large financial institutions shut down, making it difficult for people to access the cash they need to buy essentials like food, gasoline and other emergency supplies (Badreldin & Zaroug, 2016). Liquidity is a concept that many investors fail to take into account or understand and as a result their financial plans fail to come through in such critical times as retirement or college funding for a dependent (Ajibike & Aremu, 2015).

The industrial Goods sector listed on the NSE comprises of four different sub sectors namely: building materials, the electrical and electronics products, the packaging/container, and the tool and machinery (NSE Fact book, 2012). The sector is made up of a category of companies that are involved in the tools, materials, components, machinery, and other products used in construction, manufacturing and other industrial applications. Their products are different from the consumer goods sector, which are meant to be bought by the general public. As at 2013, the sector is considered for expansion by the NSE because there are 100 companies currently eyeing listing in the sector. According to the than NSE Director General, Oscar Onyema, as part of the efforts to make the sector more attractive for investors thereby encourage more listings, the NSE introduced the NSE Industrial index. This index comprises the most capitalized and liquid companies in the industrial goods sector. It is because of this raft attention given to the industrial goods sector that our study aimed at studying the sector as a whole.

Statement of the Problem

The deteriorating performance of the accounting profession both locally and globally only serves as proof that accounting regulations are not fulfilling its intended aim. Proof of this failure can be seen from the various accounting scandals that have been witnessed in the recent past in the global arena. Existing universal inclination indicates that the anxiety for the examination into the practice of earnings maneuver becomes even more salient following the existing universal inclination of corporate failures that have bedeviled large organisation such as Health South, Global Crossing, Parmalat, Hollinger, Adecco, TV Azteca, Enron, Worldcom and Tyco (Uwuigbe, 2013).

This phenomenon has led to heated debate among regulators, accounting practitioners, financial analyst and researchers to find a solution to the unprecedented corporate failures. This is particularly the case in most developing economies were in spite of the various governance structures and frameworks established by most countries, cases of

corporate malpractices still remain prevalent. This is also the case in Nigeria where despite the publication of a new corporate governance code in 2003 and 2011; cases of misappropriation of fund and falsification of reports to suit management interest has continued unabatedly (Uweigbe, Ranti & Bernard, 2015).

Objectives of the Study

The main objective of this study is to examine the effect of corporate attribute on earnings management of listed industrial goods companies in Nigeria. However, it is set to achieve the following specific objectives;

- i. To examine the effect of firm size on earnings management of listed industrial goods companies in Nigeria.
- ii. To examine the effect of leverage on earnings management of listed industrial goods companies Nigeria.
- iii. To ascertain the effect of liquidity on earnings management of listed industrial goods companies in Nigeria.

LITERATURE REVIEW

Firm Attributes

Firm's attributes can be determined based on the relevant information disclosed on its financial statements for a particular accounting period (Okolie, 2014). Dean, Agustia and Suryani (2018) posited that firm attributes are essential determinants of a firm's performance as well as its success in business. Firm attributes variables used in this study include, firm size, firm age, Leverage, liquidity and operating expenses. Firm size refers to the speed and extent of growth that is ideal for a specific company. Most companies' intent to expand the size of their business operation for them to grow either in revenue, profit, number of employees, or size of facilities (Pervan & Visic, 2012). Many companies compete in rapidly changing industries, expansion of manufacturing capacity, geographical presence, market shares and so on which may be imperative for survival (Dogan & Topala, 2014). Bala, Darry and Matthew (2005) consider firm size as an important determinant of financial performance. Similarly, most manufacturing firms use natural log of total assets. Consistent with this view, Bala *at el*, (2005), Zahid, Ali, Shahid and Muhammad (2013), Owolabi and Obida (2012) all measured firm size using natural log of total assets. To this end, firm size will be measured using natural log of total asset in this study.

Earnings Management

Earnings management is the practice of manipulating firm's earnings in order to ensure that financial statement look better than their original status. The definition of earnings management differs depending on how someone consider the practice of managing earnings, for those who accept the practice of earnings management indicating it is good for the firm, they define earnings management as the means used by managers to improve the financial position of the firm (Mostafa, 2020). For those who see earnings management into a negative way considers the practice as manipulation of earnings by management in order to gain out of it or to show that the company is performing while it

is not at the expense of the shareholder's wealth as well as the investors (Mahawyahrti & Budiasih, 2017, Nalarreason, Sutrisno & Mardiaty, 2019). Company earnings is a measure of performance of the company for the particular accounting period which is computed as the difference between revenue generated and the expenses incurred in earnings such revenue for the period. For various reasons, managers of the companies tend to intervene into the process of calculating the earnings by manipulating the figures to be reported for their own benefit or in order to ensure that the report shows a better performance on earnings for the period. According to Mostafa, and Ibrahim (2019), earnings management occurs when the managers of the company decide to use judgment in financial reporting by restructuring the accounting transactions in order to alter the financial report with the aim of either misleading the stakeholders about the actual economic performance of the firm or to influence contractual outcomes such as bonus which depends on the reported figures on financial reports.

Review of Empirical Studies on Firm Attributes and Earning Management

Sutrisno (2021) analyzed the effect of leverage, profitability, the amount of commissioner board and audit committee towards earnings management in bank that registered in Indonesia Stock Exchange 2016-2017. The results shows that leverage (DAR) has positive significant effect towards earnings management, profitability (ROA) doesn't have significant effect towards earnings management, amount of commissioner board (BS) and audit committee (KA) doesn't have significant effect toward earnings management. Dian (2020) examined the effect of capital structure, profitability and company size on earnings management. The population in this study is companies with manufacturing types listed on the Indonesia Stock Exchange in the period 2013 to 2017. Samples were obtained using a purposive random sampling method. Data analysis was performed using the Simultaneous Regression Coefficient Test (F Test) and Partial Test (t-Test). Data analysis uses fixed effects. The results showed that the capital structure, profitability and size of the company have a positive and significant effect on earnings management.

Rusdiyanto and Narsa (2020) analyze the effect of company size, leverage and return on assets on earnings management. The research method uses descriptive methods with a quantitative approach. The population in the study was the Company's financial statements on the Indonesia Stock Exchange from 2014 to 2018. The research findings explain that company size has no influence on earnings management, while leverage and return on assets have an influence on earnings management. The study concluded that total company assets cannot influence earnings management. Saleh, Afifa and Haniah (2020) examined the effect of financial factors on earnings management and earnings quality. Moreover, the study examines the role of earnings management as a mediator in the effect of the financial factors on earnings quality. The results indicate that all financial factors in the model combined affect the earnings management and earnings quality. In addition, earnings management negatively affects earnings quality, and earnings management fully mediates the effect of financial factors on earnings quality. Religiosa and Surjandari (2021) analyzed the effect of Company Risk, Liquidity, Leverage and Capital Adequacy Ratio on Earnings Management and whether Capital Adequacy Ratio

moderates the relation between Company Risk, Liquidity, Leverage and Earnings Management of Banking Companies listed in Indonesia Stock Exchange during 2014-2018. The result shows that in partial, Company Risk, Liquidity and Capital Adequacy has a negative significant effect on Earnings Management.

Kadek, Sutrisno and Endang (2019) determined the effect of leverage and firm size toward earnings management. This study used a sample of the financial report data from manufacturing companies listed on the Indonesia stock exchange for the 2013-2017 period. The empirical results showed that leverage and firm size increases provide encouragement for managers to manipulate earnings. Yulia, Krisna and Ika (2017) identify the effect of good corporate governance (GCG) (institutional ownership, managerial ownership, frequency of board meetings, frequency of audit committee (AC) meetings), firm size, and leverage on the EM. The results of the research show that partially, only leverage has significant effect on earning management. Uwuigbe, Ranti and Bernard (2015) assessed the effects of firms' characteristics on earnings management of listed companies in Nigeria. The corporate annual reports for the period 2006-2010 were used for the study. In testing the research hypothesis, the study adopted the use of both descriptive statistics and econometric analysis using the pooled ordinary least square regression for the listed sampled firms. Findings from the study revealed that while firm size and firms' corporate strategy have a significant positive impact on earnings management (proxied by discretionary accruals).

Ahmad and Yasser (2020) scrutinize whether surplus free cash flow is correlated with earnings management. The research hypotheses are built upon a sample of 103 companies listed on the Tehran Stock Exchange during the years 2013 to 2017 and then tested using multiple regression model based on panel data techniques. The results reveal that earnings management is significantly associated with surplus free cash flow. Furthermore, the findings confirm that auditor size exerts no significant impact on the relationship between surplus free cash flow and corporate earnings management. Asim and Ismail (2019) examined the impact of leverage on earnings management in the manufacturing sector of Pakistan. The findings revealed that a significant positive relationship exists between leverage and earnings management activities while other variables ROA and firm size are also found to be significant. Khanh and Thu (2019) examined the effect of leverage on the form and extent of earnings management in Vietnamese listed firms. The study used panel data of 241 companies on Vietnam stock markets in the period from 2010 to 2016 (1687 firm-years) and conducted GMM regression. The study found a positive relationship between leverage and earnings management, which is consistent to "debt hypothesis". Furthermore, a preference for real earnings management over accrual-based earnings management is observed among highly leverage firms.

THEORETICAL FRAMEWORK

Signaling Theory

The signal is an action taken by the company to give instructions to investors about how

management views the company's prospects. According to (Brigham & Houston, 2013) Information released by companies is important, because of its effect on investment decisions of parties outside the company. This information is important for investors and business people because the information essentially presents information, notes or pictures, both for past, present and future conditions for the survival of the company and how it affects the company. Information is an important element for investors and business people because the information essentially presents information, notes or pictures both for the past, present and future conditions for the survival of a company and how the market effects.

RESEARCH METHODS

This section stresses the methodology to be employed for this study. The population of this study is the listed industrial goods companies in Nigeria as at 31st December, 2020. The sampling frame of this study was twelve selected companies considering the viability, working population strength and availability of annual financial statement to date, as the period under review covers ten years from 2011 to 2020. This study made use of secondary data from the Nigerian Stock exchange, bulletin of the Central Bank of Nigeria (CBN), Annual reports and accounts of the sampled companies. The data were analysed using descriptive statistics, correlation and regression analysis. Data were sorted and imputed into the STATA software package version 13 for production of tables, descriptive statistics and inferential statistics. Descriptive statistics was used to determine the effects of firm attributes on earning management of listed industrial goods companies in Nigeria.

Model Specification

A regression model was used for establishing the relationship between the firms attributes and earnings management. The model adopted consisted of two variables. The independent variable is the firms' attributes of the companies while the dependent variable is earnings management.

$$DAC_{it} = \beta_0 + \beta_1 FS_{it} + \beta_2 LEV_{it} + \beta_3 LIQ_{it} + \epsilon_{it}$$

Where:

DAC = Discretionary Accruals (Earnings management) representing the dependent variable;

$\beta_1, \beta_2, \beta_3$; are regression coefficients or parameters;

FS, LEV, and LIQ; are independent variables;

FS = Firm Size

LEV = Leverage

LIQ = Liquidity

β_0 = Constant (DAC-intercept)

ϵ = Error term.

The study used a multiple regression model to show the effect of corporate attributes on earnings management of listed industrial goods companies on Nigeria Stock Exchange.

Results and Discussion of Findings

This section presents the results of the analysis and findings of the study based on the research objectives. The results are presented in tabular form. Regression and Correlation analysis were used in analyzing the data collected.

Descriptive Statistics

The descriptive statistics for each of the variables collected is presented and discussed in this chapter, where Minimum, Maximum, Mean and Standard deviation of the data result for the variables used in the study are described. The summary of the descriptive statistics are presented in Table 4.1 as follows:

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Minimum	Maximum
DAC	60	.135	.155	.001	.631
FS	60	9.698	.641	8.467	10.829
LEV	60	.375	.230	.004	.809
LIQ	60	1.273	.731	.028	2.682

Source: Stata Descriptive Statistics Result

Table 1 presents the detail account of descriptive statistics for the dependent and independent variables. From the table, Discretionary Accruals (DAC) has minimum and maximum values of .001 and .631 respectively and the mean and standard deviation of .135 and .155 respectively. It can also be deduced from the above table that Firm Size has the mean and standard deviation of 9.698 and .641 respectively and also minimum and maximum values of 8.467 and .809. Leverage from the table also shows the minimum and maximum values of .004 and .809 respectively and the mean of .376 and .230 as the standard deviation. The table also shows that the minimum and maximum values for Liquidity are .0279627 and 2.682231 respectively. The mean and standard deviation are 1.273376 and .7308399 respectively.

Correlation Analysis

The summary of the Pearson correlation coefficients of variables of the study are presented in Table 4.2 as shown below.

Table 2 Correlations Matrix of the Dependent and Independent Variables

Variables	DAC	FS	LEV	LIQ
DAC	1.000			
FS	0.272	1.000		
LEV	0.068	0.351	1.000	
LIQ	-0.072	0.618	0.395	1.000

Source: correlation matrix – STATA

The above table shows the relationship that exists among variables. Correlation analysis is used to assess the nature of relationship between the dependent and independent variables and to determine whether multicollinearity exist amongst the variables of the study. The table shows a positive and significant impact of firm size on Discretionary Accruals (DAC) with correlation coefficient of 0.272 and also p-value of 0.002 which is significant at 1%. This implies that as firm size increases, Discretionary Accruals (DAC) will also increase in the same direction. However, leverage has a positive and insignificant effect with correlation coefficient of 0.068 and p-value of 0.709 which is positively insignificant. This shows that as leverage increases, it will also result to an increase in earning management as measured by Discretionary Accruals (DAC). Liquidity on the other hand also have a negative and significant effect on earning management of listed industrial goods companies with correlation coefficient of -0.072 and p-value of 0.015, the result point out that there is relationship between liquidity and earning management of listed industrial goods companies in Nigeria.

DIAGNOSTIC TESTS

Variance Inflation Factor

This study applies panel data analysis which requires certain estimations to account for time-series and cross-sectional dimension of the data. The study carried out diagnostic tests which include Variance Inflation Factor (VIF) to check the absence of multicollinearity in the model, the Wooldridge test to check the absence of autocorrelation and serial correlation to check the absence of heteroskedasticity in the model. The outcome shows that multicollinearity does not exist, because it is apparent that the coefficient of VIF for the model is less than the threshold of 10 and the mean is less than 5 (Hair et al., 2014; Pallant, 2005).

Table 3: VIF/Tolerance Values

Variable	VIF	1/VIF
LIQ	1.72	0.582
FS	1.65	0.605
LEV	1.21	0.826
Mean VIF	1.53	

Source: VIF/Tolerance Values – STATA

The results in Table 3 indicate that the VIF value for firm size was established to be 1.65

while its tolerance statistic was reported to be 0.605. VIF value for level of leverage was established to be 1.21 while its tolerance statistic was reported to be 0.826 VIF value of Liquidity was established to be 1.72 while its tolerance statistic was reported to be 0.582. Based on these findings, it has been established that there was no multicollinearity between predictor variables as the reported VIF and tolerance statistics were within the accepted range. This justified for a multiple regression analysis to be conducted to show the relationship among the study variables.

Hausman Specification Test

Table 4 indicates that the null hypotheses was rejected, this indicates that fixed effects model is not appropriate and that random effect model to be preferred.

Table 4: Hausman Specification Test

	chi2(13)	Prob > c hi2	Null (H0)
FV	0.16	0.9832	Accepted

Note: the null hypotheses were accepted, this indicates that fixed effects model is not appropriate and that random effect model to be preferred. This call for the running of lagrangian multiplier test for random effects (xttest0)

Langragian Multiplier Test

Where the result of RE is preferable to that of FE Under Continuous Dependent Variables. Then a choice has to be made between the Pooled-OLS results and GLS Random-effects results.

Table 5: Lagrangian Multiplier Test

	chi2(13)	Prob < c hi2	Null (H0)
FV	26.53	0.0000	Rejected

Based on the result displayed in table 5 above the random effect model to be preferred is rejected because the p-value for the Langragian Multiplier test is significant ($p < 0.05$). As a consequence, the Pooled OLS is explained in the study.

Regression Analysis

In the previous sub-section Pearson correlation was conducted, as stated earlier, to show the strength and direction between variables, however it cannot show the causal effect. Pearson correlation is calculated between Dependent Variable (DAC), and the independent variables (firm size, leverage and liquidity). Regression is a tool that doesn't only show the direction and strength of a relationship, but determines the casual effect of this relationship.

Table 6 below presents the results of multiple regressions used in testing the effect of corporate attribute (firm size, leverage and liquidity) as independent variables and Firm's Discretionary Accruals (DAC) as a dependent variable.

Table 6: Regression Result (OLS)

DAC	Coefficient	Std. Err.	T	P> t	[95% Conf. Interval]	
FS	.121	.038	3.21	0.002	.045	.197
LEV	.034	.090	0.38	0.709	-.147	.214
LIQ	-.085	.034	-2.52	0.015	-.153	-.017
Cons	-.944	.340	-2.78	0.007	-1.624	-.263
Number of obs					60	
F (3, 56)					16.69	
Prob.> F					0.015	
R-Square					0.169	
Adj. R-Square					0.124	
Root MSE					.145	

Source: Result output from STATA 13

The model shows that firm size is found to have a positive and significant impact on Discretionary Accruals (DAC) of listed industrial goods companies in Nigeria with p-value of 0.002 at 1% level of significance. This can be observed from the regression coefficient of 0.121 which implies that any increase in firm size will lead to an increase of 0.121 Naira in Discretionary Accruals (DAC). This may not be a surprise as sufficient amount of current assets will be used to often generate revenue for the firm where it has investment in long time profitable projects. The magnitude of the standardized differences is increasing in firm size, indicating the degree that earnings increases occur more frequently than expected for small-sized firms is lower than those for the large and medium-sized firm groups. This provides evidence that the large and medium-sized firms manipulate earnings more extensively than the small-sized firms to avoid earnings decreases. This is supporting the findings of Dian (2020); Kadek, Sutrisno and Endang (2019); Supardi and Eka (2018) who found positive significant effect between firm size and firm earnings management and refuse to agree with the study of Saleh, Afifa and Haniah (2020); Rusdiyanto and Narsa (2020) whose research findings explain that company size has no influence on earnings management, while leverage and return on assets have an influence on earnings management.

Alternatively, leverage has positive and insignificant effect on Discretionary Accruals (DAC) of listed industrial goods companies in Nigeria with regression coefficient of .0339 and p-value of 0.709 at 10% level of significance. This shows leverage does not increase industrial goods company's financial statement manipulation. This implies that for every 1% increase in leverage, will be not affect the increase in Discretionary Accruals (DAC). The implication of this result is that, higher percentage of leverage indicates higher financial statement manipulation. The results is also consistent with previous studies such as Tonye and Sokiri (2020) whose result revealed that financial leverage does not have a significant impact on accruals earnings management in listed manufacturing firms in Nigeria; but it does on real earnings management and deferred tax earnings management, and fail to agree with the study conducted by Sutrisno (2021); Waode, Yohanis and Abdul-Hamid (2021); Zafar, Naveeda, Munawar and

Muhammmad (2020); Asim and Ismail (2019) who examined the effect of liquidity, profitability, and leverage on earnings management and its impact on the value of the company. The study found a positive relationship between leverage and earnings management.

Finally, the table also reveals a negative but significant relationship between liquidity and Discretionary Accruals (DAC) of listed industrial goods companies in Nigeria. This means that for every 1% increase in liquidity, Discretionary Accruals (DAC) will decrease by 0.085 Naira. This is from the fact that the result of the regression coefficient was 0.085 and p-value of 0.015. It is clear that industrial goods company's liquidity has positive and significant effect on the dependent variable of earnings management. This is in line with the study outcome of Ahmad and Yasser (2020); Ayu, Zuraida and Mulia (2018) whose results show that financial and liquidity leverage has significant positive effect on earnings management of banks, therefore increasing the degree of financial leverage and by increasing bank liquidity, the possibility of using discretionary accruals and earnings management at banks increase and contradict that of Religiosa and Surjandari (2021).

Conclusion

Based on the findings of the study, the study concludes that firm size increases earnings management of listed industrial goods. Evidence from the study further reveals that a significant positive relationship exists between firm size and discretionary accruals (earnings management). This results appear to corroborate the suggestion that firm size is a variable that tends to increase firm's tendency to manage earnings and might affect the magnitude of earnings surprise or earnings expression. More so, it supports the argument that large firms tend to have higher motivations and more prospects to engage in the manipulation earnings and exaggerate earnings due to the intricacy of their operations and the complexity for users to identify overstatement in addition to maintaining reputation in the market they operate. Similarly while, evidence from the study also suggested the fact that a significant positive relationship exist between firms' corporate strategy and discretionary accruals of the sampled firms.

The study also concluded that debt ratios, that is, leverage has a positive association with earning management which means that high debt level does not motivates the managers to be involve in earning management either to report the desired profit level or to gain certain organizational goals. The inference derivable here is that firms manage earnings upward, to thwart the cost of violating debt agreements. Companies that have high leverage tend to do earnings management because the company is threatened with bankruptcy so it is unable to meet debt payments on time.

The results confirmed that liquidity has a negative but significant effect on earning management at 95%, so it can be said that the company liquidity has a significant negative effect on earnings (profit) management of the sampled companies and by increasing the amount of liquid assets to short-term debt, the likelihood of earnings management of the company decreases. These results indicate that manipulation of

profits in the company with much liquidity is less than other companies that possess great liquidity to keep personal interests apply a greater extent of surplus cash in dysfunctional investments and to hide the effects of such activities, attempt to manage profit (earning).

Recommendations

Recommendations from were also made based on the findings and conclusions above. These included:

- i. Auditors need to formulate policies and procedure in order to check and maintain the transparency of the financial data provided in the financial statements. As companies capitalized on the size of the firm enhances the manipulation of financial statement by management for the purpose of increasing the company's profitability position.
- ii. Based on the results of this study, it is recommended that firms should control their debt level in order to reduce the manipulation in accrual management. Higher debt level increases the monitoring of financial analysts and other stakeholders could also be subject to scrutinized earning management activities.
- iii. The Nigerian Industrial Goods Companies should increase the percentage of liquidity maintained by the organization, since liquidity influences the manipulation of the company; this gives them the power to manipulate the earnings which consequently affects the earnings they report positively.

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PROBLEMS AND PROSPECTS OF POINT-OF-SALE SERVICE DELIVERY IN NIGERIAN UNIVERSITY

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Abstract

This study examined the problems and prospects of point-of-sale service (POS) delivering Nigerian University with particular focus on Federal University Otuoke. The study discussed the level of customer's satisfaction with point of sales (POS) usage and service delivery. The research questions seek to examine the nature of service delivery by POS operators and its manifestations on the level of satisfaction derived by students of Federal University Otuoke. The study adopted diffusion and innovation (DOI) theory developed by Rogers (1962). The mixed method research design guided the study and Data were sourced through primary and secondary means. The Taro Yamane formula was used to deduce the sample size of a total of 388 students across six faculties, after which a structured questionnaire was used to elicit the needed information. The content analysis and thematic approach were used to explain the In-depth interviews (IDI) conducted among six POS merchants while descriptive statistics was used for the questionnaire. Findings indicated that customers welcomed the services of POS operators but were displeased with hike in service charge, incessant network glitches arising from epileptic internet services and paucity of funds by operators. Recommendations include the reduction in service charge, social relations between banks and POS operators and provision of strong internet services to foster smoothing service delivery.

Keywords: Point of Sales (POS), Satisfaction, Service Delivery, Students, Federal University Otuoke, Customer.

Introduction

A greater percentage of problems within the economies of most developing countries is attributable to the cash-carrying nature of their economy, and to reduce the volume of cash in circulation and reduce the risk associated with carrying cash, several electronic payment systems such as payment cards (smart card) and paper-based instrument were

introduced by the financial regulatory body in Nigeria (Amaefuleet, Njoku and Donatus, 2019). The adoption of e-payment system by consumers has improved Nigeria's payment landscape (Adeoti, 2013). The level of this adoption by the consumers has continue to increase significantly and accounted for billions worth of transactions. In January 2023, POS sales transaction hits eight hundred and seven billion(N807.16), signaling a 40.69 percent year-on-year increase from five hundred and seventy-three, seventy-two billion (573.72) transactions carried out in January, 2022 (NIBSS, 2023). Total cash transactions in Nigeria rose by 45.41 percent year-on-year to 39.58 trillion naira in January 2023 with about nine hundred and fifty-five thousand, two hundred and thirty-four(955,234) deployed POS terminals in the country as of January 2022 (NIBSS, 2023). The growth in the POS transactions was due to CBN cashless policy and resultant increase in the number of people and merchants using debit cards.

The point-of-sale (POS) system is a set of strategies, software packages and imbursement services brokers use to make sales in person. The emergence of Point of Sales (POS) terminals to make financial payment in Nigeria by the Central Bank of Nigeria (CBN) in 2012brought about increasing growth in the number of active POS terminals provided by banks for mobile money transactions. In the first three months of 2018, about one hundred and ninety-three (193) POS terminals were registered by banks for carrying out cashless transactions in Nigeria (Ogunfuwa, 2018). Nigeria Inter-Banking Settlement Scheme (NIBSS, 2023) reveals that, at the end of 2018, the number of active POS terminals in Nigeria was one hundred and sixty-four thousand, six hundred and seven (164,607) which translates to a 66.6% rise in transaction usage of POS across the country, and as of January 2018 compared to the value registered using POS for transaction in January 2024. This growth shows an acceptance of POS terminals for making payments and increasing information communication network (ICT) penetration in Nigeria. POS is a device that allows local debit cardholders to make withdrawals or make payments for products and services. The services of the banks do not serve everybody in Nigeria especially those in remote areas, banks created the POS business as a terminal to bring financial services closer to the unbanked and under-banked segment of the society, this encouraged entrepreneurs to be bank agents, while earning their commission. (Guarantee Trust Bank. n.d)

Despite its wide acceptability, the nature of POS service delivery calls for concern for customers and operators. Nzaro and Magidi (2014) posit that e-payment has brought about customer convenience, and speedy access to fund. However, there is more to a good point of sale system than just handling payments and recording sales easily and quickly. If selling of products is the core of a business, POS system should also be at a core so as to enable the tracking of sales, manage inventory, empower staff, identify regular customers, resolve debt issues and get the right pricing (Xero, 2014) which POS lacks as every technology has its pros and cons and POS system is not left out.(Olakah, 2012) POS, as many other e-payment platforms, are faced by some problems such as delays in accessing services provided. Specifically, Federal University Otuoke, is being serviced by only United Bank of Africa (UBA) with just one branch in the University campus, the

UBA is therefore expected to service the local otuoke community, teaching and non-teaching staff, and over ten thousand students which is almost impossible as POS operators has gainfully attracted more patronage. Hence, this study bridged the gap by examining the problems and prospects of POS service delivery usage in Federal University Otuoke, (FUO) Bayelsa State, Nigeria.

Statement of the Problem

Every business is fraught with difficulties as POS business is not an exemption. Adeoti (2013), Nzaro &Magidi (2014), Okeke et al, (2017) and Ojo (2022) examined the challenges of e-payment and explained that, although POS is a beneficial and convenient product and service variety, easy access to funds and speedy payment, issues such as high cost of charges, insecurity, question over frauds via e-banking and debit without credit are major problems facing POS service providers, this consequentially affects the financial experience of customers who use this services, as it has in so many cases caused delays in payment as a result of poor network, machine failure, charges disadvantages, debit card compromise, etc. Federal University Otuoke being a student environment with only one servicing bank available in the community runs majorly a cash-based system as the livelihood and wellbeing of student is paramount thus seeking the services of POS operators cannot be overemphasized. However, the challenges of POS are related to the banks, operators and the customers (Omerabi, 2013) and considering the strength of students and the disadvantage of having only one bank with just three (3) automated teller machines (ATM) to operate with overtime, students become disgruntled while seeking services from the ATM, the lack of sufficient funds for customers etc. has evolved the massive rise in POS delivery services in the community and university environment. Studies on customers satisfaction and challenges facing point of sale system (Ishraga, A; Bushra A; Omer, 2022; Abdulaziz, A; Muhammad, S; Shamsuddeen, S. 2022) revealed that POS enhanced customers satisfaction yet there is dearth in literature in the study area which the study tends to bridge by investigating the problems and prospects of point of sale service delivery in the Nigerian University. Therefore, the aim of the study is to investigate the nature of service delivery by POS operators in Federal University Otuoke, the satisfaction level of customers using POS and the challenges fraught with providing POS services for students by operators.

Review of Literatures

POS is a distinct machine which is solely designed to provide automatic service to customers and different service organizations. The POS systems offer standardized sales procedure as each POS is connected directly to the account of the merchant who completes the financial transactions (Adam, 2013). POS terminal is a portable device that allows local debit cardholders make payment for goods and services in a retail environment (Guarantee trust bank, 2023). A simple transaction takes just three steps: select the product on the screen, click the complete sale button, and take the money. This is so fast that it often takes only one associate to staff a store at any given time. Also, since these procedural steps are automated and validated, there will be fewer user mistakes due to keystrokes errors and/or giving incorrect change.

According to (Gomzin, 2014), there are two POS payment process stages: authorization is related to the payment process where the purchase is confirmed, followed by settlement which focusses on settling the account balance between parties (i.e Marchants, acquirer, and issuer). Despite their importance, the services are not without hurdles. The unique nature of POS services cannot be overemphasized especially to customers. POS in many countries were found to help businesses keep records of transactions and manage stock more effectively; it also decreases the need for paperwork and provide quick and safe services to customers. At the same time, it decreases cash payment transactions which are expected to help retain money with the banking sector (Peffer & Ma, 2003).

Nature and Types of Point of Sale

This refers to the physical environment where the POS transaction is made. A POS transaction is a financial transaction that occurs at the point where a customer makes a purchase from a business. It involves the transfer of funds from the customers payment method, such as credit card or a debit card to the operator's account. These transactions always take place in the physical retail stores but can also occur online or through a mobile payment method (Brett, 2023).

There are three basic types of POS transaction: Online POS transaction, offline POS transaction and return of products. Online transactions occur through an ecommerce website. Here, the customers visit online business or online stores and purchase goods while the Offline POS transactions occur when a customer physically visit a store to make purchase and return of product transactions occurs when customers are dissatisfied with the goods and services purchased therefore seeking for a refund or credit note.

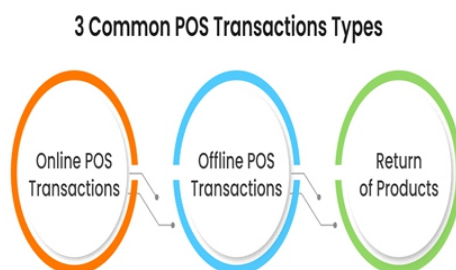


Fig 1: Picture showing three common POS types

Point of Sale and Service Delivery

According to Horus Development (2011), POS is an electronic transfer system for money that allows card holder to pay for purchases from merchants. A POS terminal consist of hardware and software, this equipment is the POS machine, which offers e-payment services. POS services is designed in a manner that its swift dispensation of cash both credit and debit will yield customers satisfaction and customers satisfaction is one key factor influencing business as once customers wait longer than expected, their level of satisfaction declines (Iqbal; Whiteman and Malzahn, 2012). POS service delivery is very

unique as decreases the need for paperwork as often experienced in the bank where tellers are filled and every little errors are sign and countered signed, with face capturing depending on the transaction. POS use has boosted sales and service delivery in small medium scale in Nigeria. It helps delivery business to manage sales, employees, inventory and more. Most importantly, it helps businesses to keep track of everything regularly or quarterly. (www.white label fox.com, retrieved March, 2024). Lastly, POS use has improved the way customers are served and helps the society to become less dependent on cash (Kelvin, 2012)

Problems and Prospects of POS

Despite the benefits of POS technology in swift retrieval of cash and deposits to banks, increasing sales, achieving profits for operators POS system are faced challenges. in Nigeria, poor internet connectivity militates against efficient service delivery. Eleanya (2021) explain that Nigeria ranks 103rd for fixed internet speed, with a fixed internet swiftness at 16.39 Mbps, a far cry from the global average download speed of 67.25 Mbps. POS machines are faced with network challenges; with agents and customers either left with the option of queuing up at brank branches to lay complaints on failed transactions or forced to lose their money, these factors are demoralizing and shows unsatisfactory service delivery. (Wondwosson, 2025, Kumaga, 2010; Taddesse & Kidan, 2005; Bassey, 2008) In a specific study POS challenge, in Ghana, the research found that the lack of the acceptance channel by users, ignorance, network failures are among the main challenges that affect the deployment of the channels. Moreover, some sales people in Ghana believed that online payments deprive them from tips that they may receive from customers. Nevertheless, the POS software can be hacked, posing a huge risk to customers and operators, a cursory observation shows that the main challenge of POS terminals is the delay in reversal of failed debits to account owners (cardholders) (Nzaro & Magidi, 2014). As a result, customers are frustrated by bureaucratic hurdles and delays associated with visits to banks. It can be observed that some Customer Care officers in the banks fail to resolve customer's complaints in record time and this erroneously portend PoS operators as culprits, aiming to swindle their customers.

Theoretical Framework

The study adopted Diffusion of Innovation (DOI) theory as developed by E.M. Rogers in 1962. DOI originated in communication to explain how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population or social system. It is a theory of behavioural change which explains that diffusion is a part of the social system and people adopt ideas, behaviours, or products which are new and consolidate on its use. Adoption means that a person does something differently than what they had previously (i.e., purchase or use a new product, acquire and perform a new behaviour, etc.).

Rogers (1962) divided the stages of diffusion into five, namely:

1. Innovators are predisposed to greater risks because they are the first to adopt new technological ideas.

2. Early adopters try out new technology and derive benefits from using technological innovations.
3. Early majority are responsible for introducing technological innovations into mainstream society
4. Late majority are individuals who follow the steps of early majority. However, they adopt these innovations into the facets of their daily lives
5. Laggards stay behind and hesitate to adopt innovations as part of their daily lives.

The key to adoption is that the person must perceive the idea, behaviour, or product as new or innovative and it is through this that diffusion is possible. Adoption of a new idea, behaviour, or product does not happen simultaneously in a social system; rather, it is a process where some people adopt the innovation than others. Halton (2023) assert that innovators and early adopters are predisposed to greater risks associated with trying out new technologies. People who adopt an innovation early have different characteristics than people who adopt an innovation later. When promoting an innovation, it is important to understand the characteristics of the target population that will help or hinder the adoption of the innovation. The theory is often regarded as a valuable change model for guiding technological innovation, where the innovation itself is modified and presented in ways that meet the needs across all levels of adopters (Kaminski, 2011). Thus, the purpose of the innovation is to meet the customer needs. Suffice, it to say that the use of POS services spreads (diffused) into the fabric of society and members of society learns(adapt) the usage (implementation) of POS technology thereby exploring the services of POS which explains the DOI assertion of a new technological idea migrates from creation to use (Rogers, 2003).

Methods and Materials

This study involves a survey across six faculties (Education, Engineering, Humanities, Management Sciences, Sciences and Social Sciences) with a population of 8,464 students, according to Registry records of 2021. Education has 640 students while Engineering and Humanities have 1,656 and 988 students respectively. Management Sciences has 1,708 students, while Sciences and Social Sciences have 2,121 and 1,260 students respectively. Two different samples were collected from the total student population. For the first sample, we employed the Yamane formula, stated as follows:

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

where:

n = the expected sample population

N = the population of the study

e = level of significance (5% or 0.05).

Given that the total student population is 8,464, and that the level of significance is taken at 5%. we derive the sample size for the study as follow:

$$n = \frac{8464}{1 + 8464(0.05)^2}$$
$$n = 399.95 \approx 400$$

Using the Yamane formula, the sample size for the study is 400. Therefore, 400 hundred respondents (students) were selected from the six (6) faculties. Employing simple percentage in respect to the number of students per faculty and the total student population, 7.56% of the sample size (30 students) were randomly selected from Faculty of Education, while 19.57% of the sample size (78 students) were randomly selected from the Faculty of Engineering. 11.67% of the sample size (47 students) were randomly selected from the Faculty of Humanities, while 20.18% of the sample size (81 students) were randomly selected from the Faculty of Management Sciences. Finally, 26.13% of the sample size (104 students) were randomly selected from the Faculty of Sciences, whereas, 14.89% of the sample size (60 students) were randomly selected from the Faculty of Social Sciences. Out of the 400 well-structured questionnaires that were distributed to the respondents, 388 questionnaires were returned. This implies that 97% of the distributed questionnaires was retrieved.

In addition, with the help of personal interview method, six POS merchants were selected within the domains of the six faculties, where a thoroughly drafted questionnaire, was administered. Quantitative data obtained from the responses are presented in simple percentage table, while the questions are structured using the four-point liker scale classification. The classifications are as follows: Strongly Agree = 4 point; Agree = 3 point; Strongly Disagree = 2 points; Disagree = 1 point. Furthermore, the mean score technique is used as a method of analysis to conclude on responses provided by the respondents. A Mean score of 2.5 and above is regarded as depicting positive decision, while a mean score below 2.5 is interpreted as depicting a negative decision. Based on the feedback received from our respondents, we present the results in the respective tables below.

Presentation of Quantitative Data and Analyses

Table 1: Table showing the socio-demographic distribution of respondents

Socio-Demographic Variables	Frequency	Percentage %
Age		
16-20	188	48.45
21-25	118	30.41
26 -30	43	11.08
31 and above	39	10.05
Total	388	100

Sex		
Males	174	44.8
Females	214	55.2
Total	388	100
Marital Status		
Single	365	94.1
Married/cohabiting	23	5.9
Total	388	100
Undergraduate Level		
100 level	79	20.4
200 level	55	14.2
300 level	144	37.1
400 level	88	22.7
500 level	22	5.7
Total	388	100

Source: Field Survey 2022

Table 1 indicated that the highest number of respondents were between the ages of 16-20 (30.4%) while the least number of respondents fell in the category of 31 years and above (16.2%). On gender, the highest number of respondents were females (214) which represents 55.1% of the respondents, while male constitutes the least with about 174 males, which represents about 44.9% of respondents.

Table 2: Nature of Service Delivery by POS Merchants

S/N	Responses	SA (4)	A (3)	SD (2)	D (1)	Total Weighted Score	Total No of Respondents	Mean Score	Decision	Group Mean
1	Students are knowledgeable about the use of PoS machines	111 (444)	100 (300)	42 (84)	125 (125)	953	378	2.52	Accept	
2	POS operators have good customer relationship with students	148 (592)	23 (69)	32 (64)	185 (185)	910	388	2.35	Reject	

3	POS services charges much for transactions	167 (668)	88 (264)	21 (42)	112 (112)	1086	388	2.80	Accept	2.53
4	POS services are readily available as and when needed	128 (512)	110 (330)	95 (190)	55 (55)	1087	388	2.80	Accept	
5	PoS merchants are rude to customers	80 (320)	58 (174)	100 (200)	150 (150)	844	388	2.18	Reject	

Source: Field Survey 2022

Table 2. dwelt on the Nature of Service Delivery by POS Operators. Item 1 on the questionnaire shows that 111 respondents strongly agreed that they are knowledgeable about the use of PoS machines. 100 agreed, 42 strongly disagreed, while 125 disagreed. The positive mean score of 2.52 agrees that POS consumers are knowledgeable about the use of POS machines. Also, item 2 on the questionnaire shows that 148 respondents strongly agreed that POS merchants have good customer relationship with students. 23 agreed, 32 strongly disagreed, while 185 disagreed. The negative mean score of 2.35 shows that POS merchants do not have a cordial relationship with students. On POS service charges, item 3 on the questionnaire shows that 167 respondents strongly agreed that POS merchants' charges are exorbitant. 88 agreed, 21 strongly disagreed, while 112 disagreed. The positive mean score at 2.80 means that PoS service charges are high. Item 4 on the questionnaire sought to find out whether POS services are readily available as and when needed. 128 respondents strongly agreed, 110 agreed, 95 strongly disagreed, while 55 disagreed. The positive mean score of 2.80 reveals that PoS services are readily available as and when needed. Item 5 on the questionnaire sought to uncover if POS service providers are rude to customers. 80 respondents strongly agreed, 58 agreed, 100 strongly disagreed, while 150 disagreed. The negative mean score at 2.18 means that POS service providers are not rude to customers. The group mean score of 2.53 shows that the nature of service delivery by POS merchants is commendable.

Qualitative Data on the Nature of Service Delivery by POS Operators.

When probed on why POS services are not readily available as and when needed, a respondent replied as follows:

“The network providers have a fluctuating system here, you know that POS requires internet to function. When there is bad network, business is dull and it affects our transactions” (female, 26 years old, POS merchant).

Further probe on the relationship between PoS merchants and customers, a respondent avers that:

“We are not rude; the problem is the students. Some of them don't

understand what we go through. When there is failed transaction and maybe we are debited without credit alert, we tell them to exercise patience because the bank will likely reverse the debit, but they will get angry and start making troubles" (male, 35 years old, POS merchant).

On reason why customers and POS merchants do not keep transaction receipts, a respondent explains that:

"The paper is expensive now, if we continue to print receipts for customers, we end up using our profit to service the customers. POS companies and banks don't give us papers. The only time we print is when a customer request for it. Even when you print, they will throw it away" (female, 29 years old, POS merchant).

On whether POS is more secured, a respondent said:

"I have heard stories of people who copy customers PIN and card number and use it to steal money from their account, so when you make withdrawal as a customer, you should be on alert" (female, 32 years old, POS merchant).

When probed on whether ATM cards are not compromised by operators, a respondent revealed that:

"Sometimes, our customers don't know what to do when they suspect that their card has been compromised. The best thing is to block your account when it occurs, but many customers don't know how to do this, that is what I observed on this job" (male, 28 years old, POS merchant).

On whether POS do not always have money for transactions above N50,000 a respondent explained that:

"The major reason why we don't keep huge sums of money is for security reason. Another reason is that this business has little returns, so it is risky to keep so much money on a business that does not yield so much profit" (male, 23 years old, POS merchant).

Table 3: FUU Students Level of POS USAGE & SATISFACTION

S/N	Responses	SA (4)	A (3)	SD (2)	D (1)	Total weight ed Score	Total No of Respondents	Mean Score	Decision	Group Mean
6	POS reduces the stress of waiting in a queue just to withdraw money	151 (604)	172 (516)	25 (50)	40 (40)	1210	388	3.12	Accept	
7	POS is fast and easy to operate	250 (1000)	105 (315)	12 (24)	21 (21)	1369	388	3.51	Accept	

8	----- ----- ----- -----	11 (44)	150 (45 0)	180 (36 0)	47 (47)	901	388	2.32	Reject	2.82
9	----- ----- -----	106 (424)	145 (43 5)	54 (10 8)	83 (83)	1050	388	2.71	Accept	
10	----- more secure	50 (200)	150 (45 0)	100 (20 0)	88 (8 8)	938	388	2.42	Reject	

Source: Field survey 2022

Table 3 determined the level of satisfaction derived by students of FUU on usage of POS. Item 6 on the questionnaire shows that 151 respondents strongly agreed that PoS reduces the stress of waiting in a queue just to withdraw money. 172 agreed, 25 strongly disagreed, while 40 disagreed, thus, the positive mean score at 3.12 shows that POS reduces the stress of waiting at ATM points. For item 7 on the questionnaire, 250 respondents strongly agreed that PoS is fast and easy to operate, 105 agreed, 12 strongly disagreed, and 21 disagreed. At a positive mean score of 3.51, we accept that PoS is fast and easy to operate. On whether customers keep POS transaction receipt for financial records (item 8), result indicate that 11 respondents strongly agreed that they keep transaction receipts, followed by 150 who agreed, and then 180 respondents who strongly disagreed. However, 47 respondents disagreed that they keep POS transaction receipt for financial records. The negative mean score of 2.32 suggests that customers do not keep transaction receipts after using POS. With reference to item 9 on the questionnaire, 106 respondents strongly agreed that POS charges is outrageous for students, while 145 agreed. Conversely, 54 respondents strongly disagreed, whereas 83 respondents disagreed that PoS charges is outrageous for students in FUU. The positive mean score of 2.71 shows that PoS charges are outrageous for students. Item 10 on the questionnaire sought to find out if PoS service is more secure. From the response, it was observed that 50 respondents strongly agreed, 150 agreed, 100 strongly disagreed and 88 disagreed. The negative mean score of 2.42 indicates that PoS transaction is not secured. In summary, the group mean of 2.82 implies that the level of satisfaction derived by students of FUU on PoS usage is positive.

Table 4: Challenges Of POS Usage As Experienced by FUU Students

S/ N	Responses	SA (4)	A (3)	SD (2)	D (1)	Total Weighted Score	Total No of Respond ents	Mea n Scor e	Decisi on	Gro up mea n
11	Network error is too frequent among POS operators in their service delivery	126 (50 4)	186 (55 8)	31 (62)	45 (45)	1169	388	3.01	Accep t	

12	Failed transactions are not easily and quickly resolved	255 (1020)	103 (309)	11 (22)	19 (19)	1370	388	3.53	Accept	3.08
13	Security of ATM card details are most times compromise by POS operators	58 (232)	65 (195)	112 (224)	153 (153)	804	388	2.07	Reject	
14	Most POS agents/operators do not always have money for transactions above N50,000	147 (588)	188 (564)	22 (44)	31 (31)	1227	388	3.16	Accept	
15	POS merchants do not liaise with banks to help solve double charges on customers	291 (1164)	75 (225)	8 (16)	14 (14)	1419	388	3.66	Accept	

Source: Field survey 2022

Table 4 examined the challenges experienced by students in a bid to use POS. Item 11 on the questionnaire sought to uncover whether network error is too frequent among PoS operators in their service delivery. 126 respondents strongly agreed, 186 agreed, 31 strongly disagreed and 45 disagreed. The positive mean score of 3.01 accept that network error is very frequent among POS operators in their service delivery. For item 12 on the questionnaire, 255 respondents strongly agreed that failed transactions are not easily and quickly resolved, while 103 agreed. Conversely 11 strongly disagreed while 19 disagreed that failed transactions are not easily and quickly resolved. The mean score of 3.53 accepts that failed transactions are not easily and quickly resolved.

Item 13 on the questionnaire asked whether security of ATM card details are most times compromise by PoS operators. Findings indicate that 58 respondents strongly agreed that PoS operators most times compromise the security of ATM card, while 65 agreed. On the other hand, 112 strongly disagreed and 153 disagreed that PoS operators most times compromise the security of ATM cards. The negative mean score of 2.07 is indicative that security of ATM is not compromised by PoS operators. On the questionnaire, item 14 sought to know whether most PoS operators do not always have money for transactions above N50,000. The results revealed that 147 respondents strongly agreed to the question, 188 agreed, 22 strongly disagreed and 31 disagreed. The mean score of 3.16 confirms that POS operators often decline transactions above N50,000 due to shortage of funds. Finally, probe on item 15 on the questionnaire which aimed to uncover whether PoS operators do not liaise with banks to help solve double charges on customers reveals that 291 respondents strongly agreed, 75 agreed, 8 strongly disagreed

and 14 disagreed. The positive mean score of 3.66 shows that PoS operators do not liaise with banks to help solve double charges on customer.

Discussion of Findings

Findings from the study show that customers are knowledgeable on the use of POS. However, they contend that merchants charge much for transactions even when their services are not readily available as and when needed. The study also found that customers perceive merchants to be rude owing to inability to resolve complains. However, it was discovered that customers do not keep evidences of transaction receipts for easier identification of complains to service providers.

Specifically, internet service is a major impediment to the realization of efficiency in POS services, as Adeoti (2013), Amaefule *et al* (2019) and Eleanya (2021) points out, poor internet services threatens the effective utilization of POS terminals and this is not peculiar with growing economies like Nigeria. The study also corroborates the findings of Okeke *et al* (2017), Ojo (2022) and NIBSS (2023) which agrees that, the growth of commercial POS services in Nigeria have alleviated time waste associated with queuing at deposit money banks. However, it was found that complains arising from failed transactions do not receive expected attention, hence a reduction in customers satisfaction level.

Conclusion and Recommendations

This study concludes that POS users will continue to face challenges arising from poor internet, and network failure, excessive charges, limited number of PoS, and other financial transaction irregularities such as inaccurate debit system. To this end, the study recommends that PoS users should liaise with banks for a fast, easy and efficient means of solving transaction errors. Furthermore, PoS merchant should endeavor to build more friendly relational skills especially with student population. Transaction charges on customers and students by POS operators should be timely and uniformly, beside. POS users should maintain multiple sources of accessing cash as a way of solving the challenge of cash shortage. Finally, customers should endeavor to demand for and keep receipts as evidences of failed transactions and further communicate their dissatisfactions to terminal operators.

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PREFERRED PREFAB: EXAMINING THE CULTURAL ACCEPTANCE OF ASSEMBLY-LINE HOMES FOR SUSTAINABLE HOUSING DELIVERY IN NIGERIA

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Abstract

This study takes an exploratory look at the extent to which culture could be integrated with building innovation for the delivery of prefabricated housing solutions in Nigeria. The study utilised a content analysis model of case studying to review developments in prefabricated housing with the specific objective of proffering sustainable off-site housing models that will not only be climate responsive and affordable, but will also draw inspiration from the cultural and ancestral patterns users can relate to. The study findings show significant ongoing dialogue between design/building innovation and social architecture which imbibe cultural values in a few of case studies. The study also uncovered potential for improved affordability of prefabricated housing using 3D printing techniques and modular installation of housing units crafted from locally sourced or recycled eco-waste. The study recommends widespread experimental testing of alternative building materials and products to further drive prefab housing costs downwards, as well as future collaborations between vernacular architects and building innovators towards practical realisation of sustainable development housing goals. The study also encourages wider empirical studies on the degree of acceptance of prefab housing solutions in countries like Nigeria in a bid to sensitise target users on the potentials of off-site construction.

Keywords: Prefabrication, Sustainable housing delivery, Vernacular architecture

INTRODUCTION

Housing is universally acknowledged as one of the most basic of all human needs. However, despite significant intervention and concerted efforts, global housing shortages persist at a worrying rate (Ogundeji, 2024). It is estimated that 1.8 billion of the world's population live in less-than-adequate housing, 150 million persons currently live in some state of permanent homelessness, and over 15 million people live under the threat of eviction annually. These figures are likely to be exacerbated by the increase in

economic, political and social tensions in countries like Ukraine, Gaza, Haiti and Afghanistan over the past 2 years (Morrison, 2023; Morrison & Stadelmann, 2023). To overcome this global housing deficit, it is estimated that countries like the USA and the UK need to provide up to 6.5 million and 4.3 million homes per annum, respectively. The housing deficit in Nigeria stood at over 28 million units as at November 2023 by official figures but so dire is the situation on ground, many housing speculators believe this shortfall is closer to 50 million units (Oshundairo, 2023; Ibem, Aduwo & Ayo-Vaughn, 2015; Olayiwola, Adeleye & Ogunshakin, 2005). The deficit is particularly noticeable among the vulnerable in society such as women (Okafor, 2020) and displaced persons whose rights to land ownership and development have been restricted through normative or disruptive patterns (Adesote & Peters, 2015). The housing crisis has spurred several discussions about sustainable solutions centred around three main components, being: cost – the need for affordable yet profitable solutions for whom they are intended; climate – adaptive and suitable enough for the planet; and culture – conformity and acceptance for the people who will use them (Ghisleni, 2024). Though several studies effectively lend to the discussions of lowering building cost and climatic needs, there is scant evidence on the cultural features of updated housing needs. Prefabricated housing is often perceived as a culmination of sustainable housing innovation (Wormald, 2024; Steinhardt & Manley, 2016). Cheaper to erect than most comparable in-situ versions, and available in a wide range of eco-friendly compositions, prefabricated solutions have come a long way from the transportable castles and forts of conquerors first documented in the 9th century to modern day buildings with components such as the floors, walls, roofs and services, that are partially or wholly manufactured in a factory or plant and easily assembled on the eventual site (Hearn, 2018). The scope and technology behind prefabricated construction varies significantly from small, single dwelling units (e.g., micro-units, tiny houses, Hex® homes, etc.), to large institutional projects such as hospitals, schools, offices and even religious buildings (Grossmann, 2023; McKnight, 2016). Though sometimes considered transitory housing, prefabricated structures are still mandated to conform to all standard building codes as permanent (or in-situ) buildings (Dave, Watson & Prasad, 2017). This defers to all considerations concerning construction techniques and materials, cost considerations, and the cultural contexts for each of these buildings to be deemed suitable.

This study provides an overview of the prefabricated housing industry as it impacts the provision of affordable housing for the vulnerable in society in developing countries. The paper examines the economic and technical considerations which have led to advances in off-site building, particularly in the housing sector. In order to evaluate the effect of cultural influences on the development of prefabricated housing solutions, the study seeks to address the following questions: What has been the national response to the introduction of prefabricated housing solutions in Nigeria? How influential are cultural factors in determining the degree of acceptance of prefabricated housing in Nigeria? How can prefabricated homes incorporate the cultural ethos of vernacular

architecture that will endear them to address the housing needs of the socially vulnerable in Nigerian society?

Literature Review

Prefabrication is, by no means, a novel concept in the erection of buildings. Earliest records of prefabricated buildings come from nearly a thousand years ago when explorers and conquerors sought out foreign lands with movable garrisons and accommodation. These were neither designed to be permanent or urgent as there was no need to develop them further once a new colony had been established (McKeever, 2024; Kamali & Hewage, 2016). Modern building prefabrication, or simply “prefab” as they more commonly called, has evolved in scope and execution due to growing concerns for building cost efficiency, faster turnaround and, in some cases, reusability (Morrison, 2023). Controlled building environments, the use of mass-produced components, and more recently, the use of 3D printing techniques have contributed to making the production process of prefab more efficient (Dooley, 2024; Williams, 2024; Akeremale, 2020; Azman, Ahamad, & Wan Hussin, 2012). Prefab construction is also doing well to ride on the trends of eco-friendly and sustainable building practices with the development of a variety of materials and construction techniques using materials such as straw, recycled plastic, food waste and by-products, earth, bamboo and so on (Dua, 2024; Thorsby, 2023; Povinelli, 2022; Arkin, 2020; Jain, 2017) as shown in Figure 1. In this way, many prefab models have demonstrated that it is possible to live symbiotically with the environment without clashing with it.

Several studies and reports have hailed modern prefab housing as a much-needed innovation in a sector beleaguered with delivery and performance woes (Zhang, Tan, Shi, Hou & Zhang, 2022). However, despite significant strides and development, the prefab industry is still plagued by inconsistency and challenges (Erlich, 2023; Zairul, 2021; Correia, Simões da Silva, & Murtinho, 2012). The last decade has been specifically hard hit by global recessions which caused a significant decline in the construction industry over low housing demand. This period coincided with the boom in prefab start-ups, many of which were forced to downscale, liquidate or, in some cases, file for bankruptcy following the inability to recoup the losses incurred to high energy costs, interest rates and cost-of-living problems (McKeever, 2024). Another challenge facing the prefab industry is the imbalance in technical capabilities between developed and developing countries, with the latter contributing less than 3% of the worlds global prefab needs, and half of which are found in India (Ruddick, 2014; Smith & Narayanamurthy, 2008).

Although prefabrication has been hailed by technology and energy enthusiasts as a game-changer in the building industry (Savvides, Michael, Vassiliades, Parpa, Triantafyllidou & Englezou, 2023; Chippagiri, Bras, Sharma, & Ralegaonkar, 2022; Wu, Luo, Li, Wang, Bi & Antwi-Afari, 2021), the gradual acceptance of the phenomenon has caused the transformational change expected of the prefab revolution appear to be more evolutionary than disruptive (Smith & Rupnik, 2019). Yet another shortfall in embracing

prefab housing stems from the perception that potential owners are discouraged by the possibility of mass-produced factory building units ending up as nothing more than standardised duplicates of banal, stereotypical dwellings lacking in character and individualistic appeal. Traditional models of prefab housing are often thought to be uninspired or stereotypical, especially where mass-production of the building components are somewhat generic and potentially alien to the very users they are intended for (Gattupalli, 2024). As a show of confidence in the phenomenon, some writers have argued that prefab building may eventually have to learn to coexist peacefully with on-site buildings for the foreseeable future.



Figure 1: Alternative building materials.
Sources (Clockwise from top left): Dua, (2024); Arkin, (2020); Thorsby, (2023); Jain, (2017)



Figure 2: Growing slums in Lagos, Nigeria
Sources (top and bottom): Tade, (2021); Ogundeji, (2024)

Nonetheless, researchers and designers have been continuously encouraged to innovate sustainable low-cost housing solutions for developing countries for decades, which includes the introduction of prefab housing (Bras, Ravijanya, Torres de Sande, Riley & Ralegaonkar, 2020). Following the tumultuous economic downturn due to foreign exchange instability in the country, recent demands from the Nigerian public domain extend the call for a step further in innovation to include locally-sourced materials, a shift from the dependence on concrete- and steel-based construction, and improved access to mortgage schemes that are effective. Building construction costs have risen by as much as 300% since the beginning of 2024 and the resultant continued decline in the erection of adequate low-cost housing will invariably lead to the resurgence of more low-income squatter settlements in urban and semi-urban areas known as slums shown in Figure 2 (Oyekola, 2024; Ogundeji, 2024; Tade, 2021).

Some writers have attributed the slower-than-forecast uptick in prefab housing to the deep-rooted attachment of stakeholders and experts to age-old on-site production processes. With studies highlighting the persistence of the “culture of in-situ building” – driven by the use of hard hats, heavy site equipment, and drawn-out construction timelines (Smith & Narayanamurthy, 2008) – building culture affects the way buildings

are not only erected, but also how they are used. Previous studies of prefab housing in Nigeria fully acknowledge the non-availability of the technical know-how and the financial backing to advance the proliferation of manufactured homes (Kolo, Pour Rahimian & Goulding, 2014; Akeremale, 2020). In a drive to embrace emerging technology, conformity to normative values and behaviour within prefab spaces often gets overlooked: much to the detriment of designers, fabricators and eventual users. People will simply not desire spaces in which they can neither function nor carry on their normal lifestyle activities (Ajufoh, Prucnal-Ogunsote, Enwerekowe & Ndandok, 2023; Ehteshami, 2018; Torabi & Brahman, 2013). This has spurred some prefab manufacturers to consider the use of indigenous and contextual forms in modern adaptation (Figures 3 and 4) which may hold greater appeal to the diverse cultural value preferences of their intended users (Valsson, 2020; El-Abdi, Ofori, Zakaria & Aziz, 2019).



Figure 3: Hex House (prototype) Source: McKnight (2016)



Figure 4: Traditionally inspired prefab prototypes. Sources: Google images, Pinterest (n.d.)

This study takes a closer look at the cultural value preferences of prefab which could attract or dissuade Nigerian users, particularly the socially vulnerable rural or semi-urban dwellers, women and internally displaced people. The influence of key features of layout, use of materials and building form on the evolution of truly affordable prefab options will be reviewed with the aim of understanding the preferred options for manufactured homes in developing countries.

Methodology

This study utilised a systematic literature review and desk research of over 40 scholarly articles, published product reviews, media editorials, ethnographic case studies and a conceptual simulation to examine the potential influence of cultural value preferences affecting prefab housing adoption in Nigeria. The study plan includes a review of emerging prefab trends incorporating indigenous and vernacular architecture, highlighting the successes and shortcomings of existing models. The study examines low-cost building trends and styles which persist in semi-urban and rural communities

across Nigeria, and discusses how prefab (in conjunction with other modular construction) may be considered as a sustainable option to address housing shortages. The study analysis relies on a qualitative interpretation on identification, comparison and contrasts of underlying patterns and themes in off-site construction (Dudovskiy, 2018). The findings critically assess the national response to prefab building in Nigeria and the perceived level of acceptance of models which incorporate vernacular architectural layouts and styles. The data is presented as an architectural content analysis captured in the descriptive interpretative images of direct and published observations from where conclusions and recommendations can be drawn (Crossman, 2017). The risk of cultural bias in the analysis was minimised through the use of universal criteria that accepts contextual cultural differences of existing prefab models.

Findings and Discussion

This section of the paper presents the findings from the case study analysis of the perceived cultural impact on perceptions and acceptance of prefab building in Nigeria. It was Rapoport that posited that socio-cultural influences have a higher level of critical precedence over physical forces which determine how houses are built. It therefore stands to reason that socio-cultural influences (including religion), availability of materials, and environmental conditions are largely responsible for the ways in which different cultural groups accept and adopt housing styles, layouts, and models.

Cultural factors affecting the degree of acceptance of prefab: Styles, layouts and models

Despite several differences in the layout, styles and models of Nigerian vernacular architecture due to tribal peculiarities, research has shown many commonalities in the key features that define Nigerian traditional housing composition. Three key features include:

1. Courtyards (or the impluvium) – these held immense significance to the traditional housing set up from a perspective of clustering and a history of communality predicated on defence or social interaction. They functioned as shared spaces for interaction among family members, and were often used for performing various domestic functions which include cooking, religious rites and worship, folklore and entertainment. Courtyards also served as a transition space between public and private areas, as well as sources of natural light and ventilation.
2. Rectangular and circular based plans – several researchers maintain that “inferior” or “primitive” circular African buildings evolved into rectangular-based plans only after the influence of western cultures. Though the origins may be subjective, evidence shows most traditional Nigerian housing layouts evolved to combine rectangular-based plans for living spaces and circular-based plans for storage, utility and granaries.
3. Multi-room dwellings – Nigerian traditional architecture widely incorporated the use of multi-room configurations with a distinct separation of functions for living, sleeping, and services. This feature persists even in modern adaptations of

Nigerian architecture which favour multi-room layouts in monochronic or polychronic capacities (Lodson, Ogbeba & Elinwa, 2018).

In Northern Nigeria, the impact of Islam which displaced many of the indigenous northern tribes and cultures from as far back as the 12th century introduced the isolation and privacy of women to the “*cikingida*” (inner rooms) from where pubescent and non-family males were strictly prohibited access. Also, in Southern Nigeria, houses of tribes such as the Ibo and the Yoruba were comprised of individual windowless rooms around a colonnaded courtyard separated into private and public areas similar to northern dwellings, with male sections were separated from women and children (Figure 5). Consequent upon the climatic region, walls were traditionally made of mud bricks (wattle and daub, adobe or “*tubali*” – a pear-shaped earth brick with vegetable admixtures) or rammed earth, palm fronds, rough-cut wood or unhewn stones; roofs incorporated the use of sisal grasses, rammed earth domes or flat roof moulds, or bamboo (Umar, Yusuf, Ahmed & Usman, 2009; Minke, 2006).



Figure 5: Traditional Ibo homestead layout; traditional Hausa homestead layout, Hausa home façade and decorative motifs; traditional Yoruba elevation. Sources (Clockwise from top left): Henderson & Henderson, (2024); Sa'ad, (1981); Bayt Al Fann, (n.d.), [Alaayemoré, \(n.d.\)](#)

The Global impact of Vernacular Architecture on Prefabricated buildings

There has been considerable effort in the development of prefab, modular and 3D printed model housing to reflect the aspirations and yearnings of vernacular architectural needs which are not only climate responsive, but also cost effective. However, a key finding from this study is that insufficient research and development has gone into widely-acceptable adaptations of the aforementioned off-site construction

models towards embodying sociocultural norms and practices. An example is the 2016 collaboration on the Hex House designed for refugees by Architects for Society (AFS). With a projected lifespan of 15-20 years and an estimated unit cost of \$15,000-\$20,000 (~₦18,000,000-₦24,000,000) for 40m² of floor space, the model hosts a central open-plan living space and walk-in kitchen, a bathroom and 2 bedrooms (Figure 6a and b).

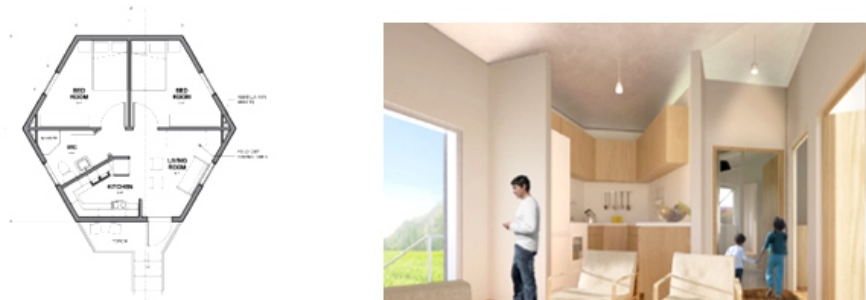


Figure 6a and b: Hex House floor plan and living room/kitchen interior. Source: McKnight, (2016)

An online survey of property markets in Nigeria in the first quarter of 2024 revealed the average cost of an in-situ 2-bedroom unit of the same floor area would retail for ₦65,000,000; ₦3,290,000-₦7,410,000 being the cheapest available options (Nigerian Property Centre, 2024). These figures seem to suggest the Hex House would not only be an inadequate low-cost housing option for the socially vulnerable in Nigeria, the open-plan living and kitchen space deviates significantly from the culturally acceptable multi-room layout typically endeared to low-income home owners which imbibes a distinct separation of internal function.



Figure 7: BioHome3D prototype. Source: The University of Maine (2022)

Another model examined in the study is the 3D printed BioHome3D© developed by the Advanced Structures and Composite Centre (ASCC) of the University of Maine, US in 2022 (Figure 7). This 56m² one-bedroom, one-bathroom prototypical eco-friendly model was developed without the use of any concrete-based material. Rather, the sustainable printing material used is a bio-based wood waste composite of pulverised sawdust and a polymer binder which becomes a pellet fed into the 3D printer. The layout is considered less open-plan than most prefab models which may lead to the development of multi-room models favoured by Nigerian vernacular trends, and it boasts a significantly lower carbon-footprint in both construction and operation, as well as customisable R-values. The building was also able to withstand severe weather extremities, making it one of the most environmentally-conscious prefab composites till date in a country like Nigeria with a diverse stream of climatic extremities. The production process of the BioHome3D almost totally eliminated any form of construction waste and the buildings are totally recyclable due to the nature of the materials used: meaning they have an almost unlimited lifespan. However, at an estimated cost of \$40,000 (~₦48,000,000), the BioHome3D is among the higher end versions of prefab homes, but its advanced production process does present an option for the conversion of more readily available organic and inorganic waste in Nigeria such as single-use plastics, fly-ash, corn husks, etc. to potentially drive printing costs further downwards.

In a few countries such as Chile, Colombia and Indonesia, efforts have been made to infuse vernacular architectural styles and practices into the development of prefab homes designed to address the needs of low-income earners (Figures 8a, b and c). The use of locally sourced materials in conjunction with traditional building methods have led to the emergence of scaled affordable prototype homes which are respectful of the ancestral culture yet reflective of modern building techniques. Each of the submissions imbibe the principles of customisation and globalisation in order to address the specific local needs brought about by climate change and natural disasters.



Figures 8a, b and c: fusion of vernacular and modern low-cost prefab prototypes in Chile, Colombia and Indonesia. Source: Ghisleni (2024).

These developments have also increased the dialogue on longevity and durability of prefab models made entirely of locally sourced materials such as wood, bamboo and earth, of which extensive product testing is highly recommended. This is of particular significance to the 18m² two-storey Pemulung House in Indonesia (Figure 8c) which was intended for transitory migrant workers and not permanent residents. The use of locally sourced materials, however, resulted in a significant decrease in the unit cost of the vernacular-inspired modular units in South America and Asia bringing cost of

prefabrication down to between \$51 to \$120 per square metre, excluding delivery or installation costs. The development of more resilient and durable models would invariably lead to a marginal increase in unit cost but is less likely to defeat the overall goal of achieving affordable housing for the urban and semi-urban poor.

Perception and reception of prefab in the Nigerian low-cost housing model

Entrance of prefab into the Nigerian construction industry has been widely viewed with both curiosity and scepticism. Product reviews, existing literature and field observations reveal prefab buildings are predominantly used as security outposts, construction site offices, storage facilities, institutional buildings (such as school building extensions and pop-up industries), and workshops. Use of prefab as a housing solution remains largely experimental and customised to suit the needs and aspirations of an elitist demographic and not the desirable urban or semi-rural poor dwellers (Figure 9). The Federal Republic of Nigeria [FRN] revised the National Building Code [NBC] (2006) to incorporate rules, minimum standards and guidelines for the erection of prefab buildings and the Federal Government offers several tax incentives for developers of modular construction projects to address Nigeria's housing shortage needs. Manufacturers such as Karmod®, EazyHomes Company®, Vitapur Insulation® and Nigerian Portable Cabins® offer a variety of single- and multi-floor bespoke housing configurations with starting prices from ₦5,000.000 for a single room dwelling, exclusive of transportation or actual installation costs. The steel framed structures are typically clad with shipping-container steel panels or Structural Insulated Panels (SIP's). However, most of the existing prefab prototypes advertised adopt distinctly western layouts and aesthetics, paying scant attention to traditional homage of vernacular architecture.



Figure 9: Exterior and interior images of 1-bedroom prototype prefab house, Abuja, Nigeria. Source: <https://tiktok.com/@sannivictor> (2024)



Figure 10: Nigerian traditional construction practices using earth and other low-cost materials. Source: Authors' field work (2023)

Traditional methods of in-situ construction which typically includes the use of rammed or compacted earth blocks, tin or aluminium roofing sheets and/or rough-hewn wood trusses (Figure 10) alongside selective use of modern elements such as concrete, glass and

steel, have long been the preferred options for low-income dwellers and transitional residences despite the economic strain they impose. The materials and construction techniques often provide for hamlet-style layouts composed of individual dwelling units delineated into public, semi-private and private zones to accommodate family activities. The observed available and evolving options in prefab housing make it possible to fuse the properties of speed and efficiency of modern construction with the feeling of belonging and identity from vernacular architecture. Radical developments in 3D printing techniques, such as in the BioHome3D, allows for customisation of design elements by also minimising the resultant effect of stereotypical duplications of housing units. Using alternative building materials made up of recycled waste or eco-friendly composites as sampled in the South American and Asian prefab and modular building production trends indicates the possibilities of eventually lower building costs to meet the needs of the vulnerable in society.

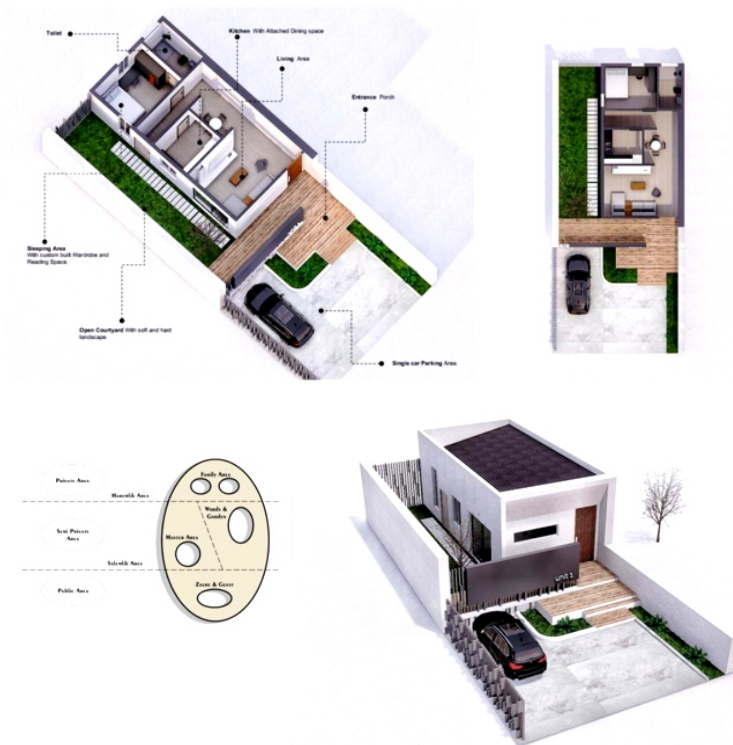


Figure 11 (Clockwise from bottom left): Traditional internal homestead zoning; isometric view, floor plan and exterior view of Nigerian vernacular prefab prototype. Sources: Noma et al (2022); Authors' conceptual design (2024)

From a critical review of emerging trends in the fusion of high-tech composite building practices and sustainable vernacular architectural patterns, proposals can be made with the ultimate goal of providing truly affordable social architectural solutions with an affinity to endearing cultural values. An example of such a proposal is a prototype in Figure 11 above which conforms to vernacular housing patterns of northern Nigerian

architecture having distinct internal zoning requirements with access to a screened-off external courtyard; finished with 3D printed SIP claddings reminiscent of the traditional materials of construction, namely earth (mud), wood and stone. The front room, which serves as a public reception space, is demarcated from the private sleeping space by the concealed kitchen which is traditionally considered as a semi-private area in the Nigerian homestead. The building façade utilises a mono-pitched roof and clean lines symbolic of northern Nigerian architecture, with relief motifs adorning textured walls, architraves and window casings.

Conclusion

Overturning the global housing deficit remains a leading sustainable development goal which can only be achieved when solutions proffered offer users climate responsive alternatives which align with their financial capacity and cultural building patterns. From a review of leading models and innovative trends in the prefabricated housing markets, the study finds that the foundations have been laid for sustainable, revolutionary collaborations between past building practices and future building techniques. The study recommends the continued targeting of efforts towards providing prefabricated housing for the urban and semi-urban poor, and other socially vulnerable users for whom the provision (or lack) of quality housing is a strong determinant for the existential growth of slums and other substandard informal settlements. The prospects for widespread integration of culturally-responsive prefab models in the Nigerian building space could become a key factor in the discussions on national housing policies and practicable mortgage schemes for the urban poor. The study recommends expanded empirical studies into users' preferences in prefab housing, particularly in developing countries where they are yet to be widely introduced to the general population. The study also suggests the extended collection of data from practical testing on prefab building modules such as 3D printing which have the capabilities of repurposing eco-waste and other sustainable building materials to lower the cost of purchasing prefab housing. Lastly, the study advocates for further collaborations between culture and innovation in architecture to ensure lasting values such as spatial arrangements, architectural identity, building shape and form, and so on, remain visible in evolutionary building trends.

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EFFECTS OF ILL-EQUIPPED LABORATORY IN THE CONDUCT OF BIOLOGY PRACTICAL IN SECONDARY SCHOOLS IN KAGARKO LOCAL GOVERNMENT AREA OF KADUNA STATE.

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Abstract

This research work examined the effect of ill-equipped laboratory on the conduct of Biology practical in secondary schools in Kagarko local government area of Kaduna State. A survey research design was used; simple random sampling technique was used for selection of the schools, one hundred and fifty (150) students and eighteen (18) teachers were the sample population used for the study. The questionnaire titled "Effect of ill-equipped Laboratory in the conduct of Biology Practical in Secondary School" (EIELCBPSS) was the instrument employed. Data collected were analyzed using simple percentage and Chi-square statistical tools. The results shows that poor laboratory and insufficient practical materials and equipment have a great effect on the conduct of biology practical and teachers need to improvise instructional materials for effective delivery of their lessons or practical work. For Chi-square analysis, the entire three formulated hypotheses were of no significance as X^2_{cal} was less than x^2_{crit} . This implies there is no significant difference between ill-equipped laboratory and well-equipped laboratory including students' failure and there is also no significant difference between out-dated equipment and teacher's improvisation of instructional materials in the conduct of biology practical. It was recommended amongst others that non-governmental organization should take interest and bold steps in enhancing the quality of school science laboratories in our various institution of learning; teachers should be encouraged to attend regular workshops and seminars on improvisation and laboratory techniques so as to improve their laboratory skills.

keywords: Effects, Ill-equip, Laboratory, Biology Practical & School

Introduction

Biology is defined as the scientific study of living things, it is a branch of science which deals with structure, functioning and developmental process of maintaining life

(Akinagboto, 1990). Learning by doing as a concept has been described as a learning situation where hand-on and minds-on activities or a concrete sensory experience are used to aid understanding of learning experience that is student-centred and contrary to traditional lecture pattern of instruction which is teacher-centred (Maduabum, 1992 and Ajeyalew, 2011). Therefore, the government or any nation should foster enabling environment for learning by doing what would guarantee quality science education. This is by making adequate provision of laboratory facilities, equipment and instructional materials that are necessary for scientific learning by doing. According to Wasagu (2009) learning by doing (inquiry-based) is advocated in school, he drew an ancient proverb which says that:

*“Tell me and I forget
Show me and I remember
Let me do it and I will understand”*

However, one can say without fear of contradiction that contemporary science laboratories at senior school level in Nigeria are grossly ill-equipped thereby making it impossible to ensure the practice which could motivate learning by doing and the generation of globally competitive indigenous scientists (Wasagu, 2009). Arneh, (1990) stated that most of our secondary school laboratory are poorly equipped. Mustapha (2009) said teaching facilities such as relevant science textbooks, instructional aids, laboratory equipment etc. are either grossly inadequate or non-functional (obsolete) or not even available at all in some schools' laboratories. Gyuse, (2009) also observed that facilities; teaching materials, laboratories/ workshop equipment and other accessories in our schools setting are part of problems that lead to professional job inefficiency amongst the Nigerian school. The term practical is an examination or lesson in which theories and procedures learned are applied to the actual making of doing something.

Statement of the Problem

The problem with ill-equipped laboratory in conducting biology practical in senior secondary schools in Kagarko and environ has been a great concern to the people and students of the area. Here are some points that lead to the problems of ill-equipped laboratory as follows:

1. **Lack of fund:** The laboratories in most of our secondary schools require adequate funding and capital. This problem is often compounded by lack of interest by government, private and public organizations to provide adequate funds for the laboratory sector in the school.
2. **Lack of equipment, facilities and materials:** The laboratory requires adequate provision of necessary materials and facilities in terms of quantity and quality. The situation is compounded by lack of effort and interest to provide and maintain such facilities in the laboratory.
3. **Lack of quality technologist:** The laboratory needs people that are qualify on the field to study not just someone without the knowledge or skill, when there are technologist in the sector, the laboratory will not damage the way some of the laboratory are today. Good technologist, good laboratory.

Purpose of the Study

The aim of this study is focused at finding the effect of ill-equipped laboratory in the conduct of biology practical, with the view of finding the problems or causes of ill equipped laboratory in our senior secondary schools.

Research Questions

In relation to the ill-equipped laboratory in conducting biology practical in secondary schools, the following research questions were thrown forward:

1. Does poor laboratory and insufficient practical materials or equipment have any effect in organizing effective biology practical?
2. Is the equipment or materials in the biology laboratory functional and teacher knowledgeable?
3. Do teachers improvise instructional materials in case of insufficient practical materials or equipment?
4. Do teachers create humour and good relationship with their students during biology practical?

Research Hypothesis

The following hypothesis would be treated at $p \leq 0.05$ of significance:

1. **HO₁:** there is no significant difference between ill-equipped laboratory and well-equipped laboratory in the conduct of biology practical.
2. **HO₂:** there is no significant difference between ill-equipped laboratory and students' failure in biology practical.
3. **HO₃:** There is no significant difference between out-dated equipment and improvisation of instructional materials by the teacher.

Methodology

The design for this research was the survey design. This design was chosen because the research is a descriptive research and aims at collecting and presenting people's opinions through the use of questionnaire. The population for this research work comprises all senior secondary schools in Kagarko local government area of Kaduna State. Three (3) schools were randomly selected for the study. This is to make sure that the schools sampled had laboratories. The three (3) schools purposively sampled include; Government Secondary School Kagarko (Senior), Government Secondary School, Jere (Senior) and Government Secondary School, Kuse. Fifty (50) students from each school were randomly selected by picking from hat method making a sample population of one hundred and fifty (150) students. Also, six teachers who teach biology were randomly selected from each school for the study.

The research instrument used in the study to generate data was the four Linkert scale questionnaire. The questionnaire designed was of two types; one for the students and the other for the teachers, both titled "Effect of ill-Equipped Laboratory in the Conduct of Biology Practical in Secondary Schools" (EIELCBPSS). The questionnaire comprises of twelve (12) items statements for both students and teachers to respond to either; strongly

agree (SA), agree (A), strongly disagree (SD) and disagree (D). The questionnaire was constructed by the researcher and face validated by experts in the field. The instrument was field tested on a random sample of fifty (50) students selected from two schools; Government Secondary School Kagarko Senior and Government Secondary School (Senior) Jere and the result of the test was used to determine the reliability coefficient, which was found to be 0.76. The researcher visited the selected schools; copies of the questionnaire were distributed and respondents were asked to tick the appropriate columns as it is specified in the questionnaire and later retrieved for analysis.

Data Analysis

The data obtained from the student's questionnaire was used to answer the research questions by using simple percentage scores, while data collected from teacher questionnaire were also analyzed using chi-square statistical tools.

Research Questions

Does poor laboratory and insufficient practical materials or equipment have any effect in organizing effective biology practical?

Table 1: Percentage analysis of research question one based on poor laboratory and insufficient practical materials.

S/N	Items	SA	A	SD	D	SA & A%	SD & D%
1	Insufficient practical materials hinders effective conduct of biology practical.	211	134	48	57		
2	The equipment and materials functional and in good conditions for practical	46.89%	29.78%	10.67%	12.66%	76.67%	23.33%
3	Ill-equipped laboratory is a dangerous place for learning as students may prompt to any forms of laboratory accident						

Source: Field Work 2023

The table above comprises of three (3) questions in which the students who responded to strongly agree and Agree had a total of 76.67% while those who strongly disagree and disagree has a total of 23.33% indicating that, poor laboratory and insufficient practical materials or equipment have an effect on the conduct of biology practical.

1. Is the equipment or materials in the biology laboratory functional and teacher knowledgeable?

Table 2: percentage Analysis of Research question 2 based on functionality of materials.

S/	Items	SA	A	SD	D	SA & A%	SD & D%
1	Teachers are knowledgeable In the use of laboratory equipment	117	118	124	91		
2	The laboratory has all relevant equipment for carrying out practical	26.00	26.22	27.56	20.22	52.22%	47.78%
3	Teachers carried out biology practical one's in two weeks						

Source: Field Work 2023

From the table above, the table comprises of three (3) questions, students who responded to strongly agree and agree had a total of 52.22% while those who responded strongly disagree and disagree has a total of 47.78% indicating that, the equipment or materials in the biology laboratory are functional and the teachers knowledgeable in the subject matter.

1. Do teachers improvise instructional materials in case of insufficient practical materials or equipment?

Table 3: Percentage analysis of research question 3 based on teacher improvisations.

S/	Items	SA	A	SD	D	SA & A%	SD & D%
1	Teachers are knowledgeable in construction of improvised materials	141	143	85	81		
2	Teachers improvise instructional materials in the absence of practical materials	31.33%	31.78%	18.89%	18.00%	63.11%	36.89%
3	All biology teachers conduct practical in your school						

Source: Field Work 2023

The table above also comprises of three items in which the students responded to the research questions. 63.11% of the students responded strongly agree and agree to the question while 36.89% of the students responded strongly disagree and disagree to the questions which indicates that teachers improvised instructional materials for the conduct of biology practical.

1. Do teachers create humour and good relationship with their students during biology practical?

Table.4: Percentage analysis of research question 4 based on good relationship between teachers and students.

S/	Items	SA	A	SD	D	SA & A %	SD & D%
1	Learning of biology is most appreciated and better understood in the laboratory	244	135	31	40		
2	Teachers are role model for their students to follow during practical works	54.22	30.00	6.89%	8.89%	84.22. %	15.78%
3	Good practicals environment for the teachers and students enhance better learning						

Source: Field Work 2023

Table.4 shows that, 84.22% of the respondents respond strongly agree and agree to the item while 15.78% of the respondents responded strongly disagree and disagree to the items of which states that, teachers create humor and good relationship with their students while carrying out biology practical, indicating that teachers relate well with their students during biology practical.

Research Hypothesis

Ho₁: There is no significance difference between ill-equipped and well equipped laboratory in the conduct of biology practical.

Table 5. Chi-square analysis of difference between ill-equipped laboratory and well equipped laboratory in the conduct of biology practical.

S/N	Ill-equipped laboratory and well equipped laboratory	Nf	Ef	Df	X ² cal	x ² crit	Remarks
1	Inadequate materials	150	145				Not significant
2	Functionality and good condition	150	145	3	0.32	07.81	(NS)

Source: Field Work 2023

From the data analysis in table 5 above, the hypothesis was retained. This goes against the back drop that ill equipped and well-equipped laboratory affects biology practical positively or negatively. However, results obtained from the research shows that ill equipped laboratory does not affects biology practical, this could be because teachers improvised materials in the absence of the real ones.

H₀; There is no significance difference between improvised materials and student's failure in biology practical.

Table 6: Chi-square analysis of difference between provision of improvised materials and students failure in the conduct of biology practical.

S/N	Ill-equipped laboratory	Nf	Ef	Df	X ² cal	x ² crit	Remarks
1	Teachers pay for improvised materials	18	17.8				Not significant (NS)
2	Schools' management lack adequate funds in setting up standard laboratory	18	17.8	6	0.600	12.6	
3	Teachers improvised instructional materials	18	17.8				

Source: Field work 2023

The results obtained from table 6 shows that there is no significance difference between ill-equipped laboratory and student's failure. Once again this goes against the fact that an ill-equipped laboratory has an effect on students' failure or success. The reason for retaining the hypothesis could be attributed to the improvised materials used by the teacher in delivering of his lessons.

H₀; There is no significant difference between out-dated equipment and improvisation of instructional materials by the teacher.

Table 7: Chi-square analysis of different between outdated equipment and materials and improvisation of instructional materials by the teacher.

S/N	Outdated equipment	Nf	Ef	Df	X ² cal	x ² crit	Remarks
1	Equipment or materials outdated	18	17.8				Not significant (NS)
2	Absence of practical's materials	18	17.8	6	0.600	12.6	
3	Equipment and materials are functional.	18	17.8				

Source: Field Work 2023

Table 7 above indicates the X^2_{cal} . value of 0.600 is less than the X^2_{crit} value of 12.6 from $p \leq 0.05$ level of significance. Therefore, the null hypothesis of no significance difference is retained for H_{o_3} .

Discussion of results

The analysis made in table 1 indicates that majority of the students are of the opinion that ill equipped laboratory and insufficient practical materials have effect on the conduct of biology practical. This could be in line with the opinion of Chimezie, Ike & Iwu (2002) who opined that many teachers and students are ignorant of the importance of using biology laboratory materials in teaching and appropriate teaching methods to use to effectively actualize educational objectives. This ignorance is further demonstrated in the habit of vandalization in students wanting to destroy properties whenever they revolt against the school authorities.

Table 2 indicates 52.2% respondents who strongly agreed that materials or equipment found in their schools are functional and the teachers teaching the subject are knowledgeable. However, Dahar (2011) argued that the facilities for teaching biology practical in some schools are not up to standard and are inadequate. In table 3 of the data analysis, 63.11% of the respondent strongly agreed that teachers improvise instructional material during the conduct of biology practical in the absence of none which makes it possible for the students to be exposed to biology practical at least once in a week.

Table 4 of research items states that the teacher creates humor and good relationship with their students during biology practical, here 84.22% strongly agree while 15.78 disagree. Agun and Imogie (1991) is of the opinion that creating good humor in practical class provide students with opportunity of explaining and establishing relationship between part and event that makes the students to love science. In table 5 which shows the chi-square analysis of difference between ill-equipped laboratory and well equipped laboratory in the conduct of biology practical, the results indicates that the null hypothesis was accepted indicating that there is no significance difference between ill-equipped and well equipped laboratory and the conduct of biology practical. In view of this, Tenew (2015) concluded in his own research that ill-equipped laboratory do not play a significant role always in the conduct of biology practical. Also, Osuafen (2010) viewed ill-equipped laboratory as a laboratory in which all necessary equipment that are needed for practical is not available, which will determine the conduct of biology practical.

Table 6 which are on the difference between provision of ill-equipped improvised laboratory materials and conduct of practical. The results show that the null hypothesis was accepted which implies that there is no significance difference between provision of ill-equipped improvised laboratory materials and conduct of practical and even the lack of funds by schools; teachers are trying by providing materials to make the lesson acceptable. The results show that when the teachers are capable of improvising unavailable materials (equipment) to replace the ill-equipped materials will determine

the success of biology practical. Nwaegbo (2005) opined that ability to improvise is one of the characteristics of science teacher when the real equipment or materials are unavailable. Oladipo (2010) also add that improvising the ill-equipped materials will assist in elevating the promotion of biology practical.

The result in table 7, which is on the difference between out-dated equipment or materials and conduct of biology practical shows that the null hypothesis of no significance difference is retained which implies that the success of every student in biology practical is determined by good equipment and the effort of the teacher. Oladipo (2010) opined that to have a successful record in biology practical it require a very update materials or equipment. This result agrees with Ali (2004) that production of instructional materials is usually done in two broad ways, by improvisation which is often done by the teachers and occasionally learners and by publishers and instructional development centers. 36.89% respondents disagree that teachers do improvised instructional materials.

Conclusion

The research work has tried to discuss the issue of ill-equipped laboratory in the conduct of biology practical. It discusses the effect of poor and insufficient practical materials or equipment on the conduct of biology practical, the functionality of the equipment and improvisation of instructional materials among others. The results shows that the students taught in a well-equipped laboratory have greater advantage over those taught in an ill-equipped laboratory. It also revealed that teachers should endeavour to improvise instructional materials where there is need for it so as to remedy the real materials that may not be available in the laboratory. Conclusively, the research shows that biology practical is an important aspect of biology curricula; so therefore, time and energy should be put into it for the attainment of its objective.

Recommendations

In the light of implications of findings of this study it is recommended that the Government and all the stakeholders in science education should ensure that there are adequate facilities as follows:

- i. Provision of laboratory materials, equipment and facilities so as to enhance effective teaching of biology.
- ii. Non-Governmental organizations should take interest and bold steps in enhancing the quality of school science laboratories in our various institutions of learning.
- iii. International donor organizations to assist in equipping school science laboratories with the modern-day laboratories.
- iv. Teachers should be encouraged to attend regular workshops and seminars on improvisations and laboratory techniques so as to improve their laboratory skills.
- v. Teachers should not overload themselves with work so as to have enough time to improvise relevant materials they will use to teach.

- vi. Schools administrators should provide funds for teachers to improvise science equipment.
- vii. Sufficient time should be created by science teachers to improvise.

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THE USE OF POLITENESS PRINCIPLES BY NIGERIAN POLITICIANS IN THEIR POLITICAL CAMPAIGNS TO PRECLUDE POLITICAL DISASTER

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Abstract

This paper examined the use or nonuse of politeness strategies by Nigerian politicians in their political campaigns. The study employed a combination of two analytical approaches – the Close Text Analysis (CTA) and the Narrative Paradigm - to interpret and analyse the selected texts and contexts (sourced from You Tube platform) of utterances of two gubernatorial candidates in Kaduna State during their campaigns for governorship election in 2015. The paper used the Leech's framework of politeness maxims in the analysis of the sampled texts of political campaign utterances by politicians from the two prominent political parties in the country, to determine their conformity or otherwise with the politeness principles. The paper found out that politicians do not make use of politeness principles in their campaigns; consequently, they divide the Nigerian populace along the various interests of the different political actors, and have therefore brought about conflicts within the society; the state that, usually, threatens the survival of democracy in the country and brings about chaos and disaster. It concluded that a peaceful and politically developed Nigerian society is achievable only when politicians in Nigeria adjust their conduct by adhering to maxims of politeness. It therefore recommended that Nigerian politicians should be sensitized to develop the skill of display of socio-political expertise and competence, personal ethics and integrity, control of emotions, and development of professional image in order to produce nationalistic followership and create a balanced political atmosphere in the country.

Introduction

Throughout man's life, communication remains the most vital ingredient for coexistence. Depending on one's intention or purpose of communication such as to inform, to persuade, to convey goodwill, or to establish credibility (Quora.com), one is required to pattern language to effectively suit one's purpose. To achieve one's purpose(s) of

communication, he/she should use certain strategies to help achieve the goal of communication as well as establish and, or, maintain harmonious relationships between him/herself and co-communicator(s). Thus, to create a serene community, the place of refined interpersonal communication is fundamental.

This paper examines the use or otherwise of politeness strategy by the Nigerian political actors in their campaigns in relation to the state of political conflict between political leaders and their supporters within the Nigerian society.

Objectives of the Study

The study aimed at achieving the following objectives. To find out:

- i. Whether or not there is positive application of politeness principles by Nigerian politicians in their campaigns;
- ii. How the campaign utterances of Nigerian politicians adhere to politeness principles; and
- iii. How campaign utterances of Nigerian politicians contravene the politeness principles.

Literature Review

Politeness

Various scholars have differently treated the concept of politeness. Of these are Brown and Levinson (1987) who have defined politeness as repressive action taken to counter-balance the disruptive effect of Face-Threatening Acts (FTAs). They define face as “the public self-image that every member of a society wants to claim for himself”. They refer to face as a speaker's sense of social identity. Consequently, any speech act that seems to impose on one's sense of social identity (face) is regarded as a face-threatening act. In their framework, face consists of two related aspects. One is negative face referring to rights to territories, freedom of action and freedom from imposition, i.e. wanting one's actions not to be constrained or inhibited by others. The other is positive face implying consistent self-image that people have and their desire to be appreciated and approved of by at least some other people. Face-threatening acts (FTAs) therefore are acts that infringe on the addressees' need to maintain his/her self-esteem, and be respected. The rational actions people take to preserve both kinds of face for themselves and the people they interact with, add up to politeness.

To lessen the threat, speakers use face and politeness strategies such as positive face (positive politeness) and negative face (negative politeness). Negative face according to Yule (2010) refers to the need by an individual to be independent and free from imposition; while positive face is the need to be connected, to belong, to be a member of a group. Positive politeness signifies a speaker being complimentary and gracious to the addressee; which, however, should not be overdone, as the addressee may be alienated (core.ac.uk); while in negative politeness, a speaker uses various ways to mitigate an imposition on his/her audience. Using these strategies to lessen the possible threat to another person's face can be described as face-saving act which comprise hedging,

pessimism, indicating deference. Apologising and impersonalising; all of which are used to minimise the possible threat to the listener's face.

To sum up, politeness can be viewed as a social phenomenon, a means to achieve good interpersonal relationships and a norm imposed by social conventions; as it can be observed as a phenomenon in all cultures and it is recognized as a norm in all societies. To be polite, means to live up to a set of conventionalized norms of behavior. Thus, this paper seeks to measure the conduct of political campaigns by politicians in relation to politeness.

The Politeness Maxims

Consequent upon the indispensability of politeness in human communication, scholars such as Leech (1983), Brown and Levinson (1987) and Yule (2010) proposed certain principles guiding (the use of) politeness in one's communication. Leech proposed a series of maxims which explain how politeness operates in conversational exchanges. Below are his maxims.

The Tact Maxim

The tact maxim is other-centred where the speaker (in directives and commissives) ensures that (s)he not only minimizes cost to his/her hearer but also maximizes benefit to the hearer, as in the following:

(i) *Peel these potatoes.*

(ii) *Hand me the newspaper.*

At some rather indeterminate point on this scale (depending on the context), the relevant value becomes 'benefit to hearer' rather than 'cost to hearer'; but clearly, if we keep the imperative mood constant, there is a general increase in politeness (other factors being equal) between i and v. (Leech, 1983: 107-108).

The Generosity Maxim

This maxim is self-centred as it makes the speaker to minimize benefit to self and maximise cost to self, as can be seen in the examples below.

(a) *You can lend me your car. (impolite)*

(b) *I can lend you my car. (normal, polite)*

(c) *You must come and have dinner with us. (normal)*

(d) *We must come and have dinner with you. (impolite)*

The Approbation Maxim

This maxim is observed in expressives and representatives (which Leech (1983) calls assertives)

whereby the speaker minimises the dispraise of other and maximises the praise of other.

That is to say, in this maxim, the speaker should 'avoid saying unpleasant things about others and, more particularly, about the hearer'. Hence, whereas a compliment such as "*What a marvelous meal you cooked!*" is highly valued according to the Approbation Maxim, "*What an awful meal you cooked!*" is not (Leech, 1983:135).

The Modesty Maxim

In this maxim, the speaker minimizes praise of self and maximises dispraise of self, as shown in the following asymmetric examples.

- (i) A: *They were so kind to us. (Polite)*
- (ii) B: *Yes, they were, weren't they? (Pertinent – Polite)*
- (iii) A: *You were so kind to us. (Polite)*
- (iv) B: *Yes, I was, wasn't I? (Boastful - Impolite)*
- (v) *How stupid of me! (Kind – normal)*
- (vi) *Please accept this large gift as a token of our esteem. (Boastful - Impolite)*

(Leech, 1983:136).

The Agreement Maxim

Like the maxim of acceptance and humility maxim, this maxim is also expressed by the phrase *expressive and assertive*. In This maxim one tends to exaggerate agreement with other people and to mitigate disagreement by expressing regret, partial disagreement etc. i.e. minimize disagreement between self and other; maximize agreement between self and other. Compare the reply in (i) and the replies in (ii) and (iii) below (where ii and iii display the agreement maxim).

- (i) A: *Referendum will satisfy everybody.* B:
Yes, definitely.
- (ii) A: *English language is difficult to learn.* B: *True, but the grammar is quite easy.*
- (iii) A: *The book is tremendously well written.* B: *Yes, well written as a whole, but there are some rather boring patches, don't you think?*

The Sympathy Maxim

Maxim of sympathy requires every participant to maximize sympathy and minimize antipathy to the opponent i.e. minimize antipathy between self and other; [maximize sympathy between self and other]. E.g. if someone says he finds success or happiness, hearers should give congratulations, but where others say they are getting trouble or calamity, hearers should show mourning or express condolences as a sign of sympathy. Example:

- (i) A: *I've passed Eng223.* B: *Congratulations!*
- (ii) A: *Uncle is dead.* B: *I'm sorry to hear that.*

Discourses (i) and (ii) show politeness because the addressees each abided by the maxim of sympathy, which is, maximizing sympathy to addressee.

It is in consideration of the politeness maxims above that this paper seeks to examine the campaign speeches of politicians in the present democracy to assess how they conform to or defy the politeness principles as reviewed in the paper.

Defining Political Campaign

Political campaigns according to eprints.bournemouth (n.d.) are orchestrated attempts by political organisations to garner public support through persuasive communication in order to influence public policy in their favour. Also, politivos.com (n.d.) defines political campaign as a strategic effort by individuals, groups, or political parties to gain public support and secure elected positions in government. It is a structured and organized series of activities designed to influence and persuade voters to choose a particular candidate or party during an election cycle. Political campaigns can be ethical or defective. An ethical political campaign should possess five characteristics as outlined and discussed by pagefield (n.d.). These are clarity of vision and ambition, a collaborative rather than adversarial approach, mass movements rather than mass marketing, ability to optimise new digital technologies, and great storytelling with creative flair.

These characteristics clearly point to the significance of politeness strategy in the political campaign, as the second characteristic which, according to Pagefield (n.d.), leads to building firm partnerships with people and powerful coalition with organisations (which is the ultimate goal of the politician) comes next to the first only because the latter serves as the foundation.

Review of Empirical Studies

Various studies have been carried out in the area of use of language by politicians. These include Bdliya (2012) who worked on Pragmatic Analysis of Political Discourse. He used Co-operative Principle to analyse the presidential campaign speech of Late Bashorun Abiola, the result of which shows that politicians do not adhere to communication principle in political conversation. Sama'ila (2015) looked at Emotionalisation, Endorsement, Rhetorical Misconstruction: Reflection on 2015 Gubernatorial Campaigns in Kaduna State. The study found out that emotionalisation in the campaign of Muktar Ramalan Yero led to his defeat in the election. Furthermore, Daniel (2015) studied Political Language with Reference to Nigerian Politicians, Linguistic Rascality and the Security implications. She used Critical Discourse Analysis with Systemic Functional Grammar in the analysis of speech of some politicians in Nigeria and how these speeches triggered off political violence as a result of using negative lexical items by politicians. All of these differ markedly from the present study in focus, objective and approach.

Theoretical Framework

The present study adopted Leech's (1983) framework already discussed above, especially the tact and the approbation maxims, as according to Wikiversity (2016) not all of the maxims are equally important; *tact* influences what we say more powerfully than does *generosity*, while *approbation* is more important than *modesty*.

Methodology

The study adapted a combination of two analytical approaches – Close Text Analysis (CTA) and Narrative Paradigm - to interpret the selected texts and contexts (sourced from You Tube platform) of utterances of two gubernatorial candidates in Kaduna State during their campaigns for governorship election in 2015. These were Alh. (Dr.) Muktar

Ramalan Yero, of the People's Democratic Party (PDP); and Mal Nasiru Ahmed El-rufa'I of All Progressive Congress (APC). This was aimed at ascertaining whether or not politicians' campaign utterances conform to politeness principles.

Close Textual Analysis

Close Textual Analysis according to Brwne (2009) in Kyupers (n.d.) is an interpretive practice that explains how texts operate to produce meaning, effect persuasion and activate convictions in public contexts by attending in detail to the interplay of ideas, images and arguments as they unfold within the spatial and temporal economy of the text. In this analysis, texts are considered as sites of symbolic action whereby words are regarded as verbs that perform a range of functions. This analytic procedure seeks to see that the form and context of a text have symbiotic influence on each other in the same manner in which the "artistic density" of a rhetorical piece should be appreciated. A text can perform various types of action according to Browne (2009). It may among others: *call for, call on, call out, call in, call to, announce, create, debase, decry, deface, defer, deflect, deform, delay, demur, deny, descend, destroy, deter, direct, disabuse, disclose/camouflage, distance, dissuade, exalt, form, inaugurate, invite, lie, numb, plead, portend, promise, provoke, seduce, silence, tempt, threaten, tickle, waffle* etc.

Narrative Paradigm

The narrative paradigm according to Fisher (2007) offers a universal perspective in explaining communication behaviour i.e. to interpret a text one should seek to find if there is a certain degree of coherence in terms of whether or not the story it tells hangs together. According to this approach, the narrator of the text must not leave out any important detail of the story or fail to provide plausible interpretation of what the audience already knows, i.e. it should resonate the experience of the audience which is determined by the values embedded in the message and the overlap of the values with the worldview, belief and ideal basis of social conduct of the audience.

Data Presentation and Analysis

Text I:

If one is convinced that his mother really gave birth to him (repeated three times); if we go out as a party to campaign, let him by God stone us; if we go out to campaign, let him by God hit our car; if we go out to campaign, let him by God burn our cars; if we go out to campaign, let him burn our house. I swear to God, whoever does this, we shall avenge. No retreat, no surrender!

(Alh. (Dr) Muktar Ramalan Yero, Kaduna State Governor and PDP governorship candidate, 2015).

Text II:

Tell me what wrong I have done to you, I will apologise. But if you do not

tell me and choose to continue to fight me, it is fine. Go and ask Umaru Musa 'Yar' adua or you ask Jonathan. As Nigeria's presidents either of them had a fight with me, and one has ended in the grave, the other forced to return to Otuoke. I do not dread fighting with anyone.
(Malam Nasiru El-Rufa'I, APC governorship candidate, 2015)

Analysis

1. To determine whether or not there is positive application of politeness principles by Nigerian politicians in their campaigns; A close textual analysis of each of the two texts above evidently shows the actions it portends to do. Text I tends to deface, threaten, provoke, deter, dissuade, and distance the massive opposition that seemed to be geared up to cast the PDP candidate out of power. He therefore emotionalized the campaign with vulgarity and threat of vengeful violence, and uttered expressions that were defacing and provocative to the populace: *"If one is convinced that his mother really gave birth to him..."*, and to ensure his aim was achieved he repeated it twice. He also made a threat by saying that, *"I swear to God ... we shall avenge"* just to deter, distance and dissuade the populace from taking a decision that would not favour him.

Text II serves to threaten specifically Comrade Shehu Sani, also a member of APC, who was vehemently opposing El-rufa'I's views as a result, El-rufa'i felt he was in a political fight with Shehu Sani. El-rufa'i warned him of the danger he (Shehu Sani) would subject himself to as a consequence of fighting with him as he says:

"... But if you do not tell me and choose to continue to fight me, it is fine. Go and ask Umaru Musa 'Yar' adua or you ask Jonathan ... either of them had a fight with me and one has ended in the grave, the other was forced to return to Otuoke".

He goes on to dissuade Shehu Sani from daring to continue to fight with him by saying: *"I do not dread fighting with anyone"*. Analysis of the two texts above indicates that there was no application of either the tact maxim or the approbation maxim by both the speakers, as the tact maxim requires that a speaker should minimize cost to the hearer and maximize benefit to the hearer; while the approbation maxim advises that a speaker should avoid saying unpleasant things about others and, more particularly, about the hearer. This a speaker should do by minimising the dispraise of other and maximising the praise of other. However, both the speakers did not pay attention to tact as the texts display. Text I purports that except he picks the challenge, the hearer is not a legitimate child of his mother; the utterance that clearly says something unpleasant about the referent (hearer) and which highly maximizes the dispraise of other. Likewise, the speaker of Text II merely maximizes the dispraise of the two former presidents of whom, according to the text, one died and the other had to sorrowfully leave Aso Rock Villa for his home village as a consequence of daring the speaker.

2. To find out how the campaign utterances of Nigerian politicians adhere to politeness principles in their campaigns;

Looking at the sampled texts analysed in this study, it is evident that there is little or no application of the politeness principles in the campaigns of Nigerian politicians. Each of the texts sampled fails to demonstrate the application of any of the politeness maxims; rather, they are replete with utterances that are discourteous to the other (i.e. the target), and the utterances were not aimed at maintaining a harmonious relationship between the speaker and the target as evidenced below.

Text I: *If one is convinced that his mother really gave birth to him... let him by God stone us... let him by God hit our car... let him by God burn our cars... let him burn our house. I swear to God, whoever does this, we shall avenge. No retreat, no surrender!*

Text II:

"... But if you do not tell me and choose to continue to fight me, it is fine. Go and ask Umaru Musa 'Yar'adua or you ask Jonathan either of them had a fight with me and one has ended in the grave, the other was forced to return to Otuoke".

Neither of the utterances above favour in any way the target; the act was aimed at threatening the face of the target (Face-Threatening Act), as neither of the texts contains an element of the face-saving act.

3. To find out how campaign utterances of Nigerian politicians contravene the politeness principles;

From the sampled texts, it is evident that the utterances of politicians gravely contravene the politeness maxims, especially the tact and approbation maxims which are greater than all the other maxims. Also, the utterances in both the texts completely failed to make use of negative face; consequently, their utterances are often provocative, confrontational, and disdainful (See Texts I and II in 2 above)

Findings/Implications

From the analyses of the two texts above, one can discern that politicians usually emotionalise their campaigns to the extent of committing 'rhetorical dissonance' in which they utter words/expressions that even contradict their personal demeanor. In Text I the utterances portray the contrary of the speaker's known personality of modesty and deference, while in Text II the speaker tactlessly made a declaration or an admission of the guilt of assassinating a highly revered president. Text I aimed at dissuading members of the opposition party (APC) and raise the spirits of speaker's own party members to harass the opposition. Such utterance generated heated arguments between the citizens of Kaduna State and far beyond; one group defending the speaker, and the other condemning him for the statement. Similarly, Text II shows how inflammatory the utterances of politicians are, as such an utterance had instigated scores of opinions across the state especially as the speaker attributed the death of President Umaru Musa to himself. Some concluded that certainly there is an implication that the speaker was

guilty of assassinating, or at least was an instrument to the death of, President Umaru Musa 'Yar'adua.

Generally, there is no politeness in the campaign speeches of most contemporary Nigerian politicians as their utterances constitute face-threatening acts which are merely perceived by hearers as provocative and disrespectful thereby creating distance, resentment and division among the populace. The people are polarised along the different egocentric political conducts of their favorite politicians. However, positive application of politeness principles by a politician in his/her campaigns makes him/her more popular, makes the audience to become friendlier towards him; one is more likable, there are less chances of developing enemies, and one develops an attractive personality (and thus a peaceful, harmonious society is created), (Njuki, N. and Ireri, H.K.,2021).

Conclusion

From the discussion above, it is evident that campaign utterances of Nigerian politicians are capable of breeding political atmosphere of tension, conflict and friction. To avoid the incidence of regional or even national political calamity, politicians (who are manipulators of the thoughts and behaviour of the people and therefore responsible for creating peaceful or chaotic society) must prepare to change. They should make utterances that adhere to politeness principles, especially the tact and approbation maxims. As the major goals of politics are to gain power and (ultimately) to create a healthy, peaceful, secure and economically buoyant society, it is ideal for every politician to employ politeness principles in his campaigns to successfully build firm cordial relationships with the citizens as well as effective alliance with organisations; as this will help him/her to become (more) popular and therefore entice more supporters to achieve actual political success without developing enemies or creating resentment within the people. By this, a politician develops a life-long attractive personality within the society and upholds the integrity of fellow citizens.

Recommendations

From the foregoing, the following are found to be crucial: As every Politian desires to build credibility to self, constituted authorities, the government as well as non-governmental organizations (both local and international) should educate all politicians to appreciate the fact that factors that help an individual to build credibility include expertise and competence, personal ethics and integrity, control of emotions, and development of professional image; as the control of one's emotion will certainly help him/her to maintain credibility by showing that he/she acts reasonably, rationally, and respectfully in all situations. Students at different levels of education (from secondary to tertiary level) should be trained to acquire adequate knowledge and practice on the principles of politeness in various situations to prepare them for socio-political challenges ahead.

The constitution of Nigeria should state clearly the genre of language to (and not to) use by politicians as they discharge their political rights and activities.

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LANGUAGE EDUCATION AS A PANACEA FOR ADDRESSING THE EMERGING ISSUES IN THE 21ST CENTURY NIGERIA

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Abstract

There is no gainsaying that Language Education is the key to managing, preventing and eradicating the emerging teaching and learning issues in a society. Thus, it is used to identify, explore and explain the teaching and learning the communicative issues in a multilingual setting like Nigeria where socio-cultural, socio-economic and political are abound. Attempts have been made to solve those issues vide Trans-language theory, Cen Williams (1980). "Trans-language is an approach in language education that encourages the use of multiple languages, including the students' native language, to support learning" The theory had been found to be useful in overcoming the challenges in other societies. Hence, attempt had been made, It has been advocated that the use of the trans-language approach is effective and efficient in the teaching and learning in our schools as it facilitate easy understanding the socio-cultural, socio-economic and political issues of our society. The paper concludes that, the use of trans-language should be adopted by language educators in our schools for the betterment of the multilingual setting such as Nigeria

Keywords: *Language, Language Education, Trans-language, Trans-language Theory and Emerging Issues.*

Introduction

Language Education plays a crucial role in addressing the emerging issues in the 21st century Nigeria. A country like Nigeria with a diverse population comprising with over 250 ethnic groups and Languages. Language Education serves as a panacea for the advancement and for fostering of unity and promoting a viable, effective and efficient communication among people in such a multilingual society. Language Education in the schools promote and encourage mutual understanding in the nation/country like Nigeria. Language being the veritable tool in facilitating communication is understood to be a 'system of conventional spoken manual (signal), or written symbols by means of which human beings, as members of a social group and participants in its culture,

express themselves' (Britannica, 2024). This therefore indicates that language fosters unity in diversity. In an attempt to unravel the fact that language education in our schools and the society in general, this paper intends to use the trans-language approach in the bilingual/multilingual in our educational system in Nigeria.

In an attempt to dwell on this paper, it tries to: identify Translanguaging as a method/approach to facilitate teaching and learning in our schools, explore the significance of translanguaging in teaching and learning for the language teachers in our schools, explain how translanguaging is used in the classroom in order to impact knowledge on the learners and the effects of using translanguaging in the schools and generally the society. In the paper, we explore Cen Williams Translanguaging theory as a perspective to language education in the 21st century. The paper also observes that, language informed by the theory can serve as a powerful tool for addressing the emerging issues in Nigeria of today,

Concept of Trans-Language

According to Baker (2011) translanguaging refers to 'the process of making meaning, shaping experience gaining understanding and knowledge through the use of two languages' thus, it can be termed as the learner's ability to shuttle between the source and the target for communication purpose. However, to Garcia & Wei (2014) the translanguaging is 'the act of languaging between system that have been described as separate and beyond them' thus, this can be translated as one can be described and transfer meaning from the mother tongue to the second language in question. Translanguaging promotes a deeper and fuller understanding of the subject matter and may help the development of the weaker language, through cross-linguistic transfer (Baker, 2006, 2011; Cummins, 2008), this accordingly helps develop not only the language of the environment/National language; (Hausa, Igbo and Yoruba) but also mother tongue/native language of learners. According, Rabbidge (2004) opined that, "translanguaging improves learners' ability to participate in the classroom by improving their teacher's talk. Furthermore, Lewis et al (2012) sums up that, translanguaging enhances or enriches the use of languages (multilingualism) in a dynamic manner for effective communication and language production" this in essence is the use of language dynamically to reinforce the other language for better comprehension and understanding.

Translanguaging is an educational method that involves using multiple language fluidity to support language learners' understanding and general communication abilities in learners, hence, it encourages to draw upon their entire language repertoire to enhance comprehension and express ideas and mostly promoting a more inclusive and flexible approach to language acquisition and generally language learning. It is an opportunity to allow learners use what is already learned in the past from their experience first language to clarify ideas and concepts in form of explanation of the second language. To buttress more, trans-language is that languaging approach that encourages the use of multiple languages, including the student native language and

support that goes beyond traditional language separation thereby promoting the fluid movement between languages to enhance understanding and communication, thus, it encourages the student or learners to draw on their entire linguistic repertoire to express themselves and comprehend new information. While in school environment and generally learning a second language especially English, they find trans-language supportive as they engage with a complex, content and text in learning process. It also provides a varied opportunity for students to develop an academic language practices, pave way for students' bilingual and multilingual abilities of knowing concepts and ideas in their languages especially second language (L2). To develop the language fluency skills, the National Policy of Education (2022) 'instruction in primary schools, the first six years of learning will be in the mother tongue" thus, it encourages the use of mother tongue or the language of the immediate environment in the teaching and learning at the early basic to the late basic level of education. At this level the learners are at liberty to use their native language or the language of the immediate environment.

This approach to modern teaching and learning recognize the bilingual and multilingual abilities of the learners and thereby leveraging the benefits of using various languages be it native, community and first language to scaffold learning, this therefore, aims to create a more inclusive and supportive learning environment acknowledging learners often aiming at rich linguistic resources to educational setting.

The Trans-Languaging Theory

The translanguaging theory is founded and proposed by Cen Williams in 1980, his theory challenges the traditional view of languages as separate and distinct entities. According to him, individuals draw on their multilingual repertoires to communicate effectively, blending and mixed different language in a seamless manner. It further reiterates that it recognizes the flexibility of language use emphasizing the importance of utilizing all available linguistics resources to convey meaning. However, Proponents of the theory argued that, it is an authentic and natural way for individual to communicate, as it is a mirror the way multilingual people to interact in their daily lives. This further indicates that, there are implications for the identity as it validates the learners entire linguistic experience fostering inclusivity and respect for linguistic diversity.

Translanguaging is not the same as code switching, though it encompasses such practice but it is an overarching approach that reinforces the interconnectivity and fluidity of an individual's language capabilities instead of viewing language as a separate entity. This concept has gain traction among educators and researchers particularly in this field of bilingual education and second language acquisition. Translanguaging is therefore be seen as a pedagogical method and a theoretical concept that reflects how bilingual and multilingual speakers use of their language as an integral communication system. Thus, rather than treating each language that a learner speaker as a separate system, it recognizes the fluid language that naturally occurs in multilingual environment within educational context, meanwhile, it encourages learners to access all their linguistic resources to make meaning, learn and communicate. Akinpelu (2020) observed that

most African countries including Nigeria have to adopt the translanguaging approach to teach in the institutions to enhance learning.

Language Education as a Panacea for Addressing the Emerging Issues in the 21st Century Nigeria

In the Nigeria context where multilingualism is a common phenomenon, translanguaging offers a valuable insight for language education. Rather than viewing language in isolation, teachers and educators can encourage learners to embrace their linguistic diversity and utilize their linguistic repertoires in the learning process. By incorporating and using translanguaging as a method and strategy in the classroom, the teachers can create a more inclusive and supportive learning environment to all students/learners regardless of their linguistic background. Furthermore, the theory can help address the emerging issues /challenges policy and planning in Nigeria in the 21st century. With over 500 languages spoken across the country, it is therefore essential to adopt a more flexible and dynamic teaching and learning methods/approach to language education that empowerment among Nigerians, it enables them to navigate the complexities of the multilingual society like Nigeria a more cooperating environment.

Moreover, by adopting the approach, it can promote social cohesion and national unity and encourage a bond in socio-cultural and socio-economic development of the country. By allowing both teachers and learner to use the approach in the environment, it encourages individuals to utilize their multilingual repertoires in everyday communication as this can help breakdown the linguistic barriers and promote intercultural understanding among different ethnic groups which in turn encourage to contribute to fostering a sense of national identity and solidarity, transcending linguistic and cultural divides. Within the classroom translanguaging allows the use of (multiple) languages in discussion, writing and assignment, it encourages learners to make connections between languages while learning new contents, it provide resources and text in different ways/ languages and finally it allows code switching (alternating between languages) to facilitate learning/comprehension and participation. In this context code switching does not mean as it should be, however, it encompasses such practices.

Conclusion

In conclusion, language education informed by translanguaging theory can serve as a powerful tool to addressing the emerging issues in the 21st century Nigeria. By embracing the linguistic diversity, promoting inclusive practices, fostering intercultural communication, educators can help build a more cohesive and resilient society, as Nigeria continues to navigate the complexities of a multilingual landscape, translanguaging theory offers a promising perspective for promoting linguistic empowerment, social cohesion and national unity. Nigeria therefore is in a path to stand to gain a lot for the adoption of translanguaging approach to teaching and learning as it provides a solid ground to build a competent human capacity in terms of communication internationally.

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EFFECT OF CORPORATE SOCIAL RESPONSIBILITY PRACTICES ON FINANCIAL PERFORMANCE OF LISTED DEPOSIT MONEY BANKS IN NIGERIA

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Abstract

This study investigated the effect of corporate social responsibility practices on financial performance of listed deposit money banks in Nigeria. The study used descriptive simple percentage and table as statistical tools to analyze data extracted from questionnaires and annual reports and accounts of the thirteen sampled deposit money banks for the period of eight years from 2015 to 2022. The statistical tools of analysis used were correlation matrix, descriptive statistics and panel least square regression. The results show that corporate social responsibility expenditure on health has an insignificant positive impact on profit after tax (PAT) of selected deposit money bank in Nigeria. Also, corporate social responsibility expenditure on sport (CSRSE) has a significant positive impact on profit after tax in selected deposit money banks in Nigeria, for the period under review. The study recommends that the management of Nigerian deposit money banks should reduce and strictly monitor their corporate social responsibility health expenditure in order to enhance their performance. The study also recommends that the management of Nigerian deposit money banks should sustain and further increase their corporate social responsibility expenditure on sports in order to increase their performances.

Keywords: Corporate Social Responsibility (CSR); Financial Performance; Deposit Money Banks (DMB)

Background to the Study

Every organization has a motive for engaging in corporate social responsibility practices which affects their financial performance positively or negatively. The motive driving a firm to engage in CSR practices could be for strategic choice, philanthropic purpose, economic returns or risk management. As a result, the relationship between CSR and financial performance has been subject to several studies, which have shown conflicting results. Little evidence support that CSR and financial performance are directly related.

Lys, Naughton and Wang (2015) opined that most banks take up corporate social responsibility practices in their report to show the shareholders their investment in and commitment to social welfare. CSR investments lead to higher levels of credibility, improved image or reputation, higher employee retention and build customer relationships (Mobin, Zillur & Imran 2014).

Corporate social responsibility is important as it influences all aspect of banks operations (Ashraf Khan & Tarig 2017). CSR relates to business approach which contributes to sustainable development by delivering economic, social, and environmental benefit to all stakeholders. The level of engagement in corporate social responsibility practices varies across countries and firms. This arises from the different perception of their impact on the bank's financial performance. Since banks behave differently under different institutional settings. However, with the increase in media coverage on CSR practices, organizations are taking steps to communicate their CSR initiatives to various stake holders (Batcharya & Sen 2004). Scholten (2008) opined that socially responsible investment considers non-financial characteristics of firm's financial performance and policies. Therefore, evaluating corporate governance, environmental social and economic factors allows investors to manage their funds in a way that is consistent with their missions and values.

How socially responsible a corporation is, largely depends on the way and manner the principal actors go about its governance. Good corporate governance is the glue that holds an intelligent business practice and guarantees positive working environment management, stewardship, community engagements and strong financial performance, which help in restoring certainty and promoting economic growth (Branco & Rodrigues, 2006). Business ethics and CSR are issues facing questions on whether it is ethical to expend corporate profits on social actions. The issue of businesses allocating a certain amount of their profits towards exercising CSR is becoming a subject of considerable debate. Different arguments have emerged on the relevance or irrelevance of CSR. Originally, businesses were accountable to their private shareholders or institutional investors in the financial markets. A diversity of stakeholders now demands accountability about the impact of corporate activities on the life of the society because of the increasing adverse impact of corporations on aspects of social life and on the environment (DeRegil, 2003). These demands are further strengthened by the introduction of legislations/ codes of conduct to ensure that businesses undertake social activities. These include codes of conduct and standards like the Global Reporting Initiative (GRI), The Global Sullivan Principles (1991), Global Compact (2002), the Social Venture Network Standards and the ISO26000. These codes and standards were introduced in response to the pressure by civil rights and environmental activist groups (Tsoutsoura, 2004). The interaction between the different patterns of CSR has drawn the attention of several researchers to investigate the extent to which attaining high financial performance is facilitated or hindered by the different CSR practices of that organization. Torres, Bijmolt, Tribo and Verhoer (2012) noted that firms "do not implement various issues or practices separately but that firms prioritize various CSR issues in order to

maximize effective stake holder's management. By acting in a responsible way to the variety of social, environmental, and economic pressures, companies respond to the expectations of the various stakeholders with whom they interact. The interrelationship between organizations and their environment is becoming increasingly important because businesses operate within the context of their environment and cannot operate in isolation; therefore firms' commitment to environmental activities is non-negotiable (Gunu, 2008). The environment impacts greatly on the firms and firms in return always have some kind of impact on the environment. As organizations continually engage in CSR, their performances either financial or operational can be influenced positively or negatively. It is in view of this that De-Regit (2003) sees CSR as the inherent obligation of each business entity to account for the way its activities impact on the economic, social and environmental dimensions of its environs and to ensure that this impact generates equitable and sustainable benefits-and no harm-to all stakeholders involved. Financial performance is one of the single most important factors for organizational continuous existence, otherwise, the prospects of the business as a going concern is in question. Businesses around the world require development and growth in order to attract funding from investors. Before they invest in a particular business, investors normally make sure that the business in question is financially secure and stable and possesses the ability to produce profits in the long run (Mallin, 2007). Now, there is the fear by investors and potential investors that if firms do not have good CSR practices in place, their investment may be in danger especially if the management is only interested in their own self and not the interest of the public. It is assumed that engagement in CSR practices yield good performance and as such available literatures are of diverse opinion as to the influence of Corporate Social Responsibility practices on firm financial performance. For the purpose of this study, Return on Asset (ROA) is used to proxy financial performance as against other measure of financial performance like return on equity and net profit margin because return on asset is rated a better measure as it a weighted measure of how the asset of the company is yielding return when compare with using just the equity value.

There is no consensus on the measurement of financial performance. Some are of the view of using backward-looking firm profitability that is accounting based returns rather than forward-looking market value or stock returns. Market value is different from and probably weightier than accounting-based returns because accounting measures are retrospective while market values hinge on growth prospects or expected future performance (Rust, Lemon & Zeithaml, 2004).

In Nigeria however, the practice of CSR is still at a slow pace which is mainly caused by various bottlenecks related to environmental issues as opined by Mamman (2011). The notion of CSR is at the forefront of contemporary management thinking, such that CSR has become a significant issue in both the business and public domain which is why the Company's corporate social performance (CSP) has become an important factor in the overall business corporate financial performance (CFP). It has also been argued by several studies that companies with good CSR policies are being rewarded by consumers

and this is manifested in companies' financial position in the long term. That is, consumers will punish companies with poor CSR reputation. The more a company makes CSR part of its core business, the more profitable and competitive the company becomes (Eweje, 2006). Good corporate governance in organization enhances good corporate social responsibility.

The reputation of financial institutions relies on their socially responsible programs (Poolthong & Mandhachitara, 2009), this is why banking institutions tend to have a high ranking on the international CSR investment ranking index (Perez, De Salmones & Del Bosque, 2013). In the financial service industry, CSR has become a well-established notion due to its huge impact on society (Scholten, 2009). Banks are increasing their CSR spending by implementing CSR into practices with initiatives such as financial inclusion (Decker, 2004), microcredit schemes for the deprived, socially responsible banking and credit access to the poor (Prior & Argandona, 2008). Thompson and Cowton (2004) observed that, banks are more likely to be influenced by the risk of reputation as compare to other companies and are more vulnerable to negative reactions from stakeholders. As a result of these, it is desirable to undertake an empirical study that will examine the effect of CSR on the financial performance of listed DMBs in Nigeria.

Objective of the Study

The main objective of this study is to assess the effect of CSR on the financial performance of DMBs in Nigeria. The specific objectives of the study are:

- i. To examine the effect of Environmental management on the financial performance of listed Deposit Money Banks in Nigeria.
- ii. To examine the effect of Community development on the financial performance of listed Deposit Money Banks in Nigeria.
- iii. To determine the effect of Employee relation on the financial performance of listed Deposit Money Banks in Nigeria.
- iv. To find out the effect of Product quality and customer satisfaction on the financial performance of listed Deposit Money Banks in Nigeria.

Literature Review

Corporate Social Responsibility

Corporate Social Responsibility has been a subject of intense controversy and interest in the academic world over recent decades, and scholars have devoted great attention to this issue. The first standpoint on corporate social responsibility was offered by Bowen (1953) in his *Social Responsibilities of the Businessman*. Bowen defined Corporate Social Responsibility as an obligation to pursue appropriate policies, to make appropriate decisions, and to follow those lines of action which are desirable in terms of the objectives and values of our society. In the 1960s, Corporate Social Responsibility was increasingly discussed in the managerial context. Davis (1960) asserted that socially responsible business decisions could be justified by a long, complicated process of reasoning as offering an opportunity to bring the company long-run economic gain, thus repaying it for its responsible outlook (Carroll, 1999).

However, this viewpoint also aroused criticism. Among other scholars, Friedman, (1970), argued that the only social responsibility of a corporation was to increase its profits. Furthermore, Friedman asserted that the resources allocated to CSR are better spent on increasing company efficiency from a social perspective as well. Although Friedman's viewpoint on Corporate Social Responsibility prevailed in the 1970s, scholars increasingly started to shed light on the multiplicity of responsible business practices. First, Johnson & Greening, (1999) identified specific interest groups with a variety of different needs, stating that "social responsibility in business is the pursuit of socioeconomic goals through the elaboration of social norms in prescribed business roles". Furthermore, Steiner (1971) acknowledged the interrelationship between business and society at large, referring to social responsibility as a "social contract". Basically, a social contract can be seen as a set of rights and obligations related to corporate impacts on the welfare of society. According to Wartick and Cochran (1985) a social contract is a binding element between business behavior and society objectives. When the surrounding societal conditions change, the specifics of the social contract may also change.

Decker (2004) stated that Corporate Social Responsibility does not mean the same thing for all the concerned stakeholders and its conceptualization varies among every industry. However, a definition of Corporate Social Responsibility emerged from an international meeting of the World Business Council for Sustainable Development (WBCSD) which was organized and attended by 60 leading speakers on public opinion from inside and outside of the business world. This definition states that: Corporate Social Responsibility is the continuing commitment by business to behave ethically and to contribute to economic development while improving the quality of life of the workforce and their families as well as that of the local community and society at large. De Regil, (2003), defines Corporate Social Responsibility as the inherent obligation of each business entity to account for the way its activities impact on the economic, social and environmental dimensions of its environs and to ensure that this impact generates equitable and sustainable benefits and no harm to all stakeholders involved. The stakeholders represent the various interest groups of the society where the company operates. They comprise of workers, consumers, and indigenous groups all with a legitimate right to demand socially responsible and right corporate behavior.

Dandago and Muhammad (2011) view Corporate Social Responsibility as more of philanthropic responsibility which is the voluntary contributions to uplift the living standard of the people living in the community than about profitability, ethical, or compliance with approved legal provisions. The discharge of Corporate Social Responsibility therefore demands businesses to integrate social and environmental concerns in their business operations and in their interactions with their stakeholders on a voluntary basis. Social, economic, political or education of the community where it is but which it is not compelled to do by law (Adebayo & Oluwatoyosi, 2012).

Financial Performance

Financial performance is a subjective measure of how well a firm can use assets from its primary mode of business and generate revenues. The term is also used as a general measure of a firm's overall financial health over a given period. There are many stakeholders in a company, including trade creditors, bondholders, investors, employees, and management. Each group has an interest in tracking the financial performance of a company. The financial performance identifies how well a company generates revenues and manages its assets, liabilities, and the financial interests of its stakeholders and stockholders. There are many ways to measure financial performance, but all measures should be taken in aggregate. Line items, such as revenue from operations, operating income, or cash flow from operations can be used, as well as total unit sales. Furthermore, the analyst or investor may wish to look deeper into financial statements and seek out margin growth rates or any declining debt.

Financial Performance is one of the management strategic functions aimed at satisfying the interest of shareholders and other stakeholders in a company. Firm's performance appraisal is an evaluation which is done periodically and systematically in determining the achievements of the company's objectives (Amelia, 2002). Although measuring financial performance is considered a simple task, it also has its specific complications and there is little consensus about which measurement instrument to apply (Tsoutsoura, 2004). Some are of the view of using backward looking firm profitability, that is, accounting based returns rather than forward-looking market value or stock returns. A performance measure need to be value relevant in order to be useful (Aliabadi , Dorestani & Balsara, 2013).

Many researchers use market measures (Alexander and Bucholz, 1978; Oba, 2009; Fodio, Abdissamadf & Oba, 2013), others put forth accounting measures (Waddock and Graves, 1997, Gunu, 2009; Ngwakwe, 2008; Abdulraman, 2014) and some adopt both of these (McGuire, Sundgren & Schneeweis 1988; Lys, Naughton & Wang 2015 and Kabir& Thai, 2017). The two measures, which represent different perspectives of how to evaluate a firm's financial performance, have different theoretical implications (Hillman & Keim, 2001) and each is subject to biases (McGuire, Sundgren& Schneeweis 1988). The use of different measures, needless to say, complicates the comparison of the results of different studies (Tsoutsoura, 2004).

In other words, accounting measures capture only historical aspects of firm performance. They are subject, moreover, to bias from managerial manipulation and differences in accounting procedures (McGuire, Sundgren & Schneeweis 1988). Yet, accounting measures offer the most logical set of indicators for a share market in which the values of accounting information can be analyzed by examining the relationship between market value of equity with accounting information. Market measures are forward looking and focus on market performance; they are less susceptible to different accounting procedures and represent the investors' evaluation of the ability of a firm to

generate future economic earnings (McGuire, Sundgren & Schneeweis, 1988). Yet, the stock market based measures of performance also yield obstacles.

According to Ullman (1985), the use of market measure suggests that an investor's valuation of a firm's performance is the proper performance measure. Rust, Lemon and Zeithannl (2004) conclude that market measures are different from (and perhaps more important than) accounting measures because the latter are retrospective and examine historical performance while market value of firms hinges on growth prospects and sustainability of profits or the performance in the future. Yet, Lys, Naughton and Wang (2015) found out after combining the two approaches that market base measures do not have finite horizons. Therefore, they can capture improvement associated with corporate social responsibility expenditure that may occur in the future years. While accounting base measures only capture improvement that flow through the financials in a giving fiscal year.

The most popularly used performance measurement is the accounting-based measurement. Returns On Assets (ROA), was widely used as was found in the following studies: Bello (2012), DiGiuli & Kostovetsky (2013), El Mosaid and Boutti (2012), Olayinka & Fagbemi (2012), Uadiale & Fagbemi (2011), Usman & Amran (2015). Returns on assets represent the profitability of the firm with respect to the total assets under the firms control (Hull & Rothenberg, 2008). Return on Equity (ROE) is another accounting measure used in measuring firms „financial performance in previous studies such as the work of El Mosaid & Boutti (2012), Meijer & Schuyt (2005), Tsoutsoura (2004), and Uadiale & Fagbemi (2011),. Tobin's Q is another accounting measure of firms' financial performance. It has ability to measure long-term investment and it is calculated by the sum of a firm's equity values and its total debt divided by the firm's total assets. Tobin's Q has been used in the previous empirical studies such as the work of, Sanda, Mikailu & Garba (2005), Bhagat & Bolton (2008); Oba (2009) and Fodio, Abdissamad & Oba (2013). Profit after tax (PAT) has been used in the works of Abdulraman (2014) Bolanle, Olarenwaju & Muyideen (2012), Gunu, (2008), Okafor & Oshodin, (2012) and Uwalomwa, Olubukunola & Anijesushola (2011).

Financial performance is an indicator of the firm's attainment of economic or financial objectives. The long-term survival and value of a firm is dependent on its ability to maintain desirable profit levels through its operating activities. Information regarding a firm's financial performance is obtained from the financial statements on which stakeholders base their decisions in terms of either investment or sustenance of contractual business relationships with the entity. According to Weiss & Nusbaum (1994), the American Institute of Certified Public Accountants (AICPA) are of the view that financial statements permit analysis of a wide range of trends and relationships among the data providing insight into a company's opportunities and risks, including growth, market acceptance, costs, productivity, profitability, liquidity amongst others. The most common measures of a firm's financial performance are categorized into Profitability and Market value measures.

Theoretical Framework

Stakeholders theory

Stakeholder theory concentrates and focused on particular stakeholders' groups. It explains how an organization interacts with these particular groups. The theory holds that business organization must play an active social role in the society in which it operates. Freeman (1984) one of the advocates of stakeholder theory, presented a more positive view of manager's support of CSR. He asserts that managers must satisfy a variety of constituents (e.g. investors and shareholders, employees, customers, suppliers, government and local community organizations) who can influence firm outcomes. According to this view, it is not sufficient for managers to focus exclusively on the needs of stockholders, or the owners of the corporation. Stakeholder theory implies that it can be beneficial for the firm to engage in certain CSR activities that non-financial stakeholders perceive to be important, otherwise, these groups might withdraw their support. Stakeholder's groups vary from firm to firm, as well as the importance of each of them. CSR should begin with identification of stakeholders and follow by finding the strategy how to satisfy and harmonize their expectations.

Triple bottom line Theory

John Elkington developed the Triple Bottom line Theory in 1998 in his book entitled "Partnerships from cannibals with forks: The triple bottom line of 21st-century business" (Brin & Nehme, 2019; Elkington, 1998). The theory states that long-term partnership is vital for companies making the transition to sustainability (Elkington, 1998). The theory consists of three dimensions of performance comprising economic, social, and environmental performance, which firms must pursue to achieve sustainability, which is the focus of 21-century business (Brin & Nehme, 2019). Many organizations, both public and private, profit-making, and Not-for-profit, have embraced the Tri-ple Bottom Line Approach, otherwise known as corporate responsibility or Sustainability reporting (Colbert & Kurucz, 2007). The economic performance addresses the financial performance, which is the primary goal of a business firm. However, to achieve sustainable profitability in the long-run, social performance, which addresses workers' welfare and customer satisfaction and environmental performance regarding environmental protection and community development, is fundamental.

Empirical Review

Kabir and Thai (2017) found a positive relationship between the aggregate CSR construct but specifically reported a positive relationship which is statistically significant, in their study of Vietnamese firms. Does corporate governance shape the relationship between CSR and financial performance? The limitation of this study is consideration of each CSR dimensions separately but instead consider CSR as one all comprehensive activity. Since CSR is a multi-dimensional construct and its application is industry specific.

Ohiokha, Odion, Akhalumeh (2016) analyzed corporate social responsibility and corporate financial performance in Nigeria. The study empirically demonstrated the impact of corporate social responsibility on firm's financial performance. The study

adopted pooled survey research design covering twenty-nine (29) firms in Nigeria over a period covering 2005 to 2010. Data collected from the annual reports of the selected firms were analyzed using panel data regression analysis. Result revealed that corporate social responsibility (SR) had little impact on the financial performance of the sampled companies.

Usman and Amran (2015) in their study corporate social responsibility practice and financial performance evidence from Nigeria companies found a mixed result where product and customers CSR have significant negative relationship with accounting based financial performance and a positive relationship with market based financial performance. Their study made use of index to measure CSR and consider product and customer satisfaction as CSR proxy. The limitation of the study is, the study did not make use of principal component analysis (PCA) which would have been the appropriate tool since the study combined both accounting base and market base financial performance measurement. Also, the period coverage is three years which is too short. The period coverage is important in every study as well as the sample size in order to make generalization.

Ajide and Aderemi (2014) also examined the effect of corporate social responsibility activity disclosure on the corporate profitability of 20 commercial banks in Nigeria the year 2012. Using scoring method, the study measured corporate social responsibility practices under four subthemes namely community involvement, human resources, product quality and consumer relation, environmental. Bank size and risk proxy by owners' equity and reserve are used as control variable in the study. The result showed that CSR disclosure scores have a positive relationship with financial performance of the banks studied. While the control variable, bank size and equity have negative influence on the banks financial performance. The study recommended that the banks should improve and continue to disclose their corporate social responsibility information as well as demonstrating high level of commitment to CSR as suggested by stakeholders' theory. The period covered in the study is not relatively wide enough to ascertain the level at which corporate social responsibility practices influence the financial performance of the banks, and to make generalization. Also, the sample size is relatively large to represent the studied banks.

Mujahid and Abdullah (2014) studied the dependency of SR on firm's financial performance as well as on shareholders' wealth in Pakistan. They had selected 10 firms which are highly rated as SR firms and 10 non-SR firms to see the differences in their financial performances and shareholders wealth as well. They selected the return on equity (ROE) and return on assets (ROA) ratios as financial performance indicators and stock prices and earnings per share (EPS) as representing shareholders' wealth. They adopted a mixed methodology in the study and concluded that there was a significant positive relationship between SR and financial performance and shareholders' wealth. Richard and Okoye (2013) examined the effect of corporate social responsibility on the deposit money banks in Nigeria. The objective of the study is to determine the effect of

corporate social responsibility on the performance of Nigerian deposit money banks. The study adopted descriptive survey design in carrying out the study. The study reveals that Social responsibility has a great impact on the society by adding to the infrastructures and development of the society. The study also concluded that a company has to give back to the society in which it operates, clean up all forms of pollution it has caused in its course of operation and also provide infrastructural facilities to the society as a way of giving back and developing the society.

Iqbal, Ahmad, Basheer, & Nadeem, (2012) examined the connectivity of SR with financial performance, market value of share and financial leverage of 156 listed companies on Karachi Stock Exchange for the period of 2010-11. They adopted descriptive statistics, correlation and regression to conduct the study. This study showed a mixed result, that SR negatively affected the market value of those companies and that SR did not have any influence on those companies and also that there was no relationship between SR and financial leverage. Gaffney, and Evans, (2010) studied the impact of corporate social responsibility on performance of organization in the perspective of Malcolm Baldrige criteria of the USA and also compared this with the current academic thought. They had gone through various theories of firm's management, current academic thought and research to carry out the study in the criteria of Malcolm Baldrige. They concluded that there was a positive influence of corporate social responsibility on firm's performance.

Ngwakwe (2009) in his study Environmental responsibility and firm performance examined the relationship between social and environmental practices of 60 manufacturing firms in Nigeria. The study used differential analysis and multiple regressions as tools of analysis. using Return on Total Assets (ROTA) as measure of performance showed a significant relationship between community development (CD) and performance., the result revealed a statistically significant relationship (at 5 percent level) between CD and ROTA. The major limitation of the study however, is that the study did not conduct other robustness checks in examining the relationship and the study left out the product and customer responsibility which are included in the GRI guidelines. Scholtens (2008) investigated the relationship between CSR and financial performance of a sample of 289 firms from the US for the period of 1991-2004 by using ordinary least square OLS and Granger Causation techniques of analysis. It was concluded in the study there is significant correlating between corporate social responsibilities (SR) and financial performance, though components of SR like community involvement, employee relations, diversity, environment does not have positive relationship with financial performance in respect of return and risk.

Methodology

The study utilized an ex-post facto design considering the fact that the study uses a historical data since the event under investigation has taken place and documented as secondary data obtainable from the financial statements of the various firms. Eleven (11) banks out of the 14 quoted banks in Nigeria were used for the study covering the period

between 2018 and 2022. The variables comprise of health and sports components of firms' social responsibility. This study used the Panel Least Squares (PLS) technique to estimate the model and test the null hypotheses developed with the aid of EViews 9 software.

$$PAT = f(CSRHE + CSRSE) \dots\dots\dots (1)$$

Econometrically, the above equation becomes

$$PAT_{it} = \beta_0 + \beta_1 CSRHE_{it} + \beta_2 CSRSE_{it} + \mu_{it} \dots\dots\dots (2) \text{ [Model]}$$

Where: PAT = an indicator representing profit after tax (Dependent Variable)

β_0 = Intercept term (a constant)

β_1 = Coefficient of corporate social responsibility health expenditure

β_2 = Coefficient of corporate social responsibility sport expenditure

CSRHE = a predictor for Independent Variable (social responsibility expenditure on health)

CSRSE = a predictor representing Independent Variable (social responsibility expenditure on sport)

μ = Error term (representing the combined effect of omitted variables)

it = Dated panel data;

f = Functional relationship.

4. Data presentation and Analysis

Appendix 1 shows figures representing what the eleven banks expended as social responsibility

on health and sport and their profit after tax for five years from 2013 -2017.

Pearson Product-Moment Correlation Matrix

Correlation is a statistical method that determines the degree of relationship between two

different variables. Pearson correlation measures the strength of a relationship between two

continuous variables.

Table 1 below shows the Pearson correlation matrix indicating the strength of the relationship

between the variables.

PAT	CSPSE	CSRHE	
PAT	1.000000		
CSRSE	0.649413	1.000000	
CSRHE	0.507986	0.543080	1.000000

Source: Researcher's Computation with EViews 9.0

The result from Table 1 above shows that the figures are all positive values and less than 0.86 at which point multicollinearity does not set in (Hair, Tathan & Anderson, 2005). It, therefore, implies that there is no problem of multicollinearity in this model.

Descriptive Statistics

The result shows the Descriptive statistics of the variables using EViews 9.0 software

PAT CSRHE CSRSE

Mean 3.67E+10 80806021 37488906

Median 1.89E+10 12000000 7531500.

Maximum 1.61E+11 1.40E+09 4.86E+08

Minimum 7721000. 0.000000 0.000000

Std. Dev. 4.26E+10 2.04E+08 77728320

Skewness 1.2584125.179525 3.910647

Kurtosis 3.774309 32.98048 21.49951

Jarque-Bera 15.89031 2305.735 924.4691

Probability 0.000354 0.000000 0.000000

Sum 2.02E+12 4.44E+09 2.06E+09

Sum Sq. Dev. 9.78E+22 2.24E+18 3.26E+17

Observations 55 55 55

From the representation above, the mean and the median displayed a high level of consistency. The PAT has a mean of 3.67E+10 and CSRHE has a mean of 80806021 which both fall between their Minimum (7721000 and 0.00) and their maximum (1.61E+11 and 1.40E+09) respectively. The table also shows that CSRSE has a mean of 37488906 which also lie between its maximum (4.86E+08) and its minimum (0.00). That all the mean values fall within the range of the minimum indicates that the series is evenly spread. The standard deviations show the degree of dispersion among the variables under investigation.

Discussion of Findings

The result of this study shows that corporate social responsibility expenditure on health (CSRHE) has an insignificant positive impact on profit after tax (PAT) of selected deposit money bank in Nigeria. This implies that holding other variables constant, a value increase in CSRHE brings a value increase of 45.98 in profit after tax.

The result further shows that corporate social responsibility expenditure on sport (CSRSE) has a significant positive impact on profit after tax in selected deposit money banks in Nigeria. This means that holding other variables unchanged, a value increase in CSRSE brings about 290 value increase in profit after tax in selected deposit money banks in Nigeria.

Conclusion

The environmental management positively and significantly influences the financial performance of listed deposit money banks in Nigeria, the banks that engage in high environmental management are likely to have low financial performance while those that engage in low environmental management are likely to have higher financial performance. Community development has positive relationship with return on asset but insignificantly affects the financial performance of listed deposit money banks in Nigeria. Signifying that the return on assets of the deposit money banks is insignificantly affected by corporate social responsibility practices directed at community development. Corporate social responsibility practices directed at communities in form of developmental projects have no ripple effect on the triple bottom line. The financial performance of the listed deposit money banks in Nigeria is negatively and significantly influenced by corporate social responsibility activities to employee, implying that not all investment on employees yields better financial performance. The management of deposit money banks must increase corporate social responsibility expenditure on sports in order to enhance their profit after tax. A continuous increase incorporate social responsibility expenditure in respect of sport will significantly enhance deposit money banks financial performance in Nigeria.

Recommendations

In line with the conclusions of the study and for a continuous attainment of high financial performance through corporate social responsibility practices of listed deposit money banks in Nigeria, the following recommendations are proffered:

- I. The management of the companies should prudently explore the use of debt financing to be invested in viable projects that would boost the share value of the companies in the stock market.
- ii. The result which indicates that the financial performance of the listed deposit money banks is insignificantly affected by community development could be attributed to the inability of some of the deposit money banks to disclose more of its engagement to community regularly during the period under consideration. Therefore, management of the listed deposit money banks in Nigeria should ensure a regular disclosure of their activities directed at community development.
- iii. The management of Nigerian deposit money banks should reduce and strictly monitor their corporate social responsibility health expenditure given to their host communities in order to enhance their performances.
- iv. The management of Nigerian deposit money banks should sustain and further increase their corporate social responsibility expenditure on sports in order to increase their performances.

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YOUTH PARTICIPATION AND INFORMAL SECTOR EMPLOYMENT IN EMERGING ECONOMY: EMPIRICAL EVIDENCE FROM NIGERIA

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Abstract

This study assessed the impact of youth participation in Nigeria's informal sector on employment generation in terms of livelihood improvement of the owner and staff through self-employment and/or job creation. Survey research design was adopted with a sample of 400 youths. The responses were analyzed using descriptive statistics and hypotheses tested using regression technique. The study found among others that; youth participation in informal economy has led to employment generation in Nigeria. However, Nigerian youth prefer jobs in formalized settings regardless of the nature of their earnings. Most do not consider their present occupations/business operation as employment and so, look forward to having a formal job. The study therefore recommends that, Nigerian youths should participate fully in the informal sector and take their businesses seriously as this is a form of employment that could get formalized; also, pay better than most formal jobs.

Keywords: *Youth participation, employment generation, livelihood improvement, job creation, informal sector.*

Introduction

Unemployment remains one of the most threatening problems to sustainable economic growth in many emerging economies, especially in sub-Saharan Africa countries like Nigeria (Edewor, Kollie & Olaoye, 2023). Nigeria's growing population and the relative high unemployment rate is indeed worrisome. In 2020 for instance, the Nigerian population was estimated at 200 million people with very high proportion of this population comprising of youths between the ages of 15 and 34 years. There has been so much emphasis on youth' unemployment, especially in Nigeria where youth unemployment is on the increase. The effect of unemployment among Nigerian youth includes among others; dejection, dependency on family members and friends in some cases, as well as frustration. This negative effect contributes greatly to the prevalent

social vices such as militancy, kidnapping, poverty, political thuggery, armed robbery, prostitution, restlessness, and political instability. A similar submission from World Bank survey in 2011 showed that 40% of those who join rebel movements say they are motivated by lack of jobs, and 50% of those who are involved in one form of criminality or the other are also motivated by lack of jobs (World Bank, 2011).

As at year 2012, the International Labour Organization indicated that 40 per cent of jobless people worldwide were young. However, government was insensitive to the plight of youths, who spend their youthful years and vigour going in search of non-existent jobs (ILO, 2012). In Nigeria, according to data from the National Bureau of Statistics, Nigeria's unemployment rate increased from 23.1% in Q3 2018 to as high as 27.1% in the second quarter of 2020. This implies that, approximately 21.7 million Nigerians of working age were unemployed; 13.9 million of which are youth (National Bureau of Statistics, NBS, 2020). It is understandable therefore that, in Nigeria the informal sector employs 68% of the labour force and generates 41% of the country's GDP, according to the report by PWC (Edewor, Kollie & Olaoye, 2023). The informal sector of an economy termed Informal Economy (IE) (Becker, 2004), entails economic activities that occur outside of formal institutional boundaries and so, are not (or insufficiently) recorded but remain within informal institutional boundaries and serve a large group in the society (Castells and Portes, 1989; Webb, Tihanyi, Ireland and Sirmon, 2009). The informal economy is a significant complement to the formal economy (Webb, Bruton, Tihanyi and Ireland, 2012).

The imperativeness of informal employment in the developing world is no longer in doubt (Onwo & Ohazulike, 2021). The Nigerian informal sector for instance, has over the years shown resilience and strong dynamism in absorbing the low-level qualification holders and rural-urban drift population which the country has had since 1970s (Attah, Audu & Haruna, 2013). The insatiable feelings of the rural population from the low yield (income) agriculture in the traditional set-up which led them to abandon the rural settings for the urban area in search of office jobs is far exceeding the growth of employment opportunities in the cities and towns in Nigeria (Yusuf, 2014). Consequently, these migrants have been compelled to rely on low-income urban small-scale enterprises that constitute the so-called informal sector. This sector is further burdened by the factors relating to job opportunity in urban area illusion, earning differentials in urban area, greater availability of education and training opportunities alongside social infrastructure in the urban centre. These migrants from rural areas that were unable to find employment in the regulated sector often resorted to obtaining insufficient incomes for survival, whereby they rely on their own indigenous skill and resources to start work. This sector provides sporadic temporary employment for this population section -the rural-urban migrants that are unable to secure wage employment in the formal sector.

Over the years, the Nigerian formal sector has been unable to sustain employment generation. It is therefore not an overstatement to say the informal sector plays a vital role

and it has been the hub of employment generation in the economy (Yusuf, 2014). The significant role that the informal sector plays in providing employment for the downtrodden Nigerians can be seen as a relief for the formal and regulated sector. Also, in querying whether the informal sector should merely be a holding ground for people awaiting entry into formal sector and so being a transitional phase or whether it is here to stay and should be promoted as a major source of employment and income for the urban labour force, Michael & Stephen (2006) observed that, the Nigerian situation strongly supports the latter view as can be seen in the resilience and dynamism of the sector to an extent that major proportion of this section would rather prefer to remain in this sector to the formal sector where all the working conditions, wage, term of employment is regimented.

Today, unemployment is almost a core characteristic of every emerging economy. Unemployment occurs when a person who is actively searching for employment is unable to find work. It is a state of not having jobs. Unemployment is one of the developmental problems that face every developing economy in the 21st century. This has become a global concern and has more direct consequences on the youth who would have been the next generation of potentially productive economic and social sectors. International statistics portray that industrial and service workers living in developing regions account for about two-thirds of the unemployed, and global youth unemployment rate was projected at 12.7 % (Patterson, Okafor & Williams, 2006).

The dreadful state of unemployment in Nigeria is well known to all Nigerians with its excruciating and biting presence in their lives. For instance, as at 2012, Nigeria generates about 4.5 million new entrants into the labour market (annually). 2.2 million primary school leavers not proceeding to secondary school, one million secondary school leavers not proceeding to the tertiary level and 300,000 graduates finding no placement anywhere for productivity, and yearly graduate turnover at over 600,000 (Federal Office of Statistic, FOS, 2012). Government at various levels has introduced various policies and programmes aimed at reducing this menace but to no avail. Informal sector however, is perceived to have contributed to economic development in the area of job creation. It has helped to ameliorate the unemployment saga (Donald & Stephen, 2010), as most of the unemployed operate the traditional method of production and services. But workers in the informal sector are characterized by unstable and less income earned, and this leads to little or no access to basic protection and services.

In spite of this, there has been a persistent increase in the rate of unemployment all over the world, and particularly in Nigeria. This informs the question of whether the informal sector should really be seen as a marginalized sector, which mops up excess or entrenched workers or as a vibrant, entrepreneurial part of the economy which can stimulate job creation and so attract the participation of the teeming youths who are highly unemployed. Also, what impact does the active participation of youths in the informal economy has on employment? Does it provide just but a temporary

engagement in wait for a real job or it is actually in itself, a way out of youth unemployment?

Various researchers, bodies, organizations and institutions have defined youth, informal sector, employment and other relevant concepts differently depending on their purpose, objective and use. For this research, a youth is an individual (male or female) that is between the ages of 18 years and 35 years. Informal economy here are the economic activities by workers and economic units that are not covered or insufficiently covered by formal arrangements and so unregulated that produce goods and services for sale or for other forms of remuneration whose contributions to the economy are not well recorded. Whereas, the participation of youth here shall be the engagement of youth in economic activities which are not sufficiently covered by formal arrangements and their contribution to the nation's economy is not recorded by national income statistics. Also, unemployment here is said to occur when a person, able and willing to work is actively searching for jobs but unable to find one.

In view of the above established facts, youth population (as defined) is quite increasing vis-a-vis lack of jobs. With the reviewed imperativeness of informal sector in solving the unemployment situation in Nigeria, an increased youth participation in the sector may be of utmost pertinence in curbing the menace of unemployment prevalent among them. Youth participation in informal sector may be in the form of operating an informal business or employment in the informal sector. The main objective of the study therefore is to assess the impact of youth participation in informal sector on employment generation. Based on the background established, the following questions are asked:

- i. What is the impact of youth participation in informal economy on livelihood improvement (self-employment) of the youth?
- ii. What is the impact of youth participation in informal economy on job creation?
- iii. What is the impact of youth participation in informal economy on job satisfaction?

Conceptual Framework

Informal sector

Today, the significance of informal employment is no longer in doubt; workers that cannot find opportunities in formal wage employment result to finding work somewhere else to achieve the need for subsistence (Onwo & Ohazulike, 2021). Informal Sector as a term was first coined in Ghana in the study of income and employment opportunities of Ghana by Hart (1971). ILO (1972) used the description in its report on employment mission to Kenya. The study of urban poor in Calcutta, India also adopted the concept by Dasgputa (1973). This concept is rooted in the dualistic economy structure as propounded by Arthur Lewis (1959) and others. Michael and Stephen (2006) documented that the sector is unorganized, unregulated and mostly legal (moral) but unregistered. It is further described as the large number of small-scale production and service activities that are individually, family-owned and use simple labour-intensive technology which tends to operate like monopolistically competitive firms with ease of

entry, excess capacity and competition driven-profits or income. The players in this sector have little or no formal education, hence are generally unskilled and there is dearth of access to financial capacity. Though, this definition by characterization of unskilled and financial capacity has been refuted on certain grounds.

The productivity and income in this sector is lower compared to the formal sector. The large participants in the informal sector do not enjoy the measure of protection afforded by the formal modern sector in terms of job security, adequate work conditions. Ojo (1997), reveals informal sectors as consisting mainly of wood working including joinery and carpentry, vehicle repairs; other mechanical and electrical enterprises including watch repairs, blacksmithing, metal working, radio repairs, watch repairs, textile enterprises including tailoring, weaving, dyeing and upholstering; bricklaying and masonry; transport and associated enterprises; miscellaneous services including hairdressing, laundering, photography etc; and, retail trade which includes market women. In Nigeria specifically, informal sector should include legitimate activities such as car washing, shoe shining, street vending, hawking and illegal/criminal or immoral activities of '419' operators area boys, motor park and airport tout and prostitutes (Ojo, 1997).

Fashola & Akano (2013) cited Fapohunda (1985) and documented that informal sector constitutes "enterprises" distinguished by the following characteristics: Small-scale of operation in respect of capital and turnover; ownership of the enterprise by a family (or close relations); relatively low level of education of the owner of the enterprises; small number of employees, if any, apart from relations; predominant use of local resources; labour intensive and primitive technology; ease of entry and unregulated perfectly competitive market structure; skills acquired mainly informally or on the job and low labour productivity.

The above notwithstanding, in a bid to clearly and generally define the informal sector of an economy, Becker (2004) asserts that, the informal sector is the unregulated, non-formal portion of the market economy that produced goods and services for sale or for other forms of remuneration. In effect, the term refers to all economic activities by workers and economic units that are not covered or are insufficiently covered by formal arrangements. This definition by Becker (2004) is therefore adopted for this research.

Determinants of the Informal Economy

There are different factors that influence decisions to undertake activities in the informal sector or otherwise. While most of these factors, for convenience, can be summarized under the headings: *structuralist* (i.e., survivalist and under regulation determinants), *neoliberal* (i.e., choice, over-regulation, bureaucracy), and *poststructuralist* (i.e., corruption, social, redistributive, resistance or identity reasons), some overlaps exist. Some of the factors, the way and extent to which they influence the informal economy are briefly considered here.

Government regulation: Excessive regulation of the labour market, via minimum wages or maximum working hours. Results from OECD studies show that setting minimum wages increases the level of unemployment and size of the informal economy (Schneider and Enste, 2000). In addition, *social security contributions* tend to increase the cost of labour in the formal economy, and hence increase the size of the informal economy (Schneider *et al.*, 2010).

Bureaucracy and corruption: Informality has been observed to be more pervasive in countries requiring entrepreneurs' compliance with a large number of procedures to start a business and in those in which the time and cost associated with business entry were high" (Garcia- Bolivia, 2006). Similarly, studies have observed that the size of a country's informal economy increases with *corruption*, as entrepreneurs deliberately informalise in order to avoid the high costs associated with bureaucracy and corruption (Schneider and Enste, 2000; Ferraira-Tiryaki, 2008).

Time allocation: Individuals who have formal employment can choose to combine it with activities in the informal economy, but they can only do so if they have spare time from their formal job, and/or are willing to trade off their leisure time for these informal activities. Schneider and Enste (2003) suggest a seamless movement of individuals between the two sectors, but other empirical results tend not to support this hypothesis. For example, Lemieux *et al.* (1994) report a negative relationship between the formal economy and time spent in the informal economy, and Sookram and Watson (2008) found marginal evidence in favour of time spent in the formal and the informal economy for Trinidad and Tobago.

Socioeconomic factors: Factors such as level of education (Gallaway, and Bernasek, 2002), area of residence (Sassen-Koob, 1989), income level, number of dependents (Schneider *et al.*, 2001), skills acquired, and training undergone (Becker, 2004), and demographic factors, such as marital status (Schneider *et al.*, 2001), age and sex (Becker, 2004; Loayza, 1996) tend to affect the size of the informal economy. For example, sectors dominated by ease of employment, particularly employment without documentation, low wage, low income, low-skills, and labour-intensive jobs, which can be categorised as *structuralist* factors have a relatively larger share in the informal economy (Sookram and Watson, 2008; Williams, 2013). Also found is the prevalence of the informal economy in manufacturing (Castells & Portes, 1989; ILO, 2002) and construction (Marceli *et al.*, 1999; Losby and Edgcomb, 2002). Again, Becker (2004) noted that the growing number of women going into the labour market contributes to the growth of the informal economy, as they do not have the right to own property/land in some countries, hence cannot operate formally.

Population growth rate: The population of Nigeria has been increasing at exponential rate. It has quadrupled during the last 5 decades due to very high birth rates. Growth was fastest in the 1980s, after child mortality had dropped rapidly, and has slowed slightly since then as the birth rate has declined slightly. According to the 2017 revision of the

World Population Prospects, the total population of Nigeria was 185,989,640 in 2016, compared to only 37,860,000 in 1950. Population growth rate at present is estimated at 3.2 percent leading to the projected population by United Nations of 411 million by year 2050. Nigeria might then be the 3rd most populous country in the world. By 2050 the percentage of the population estimated to be living in urban areas is 69.6% compared to the 50.6% in 2010 (Wikipedia.org, 2018). The implication of the increase in population and that of those living in the urban areas is that, there would be (potentially) increase in the participation in the informal sector.

Unemployment in Nigeria

According to the International Labour Organisation (ILO) (2007), the unemployed are those who are currently not working but are willing to and able to work for pay, currently available to work and have actively searched for work. Nigeria does not seem to have credible data on the rate of unemployment because no institution has been able to produce accurate figures showing the current rate of unemployment (Udu and Agu, 2005 in Asogwa & Dim 2016). According to Chukwubuike, (2008) and Salami, (2011) in Asogwa and Dim (2016), despite the abundant natural resources, Nigeria is still one of the poorest nations in the world and has one of the highest rates of youth unemployment in sub-Saharan Africa, regardless of its alleged strong economic growth.

Rapid population growth is a leading cause of unemployment in Nigeria. For instance, the National Bureau of Statistics report of 2012 showed the total population of citizens in Nigeria to be around 166.2 million people and projected 180 million people by 2020, given the annual growth rate of 3.2% (National Population Commission and ICF Macro, 2009). In 2020, the Nigerian population was estimated at 200 million people with very high proportion of this population comprising of youths between the ages of 15 and 34 years. With this population, Nigeria is the most populous nation in Africa and the high population growth rate has resulted in the rapid growth of the labour force, which is far exceeding the supply of jobs (Asogwa & Dim 2016).

Corruption has deprived Nigeria of developing a base that is economically vibrant. Each successive government patiently take turns to target the national wealth by using public power, resources, goodwill, as such, this cripples the economy and intensified unemployment that generates abject poverty, hunger and frustration which is killing the zeal and means for entrepreneurship development in the Nigerian youth (Okafor 2008, as cited in Asogwa & Dim 2016). Adeniyi (2013) stated that, on the average based on statistical reports, labour force in Nigeria will be around 78.2 million in a year between 2021, and 2030 census (if there is no war, no natural disaster, no disease outbreak). This projection may be realistic because it will take least 20 years before any policy aimed at reducing population can be effective in Nigeria. Adeniyi (2013) further explains that, with the present trend, employment will only be, on the average, 55.8 million a year between 2011 and 2020 and 65.7 million in a year between 2021 and 2030 in Nigeria. This projection will cause unemployment in Nigeria to be around 9.9 million (15.07 % rate) and 12.45

million (15.93% rate) on average between 2011 and 2020, and 2021 and 2030, respectively (Adeniyi 2013 in Asogwa & Dim, 2016).

Informal sector and Unemployment Reduction in Nigeria

Employment Generation is the process involved in engaging the labour force in productive activities in the economy. Full employment is the most desired employment condition in the economy. But, this is a ruse in developing countries like Nigeria, because it is a dream that is yet to be achieved. Beveridge (1994) defined full employment as situation where there are more jobs than men. Full employment does not mean that everybody in the labour force is employed. A condition of full employment can be said to exist if the number of unfilled vacancies is equal to the number of people who are out of work (Hanson, 1996). In any dynamic economy, some unemployment rate of 4 and 5 % will be compatible with the aims of full employment (Hanson, 1996). Unemployment has been the problem that is beleaguering Nigeria and has been given the stakeholders (government, employers of labour) sleepless nights. In fact, unemployment is a phenomenon of Nigeria, which has degenerated into poor living condition of the masses. In realisation of this, several bodies, states, federal government, UN and other multilateral agencies have incorporated employment generation as their key target. It is generally believed that the formal sectors of the developing and under-developed nations lack capacity to absorb large number of labour force. Hence, the alternative sector, known as informal sector has always been serving as back up for the formal sector in employment generation. As a result of magnitude of labour force that has this sector as their last resort, the sector demands maximum attention from the stakeholders like Government, employers of labour, multilateral agencies, financial organisations and researchers.

The term unemployment denotes a condition of joblessness or lack of employment. In other words, anyone who is fit and available to work but fails to get one may be considered as being unemployed for the concerned period (Olubukola, 2013). In the work of Arosanyin et al (2011) Unemployment and poverty are two of the challenges facing Nigerian. Most urban, semi and unskilled labour have found solace in the informal sector. Ishola (2008) noted that, in 2003, Nigeria's unemployment rate declined substantially. This decline was attributed to the various government efforts aimed at addressing the problem through poverty alleviation programmes. He further noted that the decline also pointed to an increased number of people who engaged in the informal sector activities. Ishola (2008) observed that, unemployment as one of the macroeconomic problems could be reduced through the informal sector participation provided it is well supported and managed.

More so, Olubukola (2013) stated that the rapid rise in the country's unemployment rate has become a major source of concern. Several school leavers and employable adults are either finding it difficult to secure employment or are laid off work for one reason or the other. Also, Sanda et al (2006) used a sample of 360 firms in Kano and its environs to examine whether or not, large firms were better than small firms at creation of

employment opportunities. Their results were positive in that small firms were found to be relatively better, and the conclusion they derived was that a policy that gives special preference to small firms is justified. Generally speaking, the contributions of the informal sector to the development of the Nigerian economy cannot be over emphasized. Since the beginning of 1980s, the economic position of Nigeria has worsened seriously. The per-capita income fall considerably and wage employment has declined (NISER Report, 2007). One of the major social problems facing Nigeria is the high level of unemployment among youths. The youth has the highest unemployment rate in Nigeria, in the range of 40-60% among this age between 15 and 25 years. Youth unemployment denied them of their legitimate livelihood which resulted to visible idleness. This results to the gathering of youth in the bars and restaurants to drink and smoke, and at the end nurse a culture that encourages criminal behaviour (Akande and Okuwa, 2009).

The Nigerian government, at various levels, has adopted policies aimed at enhancing the performance of the small-scale enterprise (informal sector) in order to reduce unemployment. As a result different administrations, often in collaboration with the private sector, have embarked on youth employment programmes, leading to the establishment of the National Directorate of Employment (NDE), Small and Medium Enterprises Development Agencies (SMEDAN), the poverty alleviation programme, the Subsidy Reinvestment and Empowerment Programme (SURE-P), and the Youth Enterprise With Innovation in Nigeria (YOUWIN), Better Life Programme, Peoples' Bank, National Agency for Poverty Eradication, (NAPEP), the National open apprenticeship scheme, the graduate job creation loan Guarantee Scheme, Agricultural sector Employment program and the most recent of all, the President Muhammadu Buhari led administrations' n-power program.

Youths' participation in informal sector

With the gale of unemployment among youths in emerging economies, several youths have taken the path of hard work; many have engaged themselves in one business venture or the other as a means of making a living. The informal sector has in recent times reduced unemployment than her formal sector counterparts. For instance, report by PWC indicates that, in Nigeria the informal sector employs 68% of the labour force and generates 41 % of the country's GDP (Edewor, Kollie & Olaoye, 2023). A good number of youths who have completed university education don't even bother looking for jobs in Government parastatals, the informal sector seems more viable to them.

Some of the ventures many partake in are; commercial motorcycling, operating a provision store, sale of recharge cards and/or charging of phones, operating a barbing/hair dressing salon/makeup artist, vocation (such as tailoring, welding, carpentry, auto mechanic, others), taxi driving, road side hawking, food vending, operating a bar/pub and operating a boutique. These ventures among others have been the sole source of survival for youths. Many of the youths who participate in this sector

had searched for white collar jobs to no avail; the unending search for employment has forced them to venture into sectors that were formally known to be fully dominated by the uneducated lots.

Theoretical Framework

Varying approaches have been used by scholars in the explanation of the participation in informal sector and unemployment reduction. According to Webb et al. (2012), there are three approaches relevant in explaining participation in the informal sector. These are: institutional theory (North, 1990), motivation-related theories (Merton, 1968; Passas and Agnew, 1997), and resource allocation theory (Kanfer and Ackerman, 1989). These approaches are briefly discussed below. Scholars employing institutional theory traditionally examine how institutional pressures lead to activities that conform to prescriptions (Webb et al. 2012). As encompassing activities occurring outside formal institutions, the informal economy represents a contradiction to the theory's traditional focus (Portes and Haller, 2005) and provides a context to more thoroughly, examine the complexities of institutions. In this wise, Webb et al. (2009) assert that, consideration of institutional incongruence and weak enforcement facilitates recognition and exploitation of opportunities, respectively, by offering a finer-grained analysis of institutional contexts. Also, policies and policy change, institutional asymmetry, and entrepreneurs' tactics shape participation in the informal economy (Webb et al. 2012). This theory portends that, where the institutional tenets become so bureaucratic and so difficult to keep to by business operators, some turn to operate outside the scope of the institutions thereby naturally falling in the informal sector of the economy.

Motivation theories help to explain why individuals act in ways that deviate from a society's norms, laws, regulations, and other guidelines (Durkheim, 1951; Merton, 1968; Robinson and Bennett, 1995; Webb et al. 2012). According to Webb et al. (2012), motivations to participating in informal economic activities are based on the same reasons as other forms of deviance and not all deviance necessarily leads to negative societal outcomes. The theories also provide insights regarding the outcomes that surface when individuals deviate from societal prescriptions. The motivations may be economic and/or social in nature.

Resource allocation theory has been used in psychology to explain how individuals/teams manage their cognitive resource constraints. This theory can be extended by informal economy research to explain strategies individuals use to manage tangible resources, risks, and different domains, such as business versus family (Webb et al. 2012). This theory asserts that, the nature and amount of resources available to an enterprise explains its formality or informality nature of operation. This theory also helps to address opportunity exploitation when informal entrepreneurs are faced with limited resources to perform a task (Kanfer and Ackerman, 1989; Webb et al. 2012). Resource allocation theory focuses on individuals' cognitive resources, limitations, tradeoffs between competing goals, and mechanisms for overcoming these limitations. Webb et al.

(2012) further expanded the theory's logic to understand how individuals overcome constraints on their tangible resources due to various competing needs. An individual's resource investment in performing one function necessarily means that fewer resources are available for allocation to other functions. In emerging economies, the lack of formal economy opportunities leads individuals to pursue informality for subsistence purposes (i.e., to meet daily needs). Within these conditions, individuals face resource limitations and are forced to draw upon family resources to support their entrepreneurial activities (Webb et al. 2012). This theory is relevant and is used in explaining the choice of the informal sector for business participation by the youths.

All the theories identified above are relevant in explaining participation in the informal sector owing to the fact that, many youths who in search of employment participate in business at the informal sector which is perceived and christened so, because of the institutional asymmetry that exists as a result of the governments' requirements for registering and operating enterprises as depicted by regulatory agencies. Also, youths are triggered to participate in the informal economy as a means to enjoying economic and/or social benefits. One fact still remains that, many youths participate in the informal economy because, it is basically small scale in nature and so, needs a smaller number of resources to organize.

Empirical Review

Research carried out by Onwo and Ohazulike (2021), interrogated the nature of employment in the informal sector anchored on Modernisation theory. Based on a desk and literature review of relevant articles and publications as well as on employment and the informal sector. The research revealed that Nigerian Informal Sector is a major contributor to the Nigerian economy, accounting for a significant portion of employment and national Gross Domestic Product and also the informal sector currently accounts for over half of global employment and as much as 90% of employment in some of the developing countries like Nigeria. The paper therefore recommends that efforts should be made by the government and its agencies to create more jobs. Also, policies should be introduced to address identified challenges in the informal sector towards improving productivity and incomes of informal sector workers.

Ijeoma, Ani and Ifeanyi (2020) carried out a study to examine challenges to youth engagement in informal economy. A total of 385 youth was sampled in Enugu State with the questionnaire as the instrument for data collection. Both descriptive and inferential statistics were used to analyze data collected. It was found that challenges to youth engagement in informal economy range from finance to parental expectations. The researchers therefore recommend, among others, that tertiary institutions in Nigeria should counsel youth on the importance of their engagement of the informal economy. According to Tshuma & Jari (2013) who conducted a study titled the informal sector as a source of household income: The case of Alice Town in the Eastern Cape Province of South Africa, participating in the small business (informal) sector has shown that, the

poverty circle can be escaped and a faster rate of economic growth and development achieved especially if these small businesses are supported. As a result, enhancing the productivity of informal traders and making them competitive is crucial as it absorbs the job-seeking and able-bodied people who in turn produce thereby increasing national output and speeding up economic development.

Salami (2013) carried out research on Youth Unemployment in Nigeria: A time for Creative and Innovative Intervention. He said that unemployment in Nigeria is a time bomb waiting to explode if effective interventions are not put in place to mitigate the unsavory impact of high youth unemployment. His work establishes a link between entrepreneurship and youth unemployment if adequate attentions are focused on the creation of enabling socio- economic and political environment that can galvanize a culture where the youths think job creation away from the mindset of job seekers.

Farinmade (2012) worked on the challenges of improving informal sector activities conditions in Lagos Island, Nigeria. The survey was carried out using stratified random sampling to ensure a fair representation of the population on each selected street. The study reveals that there is a relationship between employment in the informal sector and formal sector unemployment, illiteracy, environmental degradation and the rampant violation of planning regulations. The study further recommended the formulation of policies and programmes that will enhance the effectiveness of both the informal sector and planning administration, provision of infrastructure such as markets and designated open spaces to enhance and promote the activities of the sector.

Arosanyin, Olowosolu and Oyeyemi (2011) conducted research on Employment Generation and Earnings in the informal Transport Sector in Nigeria. Using a case study, logistic models and Mincerian equation for the analysis of the study, it was found that, the informal sector is a source of employment for 21.7 % of jobless people and 72.3 percent of those who shift job. The study pointed out that employment and earnings can be improved upon in the informal sector if the government regulates its operation. Onyemachi (2011) in the study of Role of the Informal Sector in Development of the Nigerian Economy: Output and Employment Approach. The study employed the survey of the Nigerian informal sector carried out by CBN in collaboration with FOS and NISER. The study indicated that the traditional or informal sector is continuously expanding in developing countries and has been serving as safety belt in the provision of employment and income to the teeming poor.

In a study by Ogunrinola (2010) titled Informal Self-Employment and Poverty Alleviation: Empirical Evidence from Motorcycle Taxi Riders in Nigeria, using the descriptive analysis and OLS technique with two major cities in Nigeria as the focus of study, the researchers found that, the informal sector is a high employer of young school leavers. The study analysis showed that 86% of the participants earn above the minimum wage level. The study further confirmed that some graduates of tertiary institutions that had to get involved in auto-cycle riding due to lack of desired formal sector employment.

The study therefore recommended a rigorous regulation of the sector to promote safety of participants Emmanuella (2010) conducted a study on The Informal Sector and the Environment in Nigeria Towns: What we know and what we still need to know and concluded that people of low-income in Nigerian towns/cities rely on the informal sector for survival because the sector provides ample opportunities to support their livelihood; the study further pointed out that the sector develops and changes over time and it interacts with and affects the environment leading to environmental degradation resulting from the informal sector activities which has been neglected on a large scale.

Research gap and Statement of Hypotheses

From the review of literature so far, youths participation in informal sector can be measured in terms of youths' operation of enterprises which are of low entry requirements in terms of capital and professional qualifications, small scale of operations, does not necessarily require skills from formal education, uses labour-intensive methods of production and adapted technology (Fashola & Akano 2013 in Fapohunda 1985) not well recorded by national income statistics, not captured by the government regulatory agencies and/or has yet to pass through the process of business registration by the board of internal revenue service. employment generation on the other hand can be measured in terms of fetching an income fairly enough to cater for the youth's day to day need; improvement in living standard; earning enough to save and carryout an intended project like buying of land, motorcycle/car, furthering of academics, others; paying as good as others who are employed; can be looked at as a sort of self-employment; engaging operators just like those who are in other forms of employment; offering jobs or has potential of employing others; others who don't have good jobs can work with the enterprise and earn a living; informal sector job is just as good as any other job; absence of jobs around that have better working conditions than those of the informal sector; doing informal jobs can lead to some sort of satisfaction same as formal sector jobs.

Previous researches such as that of Ijeoma, Ani and Ifeanyi (2020); Onwo and Ohazulike (2021); Ogunrinola (2010); Tshuma & Jari (2013); Onyemachi (2011); Arosanyin, Olowosolu and Oyeyemi (2011); others have thoroughly assessed the impact of informal sector activities on employment creation in Nigeria but not any known to the researchers have explicitly described the areas of participation by youths and the impact of such participation on employment generation. This research therefore used these and several other works as a background to clearly define the areas of participation by youths in emerging economy and arrived at the impact of such activities on employment generation. This research therefore made the following null hypotheses:

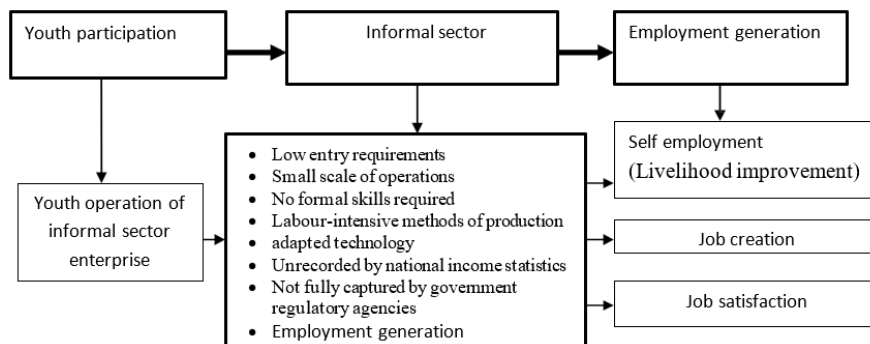
- H₀₁:** Youth participation in informal economy has no significant impact on self-employment (livelihood improvement of the youth).
- H₀₂:** Youth participation in informal economy has no significant impact on job creation.
- H₀₃:** Youth participation in informal economy has no significant impact on job satisfaction.

Model conceptualization and specification

Diagrammatical model

Figure 1 shows the link between youth participation in informal sector and employment generation. Informal sector here is characterized by low entry requirements, small scale of operations, no formal skills requirement, labour-intensive methods of production, adapted technology, unrecorded by national income statistics, not fully captured by government regulatory agencies and no full business registration. These kinds of enterprises when operated by youths may lead to employment generation in terms of self-employment, job creation and job satisfaction.

Figure 1 Diagram showing the link between youth participation in informal sector and employment generation.



Source: Researchers (2024) - Based on literature review.

Mathematical model:

Multiple regression with youth participation in informal sector as independent variable is conducted with three employment generation indicators as dependent variables. Thus, the generic model is given as:

$$EG = f(YPIS)$$

Where:

EG = Employment Generation

YPIS = Youth Participation in Informal Sector The specified regression models to be tested are:

$$SE + JC + JS = b_0 + b_1 YPIS + \epsilon$$

Where:

SE = Self Employment; JC = Job Creation; JS = Job Satisfaction

ϵ = the error term of 5% which is provided for in the course of the analysis. The a priori expectation is $b_1 > 1$

Methodology

To clearly assess the impact of youth participation in informal sector on employment

generation, it is pertinent to specify relevant procedures for collecting and analyzing data as recommended by Agburu (2007:8). Survey research design was adopted. Thus, data was collected through the use of questionnaire. This means going to the field to source for responses from respondents who engage in an informal business. Here, the researcher sought responses to the questionnaire from informal enterprise operators in Gboko, Benue state.

The population of youth who participate in the informal sector is not defined. Therefore, the population of youths in Gboko local government area according to the latest census report (2006 census) was considered for this research. According to National population Commission, as at 2006, Gboko had a total population of 361,325 people (NPC, 2006). Based on the proportion of youths to total population in Benue state which is about 27% (1,174,008: 4,253,641) (NPC, 2006), the population of youths in Gboko is deduced to be 97,557 people.

To arrive at a good sample, Taro Yamen's formula for sample determination was employed. Taro Yamen's formula determines a sample size from a multinomial heterogeneous population (Agburu, 2007; Orsaah, 2009). In line with this fact therefore, a sample of 398 is selected from the population of 97,557 using Taro Yamane's formula for sample determination as shown below:

$$n = \frac{N}{1+Ne^2}$$

Where:

n = sample size; N = population size; e = level of significance; 1 and 2 are constants.

$$n = \frac{97,557}{1+97,557(0.05)^2}$$

$$n = 398.366$$

The sample size as calculated above is 398 youths of Gboko local government area, Benue State. A sample of 400 is however taken for conveniences sake.

Since the emphasis here is on youths who operate small scale businesses, the approximate number of youths sampled is categorized into ten kinds of businesses and forty (40) questionnaires allotted to each. These are; commercial motorcycling, operating a provision store, sale of recharge cards and/or charging of phones, operating a barbing/hair dressing salon/makeup artist, vocation (such as tailoring, welding, carpentry, auto mechanic, others), taxi driving, road side hawking, food vending, operating a bar/pub and operating a boutique.

The questionnaires were therefore purposely distributed to youths in the ten selected businesses for they are seen as been homogenous regardless of their location in the study

area. A questionnaire was administered on every youth sampled. This was done through personal delivery. Also, telephone calls and personal visits were employed to follow up on the respondents to ensure that, they completed the questionnaires, and returned them in good time. To ensure validity of the measuring instrument, 40 copies (representing 10% of sample size) of a carefully drafted and wide-ranging questionnaire aimed at eliciting right responses were constructed and piloted in order to detect any ambiguities or inherent problems. While one question was open-ended, others were with a response scale ranging from strongly “agree” to strongly “disagree”. The questionnaire was designed to capture some demographic characteristics of the respondents in addition to their experience participating in the informal sector. Also, expert opinions on the subject were sought to confirm the extent to which the questionnaire has face and content validity.

To ensure reliability, this research used Cronbach alpha coefficient to test reliability. The Cronbach's coefficient alpha ranges from 0 to 1. A scale is considered to have good reliability if it has an alpha value greater than 0.60 (Zikmund, 2010). The Cronbach's alpha results were 0.821 for youth participation in informal sector, 0.645 for self-employment, 0.673 for job creation, 0.701 for job satisfaction, while the overall alpha coefficient is 0.822. Details is shown in appendix II. Hypotheses were tested using multiple regression analysis. The output shows the t-statistic and p-values for the coefficients which results in either rejecting or accepting the hypotheses at a specified level of significance. The null hypothesis is rejected where the p-value is less than the critical value (0.05). Also, the output shows the coefficient of determination (r^2), which measures the proportion of the dependent variable that is explained by the regression model. The range for the coefficient of determination varies between 0 and 1; that is $0 \leq r^2 \leq 1$. As r^2 approaches 1, the more the independent variable explains the variation in the dependent variables. Statistical Package for Social Sciences (SPSS 23.0) computer program was used to enhance the robustness of the results.

Results and Discussion

Results of Questionnaire

A total of 400 questionnaires, each containing 25 questions were designed and issued out to respondents who are youths operating in the informal economy. The questionnaire process took place from 10th January, 2019 to 15th March, 2019. The presentation and analysis of questionnaire responses was based on the copies of questionnaires as returned.

Respondents' Characteristics

The demographic characteristics of the youths sampled are shown in this section. This section contains the distribution of respondents based on age, sex, marital status, educational attainment, employment status and area of informal business they are into. The detail of these attributes is captured in table 1.

Table 1: Respondent's Distribution based on youths' Characteristics

Attribute	Frequency	Percentage (%)
Sex:		
Male	275	68.8
Female	125	31.3
Total	400	100
Age:		
From 18 to 25 years	108	27.0
From 25 to 30 years	292	73.0
Total	400	100
Marital Status:		
Single	226	56.5
Married	140	35.0
Divorced	25	6.3
Widowed	9	2.3
Total	400	100
Educational qualification:		
Primary	7	1.8
Secondary	74	18.5
OND/NCE	222	55.5
BSc/HND/BA	89	22.3
MSc/MBA/Ma and above	8	2.0
Total	400	100
Employment status:		
Government employee	122	30.5
Private sector employee	-	-
Personal/family business	278	69.5
Total	400	100
Kind of Business:		
Commercial motorcyclist	40	10
Provision Store	40	10
Recharge card vending/Charging of phones	40	10
Barbing/hair dressing salon	40	10
Vocation (Tailoring, welding, carpentry, Auto mechanic, others)	40	10
Taxi driving	40	10
Road side hawking	40	10
Food vending	40	10
Bar/pub	40	10
Boutique	40	10
Total	400	100

Source: Survey data (2023)

Result from Table 1 presents the demographic statistics of the respondents. Out of the 400 respondents, 275 representing 68.8 % are male while the remaining 125 (31.3 %) are female. None of the respondents is under 18 years, 108 (27.0 %) are between the ages of 18 and 25 years, as high as 292 (73.0 %) aged from 26 to 30 years. None of the respondents is above 30 years. Also, 226 (56.5 %) are single, 140 (35.0 %) are married, 25 (6.3 %) are divorced while the remaining 9 (2.3 %) are widowed. For educational qualification, 7 (1.8 %) had just primary education, 74 (18.5 %) are secondary school leavers, majority of the respondents, 222 (55.5 %) either had NCE or diploma, 89 representing 22.3 % are degree or HND holders while the remaining 8 (2.0 %) said they had a post graduate qualification. For employment status, 122 (30.5 %) claimed they were employed by the government but yet operating an informal business, none employed with private sector was known to be doing such businesses while the remaining 278 representing 69.5 % do not have a formal employment but are operating either a personal/family business. Also, out of the 400 respondents, 10 representing 10 % each are operators of selected informal businesses including; commercial motorcyclists, provision store, sale of recharge cards and/or charging phones, barbing/hair dressing salon, vocations such as tailoring, welding, carpentry, auto mechanic, others), taxi driving, road side hawking, food vending, bar/pub operators and operators of a boutique.

Respondent's views about the youth participation in informal sector economy. The views of respondents about the youth participation in informal sector are presented in table 2.

Table 2 Respondent's Views about youth participation in informal sector economy

Attribute	SD	D	N	A	SA	Total
Youth participate in informal economy which has low entry requirements in terms of capital and professional qualifications	18	41	21	271	49	400
Youth participate in informal economy which has small scale of operations	10	26	22	268	74	400
Youth participate in informal business which does not necessarily require skills from formal education	13	44	23	258	62	400
Youth participate in informal business which uses labour-intensive methods of production and adapted technology	15	43	19	268	55	400
Youth participate in informal business which is not well recorded by national income statistics	9	29	27	253	82	400
Youth participate in informal business whose operations are not captured by the government regulatory agencies	18	44	19	260	59	400
Youth participate in informal business which seldom pass through the process of business registration by the state board of internal revenue	17	38	19	276	50	400

Source: Survey Result, (2023)

Respondent's views about the impact of youth participation in informal sector economy on unemployment reduction

The views of respondents about the youth participation in informal sector are presented in table 3.

Table 3 Respondent's Views about the impact of youth participation in informal sector on

Attribute	SD	D	N	A	SA	Total
Informal business fetches an income fairly enough to cater for youths' daily needs	31	58	12	260	39	400
Respondents' living standard improved as a result of doing informal business	27	63	14	260	36	400
Informal business pays enough to save and carryout intended projects	27	63	15	260	35	400
Informal business pays as good as formal Employment	28	63	14	257	37	400
Participating in informal business is a sort of self-employment	28	61	15	259	37	400
Doing informal business engages one just like other forms of employment	31	56	22	244	47	400
Informal business offers jobs or has potential for employing others	32	57	21	245	45	400
Working for informal business pays an income just like formal employment	31	57	22	242	48	400
Others who don't have good jobs can work with an informal business owner and earn a living	28	62	14	260	36	400
Informal business job is just as good as any other job	31	51	25	238	55	400
Informal sector jobs have similar working conditions to formal jobs around	31	55	25	243	46	400
Doing informal business makes one satisfied	27	66	17	268	22	400

Regression result

The results captured in table 4a and 4b are the results from the multiple regression analysis with youth participation in informal economy as independent variable and the impact on employment generation as dependent variable.

Table 4a: Impact of youth participation in informal economy on unemployment reduction

Model	B	Std. Error	T p-value
Self-employment	.213	.049	4.337.000
Job creation	.116	.046	2.528.012
Job satisfaction	-.018	.047	-.396.692

Source: SPSS result (2023)

Table 4b: Test of Hypotheses

Model	T	p-value	Decision
Youth participation in informal economy has no significant effect on self-employment	4.337	.000	Rejected
Youth participation in informal economy has no significant effect on job creation	2.528	.012	Rejected
Youth participation in informal economy has no significant effect on job satisfaction	-.396	.692	Accepted

Source: SPSS result (2023)

From the test of hypotheses in Table 4b, the acceptance/rejection decision is taken based on the decision rule that states that, the null hypothesis will be rejected if the p-value (Sig.) is less than the critical value (0.05). The detail of the regression result is attached as appendix IV. Based on the decision rule therefore, the results in Table 4 show that:

- i. Youth participation in informal economy has a significant impact on self-employment (livelihood improvement of the youth).
- ii. Youth participation in informal economy has a significant impact on job creation.
- iii. Youth participation in informal economy has no significant impact on job satisfaction.

Discussion of Findings

Hypothesis one states that, youth participation in informal economy has no significant impact on self-employment. Self-employment here is measured by the improvement in the livelihood of the youth in terms of catering for youths' daily needs, improvement in living standards, and adequacy of earnings to save and carryout intended projects. Base on the regression result (p. 0.000) as backed by the result of respondents' views which fully supports the alternative view, the alternative hypothesis was accepted which says that youth participation in informal economy has a significant impact on self-employment. This finding supports the earlier research by Ogunrinola (2010) which found that 86% of the participants in informal sector earn above the minimum wage level in Nigeria. Also, the finding supports the views of Farinmade (2012) Arosanyin, Olowosolu and Oyeyemi (2011) who asserts that participating in informal sector creates employment for people who had been jobless. Hypothesis two states that, youth

participation in informal economy has no significant impact on job creation. Based on the regression result (p. 0.012) as backed by the result of respondents' views which fully supports the alternative view, the alternative hypothesis was accepted which says that youth participation in informal economy has a significant impact on job creation. This finding also supports the views of Farinmade (2012) Arosanyin, Olowosolu and Oyeyemi (2011) who asserts that participating in informal sector creates jobs for people who had been unemployed.

Hypothesis three states that, youth participation in informal economy has no significant impact on job satisfaction. Base on the regression result (p. 0.692) as backed by the result of respondents' views which fully supports the null hypothesis, the null hypothesis was accepted as stated that, youth participation in informal economy has no significant impact on job satisfaction. This clearly points to the fact that, youths who participate in informal sector either self-employed or employed by another entrepreneur are basically dissatisfied with the jobs they do.

Conclusion and Recommendations

Based on the above findings, this research concludes that youth participation in informal economy has a significant impact on employment generation in Nigeria. Their participation leads to self-employment and job creation. However, participants are not satisfied with the informal business they do as such if asked directly whether they are employed or unemployed, most if not all will still name themselves as been unemployed and as such looking for a paid job. One fact they fail to realize is that, what they earn is significantly higher than the income of an average employee of the formal sector. In line with their perception, many are not satisfied with what they do. They look forward to getting a formal employment someday. This research therefore recommends that;

- i. Nigerian youths should participate fully in the informal sector and take their businesses seriously as this is a form of employment that could pay better than some formal jobs.
- ii. Furthermore, youths in Nigeria are encouraged to regard their present occupation as employment.
- iii. Development agencies, associations and philanthropists should organize orientation programs to instill a better perception of the small informal businesses as a form of employment and motivate participants towards formalizing their operations by way of registering the enterprises.
- iv. Government should encourage their employees to participate in small scale enterprises on part time basis as a measure towards augmenting their incomes. The practice is at the moment against the civil service rule of the nation; but this restriction if lifted; many enterprises operated by government employees would be formalized. This would ultimately, reduce the pressure on the government as an employer. This however, should not be encouraged at the expense of public service which is the primary assignment of the employee.

has led to employment generation. Participants however, are not satisfied and so still look forward to having a formal job. It also, adds to the literature on informal sector and employment generation. It fills a gap by providing local evidence as to the impact that youths' involvement in informal activities have on employment generation in an emerging economy situation. It will be quite useful background for proceeding researchers.

Limitations of the study

This study is limited to the situation in the Gboko area of Nigeria hoping that this represents the case of Nigeria as an emerging economy. Gboko is however, a feint representation of Nigeria as such varying orientations, levels of economic advancement and other economic and social issues may limit the generalization of the findings of this research.

Suggestions for further studies

This research has realized that, a high number of the participants in informal sector activities are those already engaged by the government and are still in service. This is however against the civil service rule of the state which for now bans public servants from owning and operating non-farming businesses. In line with this realization, further research to unravel the reasons for their participation, the impact of such activities on their job performance and the economic advantages thereof is strongly recommended.

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EXPERIMENTAL AND NUMERICAL SIMULATION OF ATTIC VENTILATION IN MINNA, NIGER STATE, NIGERIA

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Abstract

The study is aimed at designing an appropriate ventilation strategy that will reduce the heat buildup in the attic of a model in Minna, North Central Nigeria. A model of ratio 1:3 of standard size was constructed with sandcrete blocks, fascia boards, roofing sheets and ceiling materials. The orientation of the model was such that the walls with the windows openings (which also have the soffit vents) were perpendicular to the North-East or windward directions. The model was sited around coordinate 9.53417°N, 6.4493°E within the Mechanical Engineering Department of Federal University of Technology, Minna Nigeria. Temperature measurements were taken at some designated areas within the attic space, ambient air temperature and relative humidity were also measured to inform the boundary conditions for the ANSYS simulation. Temperature data was collected when the inlet & outlet vents were Open, Half closed and fully closed. Simulations were also conducted to validate the results obtained from the experiment. The results show that the introduction of soffit and outlet vents reduced the attic temperature of the attic by 5°C in the last quarter of April 2024. In conclusion, the introduction of soffit and outlet vents reduced the heat buildup and has the capacity to reduce the attic temperature by 20°C, depending on the time of the year and the prevailing weather condition.

Keywords: *attic ventilation, windward direction, attic space, temperature data, inlet and outlet vent, model.*

Introduction

Nine (9) out of ten (10) houses in Minna, Niger State, North Central Nigeria do not have Attic Ventilation. One of the fundamental components of a building is an attic. The attic floor at the bottom and the roof at the top serve as barriers to the attic's airspace. Buildings are shielded from the impacts of the weather by their roofs. There are two types of roofs: flat and sloped. Gable roofs, hipped roofs (mono-pitched roof, hipped roof with

one straight gable, hipped roof with all surfaces sloping), and mansard or Dutch roofs are the categories for the latter. The most prevalent types of roofs are gable and hipped, with all surfaces sloping. (Piotrowski *et al.*, 2013).

It is unclear how the attic airspace architecture, the material of the roof and attic floor, and other architectural elements affect heat gains into the building caused by the action of solar radiation. The challenge of lowering energy consumption and typically the cost of air conditioning for a building in Minna, Niger State, is one of the most challenging issues that occurs during the summer. In Summer (Dry Season), the temperature of an unvented Attic space is increased due to Solar Gain thereby making the living space below it uncomfortable, which results in high energy cost for cooling. Additionally, if ceiling vapour barriers are not employed, indoor moisture may migrate into the attic. If this moisture is not removed from the attic, it could condense and deteriorate the insulation and building materials. Attic ventilation is therefore necessary to regulate temperature and moisture.

In a vented attic, cool air flows through the soffit (intake) vent and flows through the attic by pushing hot air through the ridge or gable vent. When this happens, the Living space below is cooler and comfortable to live in. This is a simple system that require no energy. Other types of ventilation systems are Turbine, Electric, Solar Power. Tyler S. Rogers (1938) was the first to investigate ventilation strategies where the study of three (3) ventilation strategies – Gable louvre/ridge vent, soffit/ridge vent and soffit/gable vents were conducted for condensation control in the third month of 1938. It was recommended that for moisture control at the early years, installation of vapour barriers and attics ventilation are the only known solutions.

The introduction of attic ventilation into the roof construction is to minimise moisture accumulation and condensation in attic space because of air leakage from the indoor environment of a cold climate (Rose and TenWolde, 2002; Wayne Tobiasson *et. al.*, 1994). In hot climate, it reduces the heat build-up as a result of solar gain. Fitsum Tariku & Emishaw D. Iffa (2016) established that Attic ventilation benefits more during the summer period by expelling hot air from the attic space thereby reducing cooling and energy demands. The venting of attics has three fundamental functions: (i) avoiding ice-damming (ii) removal of moisture (iii) cools down attic during summertime (Roppel, Norris & Lawton, 2013; Edward Allen & Patrick Rand, 2016). It is important to adequately ventilate the attic to ensure its performance (Istiburek, 2006). Several building codes recommend a ventilation ratio of 1:300 when air barrier is available (TenWolde & Rose, 1999). However, in Edward Allen & Patrick (2016) research, a ratio of 1:150 was specified as the area of the space ventilated. A few researchers have carried out a lot of research on the appropriate attic ventilation ratios (Shimin Wang & Zhigang Shen, 2012), where it was shown that a higher ventilation ratio will lower the attic cooling demand. "Excess ventilation will permit more moisture from the outside and thereby increasing the relative humidity and moisture content of the attic" (Rose & TenWolde, 2002). Conversely, too little ventilation affects the rate of moisture removal in the attic

negatively, moisture brought in will be more than what is removed (Essah, Sander, Baker & Kalagasidis, 2009).

In Roulin Wang (2018), it was stated that the main issue of ventilation of attic space in cold climates is the accumulation of snow. When the temperature rises above zero, the snow that has piled in the attic will melt, seep through the ceiling, and cause moisture issues like wood rot, mold growth, and damage to interior finishes. The installation of polyester filter membrane of the ventilated cladding at the attic entry was also mentioned as one of the solutions to the problem of snow accumulation in ventilated attics. Another method to solving the snow accumulation issue is to seal up the attic such that there is no ventilation – Unvented attic. Similarly, the unvented attic also presents with some issues. Unvented attics are highly sensitive to air leakage from the home, which is their main problem (Ueno & Lstiberuk, 2016). The sealed construction tends to keep the attic temperature higher but is hardly capable of removing trapped moisture, which could encourage biological decay and mold growth in wood-based components (Gullbrekken, kvande, Jelle and Time, 2016). Meloysund et al. determined that unventilated attics posed some level of moisture concerns after investigating six wooden un-vented chilly attics in the south-eastern part of Norway throughout the winter (Meloysund, Blom, Bohlerengen & Lianfield, 2012).

Okoronkwo *et al.*, (2018) compared the thermal conditions and airflow performance between the ceiling vented attic and the roof vented attic. Comparison was also made while varying the size of the soffits vent. The predicted temperature field showed the existence of thermal stratification for all the configurations and symmetric airflow patterns. The results showed that increasing the vents size gives rise to higher attic cooling load but barely affects the ventilation airflow while vent positions have higher effect on air ventilation and attic cooling load. For effective passive cooling in dry season, it was recommended that a ridge vent in combination with small vent be used.

Sahabudin Latiff *et.al.*, (2019) numerically investigated the heat ventilation of a traditional home attic of Buginese in a hot and humid tropical climate using Computational Fluid Dynamic (CFD) models. They used Solid works flow simulation software to determine the breakdown of steady flow conditions. Based on the numerical simulation, results were obtained and presented for temperature distribution, air flow pattern, indoor turbulence characteristics, dynamic pressure etc. It was mentioned that stack effect lowers the attic temperature by increasing the airflow through the attic space. In the year 2020, Jeffrey I. Kindagen and Octavinus H. Rogi (2020) examined the benefits of attic ventilation in zinc roofed building and determined the existence of roof ventilation and thermal comfort conditions of residents. This examination was achieved by construction and comparison of two (2) similar test cells in which one had roof ventilation and the other without roof ventilation. The air temperature in the test cell with roof ventilation is always lower than that without roof ventilation.

Recent developments in the attic ventilation strategies present a combination of attic ventilation with other strategy to improve on the existing attic ventilation strategies. Dongliang Zhao *et al.*, (2019) introduced a new roof-integrated radioactive air-cooling system with attic ventilation to reduce the attic temperature. Experimental tests showed that sub-ambient air cooling is achieved throughout 24-hour day-and-night-cycle in a summer day with clear sky conditions. Taswal Kumpurapun *et al.*, (2016) investigated the performance of a new attic ventilation concept using low-cost Thermo-electric (TE) modules. The incident solar radiation heats up roof tiles thus creating temperature difference between tiles and attic space. Using the temperature difference, laboratory made low-cost thermo-electric modules, assimilated as roof tiles, could produce an electric current to drive a fan for attic ventilation. It was found that TE tiles could induce an air ventilation rate of about 100-250 m³/h. The average daily percentage of total rate of heat gain reduction through the ceiling during 9 – 17 hr was about 14 -18%. The heat accumulated in the roof tiles was used to generate electricity for ventilation. In the case of Garth's PhD dissertation, he presented a valved soffit vent technology having the capacity of depressurizing the attic space when strategically positioned in areas of wind-induced negative pressure (wind separation zones). Valved soffit vents (VSVs) facing the approach flow are activated by wind-induced positive pressure and close for wind speeds greater than 30mph (about 48m/s) thereby preventing air intrusion and wind-driven rain into the building. Results for various wind directions showed that the net mean pressure coefficient on the gable and hip roofs increased, generating less suction on the roof envelop in the case of soffit opening with VSVs than that for soffit openings without VSVs. The hip roof with VSVs yielded an increase in net mean pressure of more than 90% on roof sheathing above the windward vents. The research gap identified in the above researches is that none of the studies was conducted in Minna, Niger State and most materials used for the studies are different from materials that can be locally sourced in the building industry of the North Central Zone.

Materials and Method

Materials

The materials used for the construction of the model of this research are cement, water, sand, sand Crete blocks, wood, corrugated zinc roofing sheet, ceiling materials (improved asbestos), hand trowel, spirit level (plumb), measuring tape, vernier caliper, digital anemometer, infra-red thermometer. Ansys, AutoCAD and sketchup softwares.

Method

A model room was constructed with window openings on opposite side walls and a door opening on one wall with the gable. The orientation of the model was such that the walls with the windows openings (which also have the soffit vents) were perpendicular to the North-East or windward directions. The model was sited around coordinate 9.53417°N, 6.4493°E within the Mechanical Engineering Department of Federal University of Technology, Minna Nigeria. The model has ground dimensions of 1.2m x 1.2m (in to in) and a height of 2.3m from ground to top of the roof, which is approximately a ratio of 1:3 for a standard building dimension. The pitch of the roof has a slope of 40 degrees and is

oriented both North-East and South-West which are the windward directions.

The attic had venting that meets ventilation ratio of 1ft² of soffit vent to 150 ft² of attic area (1:150) recommendation, this venting is provided with soffit vents and corresponding outlet vents area to ensure the air flow into the attic equals air flow out of the attic space. The soffit vents were carefully installed to fit tightly against the vented surface and tightly between the exterior wall and the fascia board. The net free vent area was calculated and applied to estimate the inlet and outlet vents sizes for fully open, half closed and fully closed configurations.

Area of attic floor = 1,200mm X 2,100mm

Adopting 1 unit of venting per 150 units of attic floor area, we divide the area of (attic) floor by 150.

Hence,

$$\text{Net Free Vent Area} = \frac{1200 \times 2100}{150} \text{ (mm}^2\text{)}$$

$$\text{NFVA} = 16800 \text{ mm}^2$$

In order to distribute the ventilation evenly and applying 2Nos soffit vents on each windward direction, NFVA / 2

$$\text{NFVA for each vent} = \frac{16800}{2} \text{ (mm}^2\text{)}$$

Therefore, NFVA for fully open configuration = 8400 mm² or 200mm by 42mm.

Temperature measurements were taken in the last quarter of the month of April 2024 from 12pm to 5pm for fully open, half closed and fully closed. Plate I shows the model for investigation with soffit and outlet vents fully open while figure 1 shows the location and dimensions of the vents.



Plate I: Model of the attic space for investigation

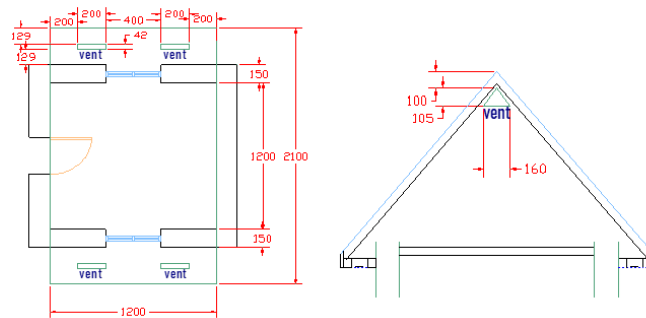


Figure 1: Inlet and Outlet Vents locations and dimensions in millimeters

Table 1. Temperature Data collection for fully open vents

Time	Location	North Wall (°C)	South Wall (°C)	Middle (°C)	West (°C)	East (°C)
12:00PM	Internal	40	42	42	40	40
	External	36.8	40.5			
1:00PM	Internal	42	43.5	44	42	41
	External	41	42.1			
2:00PM	Internal	42.5	44.5	45	43	42
	External	44	41.7			
3:00PM	Internal	44	44	45	44	43
	External	47.3	42.5			
4:00PM	Internal	42	42	43	41	40
	External	48.6	41.1			
5:00PM	Internal	43	43	42	40	39
	External	49.8	40.1			

Results and Discussion

A summary of the simulation and experimental data collected were represented in both tabular (tables 2&3) and graphical forms (figures 2&3). Results show that the case of fully closed vents has the highest temperature at all points tested for the simulation results but for the experimental results, had lowest temperature until about 2.00pm before the temperature surpasses those of fully open and half open vents configurations. This is an indication that the attic is cooler at sun rise and hotter at sun set.

Table 2: Simulation Temperature Values

Point Number	Coordinates	Fully Closed (°K / °C)	Half Closed (°K / °C)	Fully Open (°K / °C)
1	0, 0.6, 0.6	326.016	320.234	318.256
		(53.016)	(47.234)	(45.256)
2	0,0.6, 1	324.814	320.223	318.752
		(51.814)	(47.223)	(45.752)
3	0, 0.6, 0.2	324.814	320.465	318.326
		(51.814)	(47.465)	(45.465)
4	0.6, 0.6, 0.6	327.936	325.974	325.313
		(54.936)	(52.974)	(52.313)
5	-0.6, 0.6, 0.6	327.856	320.553	317.309
		(54.856)	(47.553)	(44.309)
6	0.6, 0.2, 0.6	325.508	320.389	318.919
		(52.508)	(47.389)	(45.919)
7	-0.6, 0.2, 0.6	325.482	320.389	318.031
		(52.482)	(47.389)	(45.031)

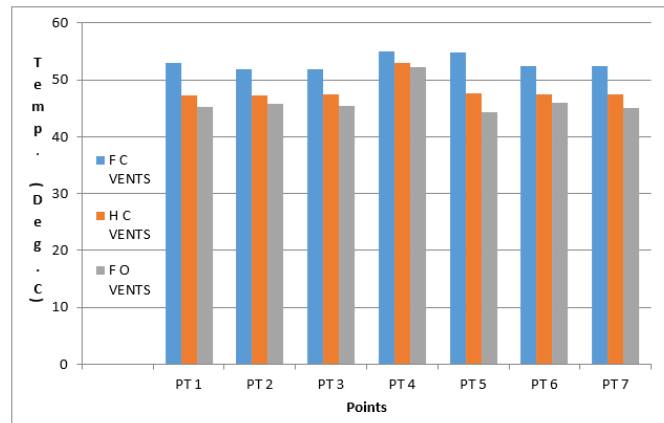


Figure 2: Simulation temperatures against points

Table 3: Experimental Temperature Values

Time	Fully Closed (°C)	Half Closed (°C)	Fully Open(°C)
12.00PM	39	44.5	42
1.00PM	41	45	44
2.00PM	45.6	45.7	45
3.00PM	50	46.5	45
4.00PM	48	45.8	43
5.00PM	46.8	44	42

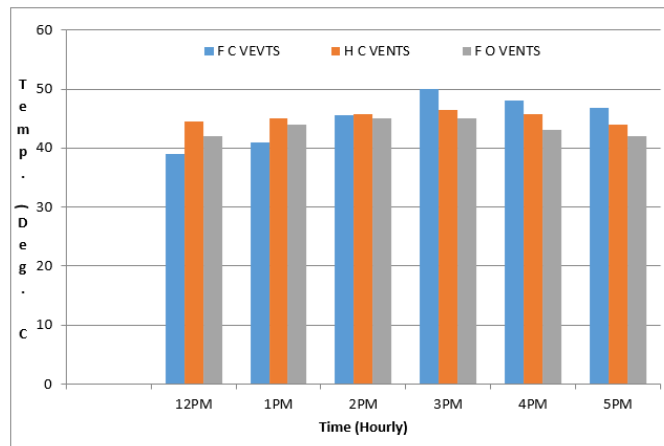


Figure 3: Experimental temperatures against time

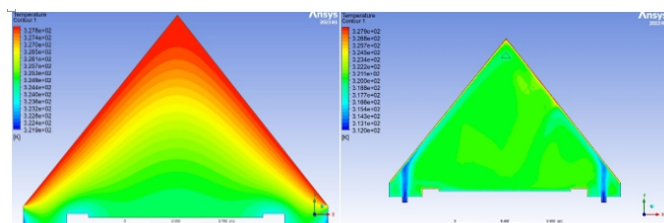


Figure 4: X-Y Plane Temperature Contours for fully closed and half-closed vents.

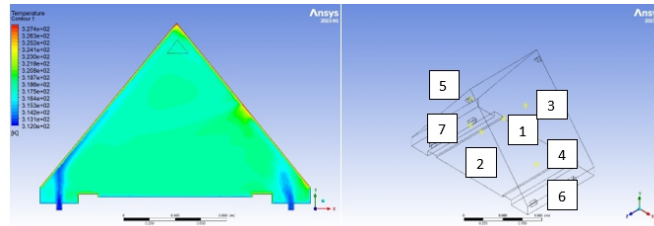


Figure 5: X-Y Plane Temperature Contours for fully opened vents and 3D temperature locations

In order to validate the experimental data collected, the simulation results in figures 4 and 5 show that the fully opened vents configuration has the lowest temperature distribution as indicated in the legend with light-green colour. The shade of green in the half-closed vent configuration shows the temperature distribution is higher than that of the fully opened configuration. Finally, the fully closed vents configuration has the highest temperature distribution within the attic space as evident in the red, yellow, and green strata in the 2D graphical representation presented in figures 4.

Conclusion

The analysis and simulation of temperature distribution around the attic space for different vent sizes were carried out. Analysis shows that the introduction of soffit and outlet vents reduce the attic temperature. In the experimental simulation, the provision of soffit and outlet vents reduce the attic temperature by 5°C in the last quarter of the month of April 2024 and has capacity to reduce the heat buildup in the attic by 20°C in extreme summer weather condition. This experiment should be carried out in other summer months when the intensity of solar radiation is high to ascertain the effectiveness of the soffit / outlet vents in those months.

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EFFECT OF COMMUNITY POLICING STRATEGY IN COMBATING BANDITRY IN TAKUM LOCAL GOVERNMENT AREA OF TARABA STATE, NIGERIA

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Abstract

The study assessed the effect of Community Policing in combating Banditry in Takum Local Government Area of Taraba State, Nigeria. The work adopted a documentary and survey research method. The main instrument for data collection was the secondary data which was completed by primary sources. The method of data analysis was the adoption of simple frequency conversion to percentages. After data collection, presentation and analysis, the study finds out that community engagement has helped reduce banditry activities, address root causes of banditry, empower local communities, and improve security and safety in Takum Local Government Area and joint patrols have increased police visibility, improved community-police relations, and contributed to the apprehension of criminals and reduction of banditry activities in Takum Local Government Area. Based on the followings, the study suggest that the local authorities and law enforcement agencies should establish or strengthen existing community-led security forums. These forums can serve as platforms for residents to actively participate in identifying security challenges, brainstorming solutions, and working collaboratively with law enforcement agencies to implement these solutions. Also, it was further recommended that law enforcement agencies and community stakeholders should collaborate to plan and execute regular, targeted joint patrol operations in areas identified as hot spots for banditry activities. This approach not only enhances police visibility and deterrence but also strengthens community-police relations by involving community members in the planning process.

Keyword: *Community Policing, Banditry, Combating, Community engagement, Joint patrols, Community intelligence gathering, Crime Prevention.*

Introduction

Community policing has gained traction worldwide as an effective strategy to maintain law and order, prevent crime, and build trust between police and communities (Oliver, 1998; Tyler, 1990). Its approach, which encourages collaboration between police and citizens, has been adopted in various countries to address diverse security challenges, including banditry. In the context of Nigeria, banditry poses a significant threat to national security, accounting for about 40% of the country's insecurity challenges (Akinlabi & Adesote, 2023). The problem is multifaceted, involving various crimes such as kidnapping, cattle rustling, and sexual violence. As a response, community policing has been implemented to engage local communities in combating banditry (International Crisis Group, 2020).

The introduction of community policing models has shown promising results in enhancing police-community relations and addressing security challenges in Nigeria (Akinlabi & Adesote, 2023). This approach has also gained ground in other regions, such as the Global South, where it has contributed to reduced crime rates and improved trust between police and citizens (Sindi, Roque, & Maguire 2021).

However, challenges persist in the effective implementation of community policing, particularly in developing countries. These include a lack of resources, inadequate training, and limited cooperation between police and communities (Community Policing in the Developing World, 2018). To overcome these obstacles, it is crucial to strengthen partnerships between police, citizens, and other stakeholders and provide the necessary support to facilitate successful community policing initiatives.

Community policing has been identified as a viable strategy to tackle the menace of banditry in Nigeria (Akinlabi & Adesote, 2023; Garba, 2023). By fostering collaboration between law enforcement agencies and local communities, community policing enhances intelligence gathering, which is crucial in preventing and responding to banditry attacks (Akinlabi & Adesote, 2023). The effectiveness of community policing in combating banditry can be attributed to the following factors:

- i. Improved trust between police and community members, leading to increased willingness to share information about potential threats (Garba, 2023).
- ii. Increased police presence and visibility, which serves as a deterrent to potential criminals (Akinlabi & Adesote, 2023).
- iii. Enhanced community involvement in decision-making processes and problem-solving strategies.
- iv. However, challenges such as inadequate resources, limited training, and mistrust between police and communities can hinder the effectiveness of community policing efforts.

From a Nigerian perspective, community policing has been recognized as a vital strategy in combating banditry, which has been a persistent issue in the country, particularly in

the northwestern region (Garba, 2023; Akinlabi & Adesote, 2023). This collaborative approach between law enforcement and local communities aims to address the root causes of banditry and enhance public safety through active citizen participation. Community policing has been identified as a crucial strategy in combating banditry in Nigeria. According to the Nigerian Police Force, community policing involves partnering with local communities to prevent crime and improve public safety through collaborative efforts between law enforcement officers and community members. This approach allows for greater communication and trust between the police and the community, leading to more effective crime prevention and control.

Improved intelligence gathering and information sharing, as community members are more likely to report suspicious activities and provide valuable insights into local security challenges (Akinlabi & Adesote, 2023). Greater trust between police and citizens, leading to increased cooperation and support for law enforcement efforts (Garba, 2023). Enhanced police-community problem-solving capabilities, as local communities are empowered to address security issues proactively (Alemika, 1988). Despite these benefits, community policing in Nigeria faces challenges such as inadequate funding, limited police training, and lingering mistrust between police and communities (Akinlabi & Adesote, 2023; Alemika, 1988). To maximize the potential of community policing, it is essential to address these challenges and promote strong partnerships between law enforcement and local communities.

Nigerian perspective on community policing underscores its importance in addressing banditry and other security challenges. By fostering collaboration and trust between police and citizens, this approach has the potential to significantly enhance public safety and reduce the prevalence of banditry in the country.

Community policing was initially introduced in Nigeria in 2003 with Enugu State piloting its first operation. The pilot project had six goals and was carried out by CLEEN Foundation with support from the USA and UK governments. The overall objective of the project was to introduce community policing to the people; foster civil society partnerships; improving inter and intra communications with host communities; provision of adequate resources and infrastructure towards security; improve leadership and management capacities within the rank and files of the police force and reduce violent crime and fear of crime (Van der Spuy and Ronstsch, 2018). Since its operation in 2004, community policing has been implemented in many other states of the federation.

According to Akinlabi & Adesote, (2023), the objectives and aim of Community Policing is to: Provide an atmosphere in which the police and law-abiding citizens can work in partnership to: solve problems; share resources; prevent crime; promote inter-agency collaboration; bring offenders to justice; reduce conflict; and improve the overall quality of community life. "Consequently, Community Policing is in everyone's interest as it enables a peaceful, secure and investment-friendly environment that promotes

development and improves livelihoods. Community Policing is founded on the democratic principle that the police are entrusted by their fellow citizens to protect their fundamental rights to liberty, equality and justice under the law. To fulfil this privileged role, the police must be a part of the communities they serve. Moreover, this positive police-community relationship, based on mutual trust and respect, encourages community members to accept their own share of responsibility for the overall quality of life in their neighbourhood.

Community policing in Nigeria has aided the Nigeria police and other security agencies in crime prevention in each areas as a result of the cordial relationship between the community people on security and security agencies which has aided them to cut down evil perpetrators/criminals in various societies. However, the success of community policing depends on addressing the challenges that impede its effective implementation. These include inadequate funding, limited police training, and lingering mistrust between police and communities. Efforts must be made to strengthen partnerships between law enforcement and local communities, provide the necessary resources, and promote transparency and accountability in policing practices. Thus, community policing offers a promising solution to the problem of banditry in Takum Local Government Area of Taraba State. By learning from the experiences of other regions and addressing the challenges that hinder its effectiveness, it is possible to enhance the security and well-being of local communities and promote a safer environment for all. Thus, there is a need for this study to assess the effect of community policing in combating banditry in Takum Local Government Area of Taraba State, Nigeria.

The criminal activities of armed bandits and kidnap gangs are the preeminent threats confronting us today. Their major activities include kidnapping and cattle rustling which are on the increase due to the high economic pay-off in terms of derivable financial benefits. They also thrive on the twin elements of fear and surprise and constitute a grave threat to personal security. Trend analysis suggests a correlation between armed banditry, militia groups, kidnapping and cattle rustling, in what appears to be a convergence of various illegal networks. This has led to loss of lives and property and ultimately undermines peace with grave implications for human security.

The North East region of Nigeria has been plagued by a persistent and devastating wave of banditry insurgency, characterized by a complex web of armed criminal activities, including kidnapping, armed robbery, cattle rustling, and attacks on civilians and security forces. This insurgency, exacerbated by socio-economic factors and regional instability, poses a significant threat to the safety, security, and stability of the affected state, specifically with Takum Local Government Area of Taraba. The persistent threat of banditry in Takum Local Government Area of Taraba State, Nigeria, has significantly impacted the safety and well-being of local communities. Banditry, characterized by violent attacks, kidnappings, and cattle rustling, has led to loss of life, displacement, and economic hardships for residents (Akinlabi & Adesote, 2023; Musa et al., 2021).

Community policing has been identified as a potential solution to address the issue of banditry in the region. However, there is a need to critically examine the effectiveness of community policing initiatives in combating banditry and identify factors that may hinder their success (Garba, 2023; Alemika, 1988)

Banditry has become a significant security challenge in Takum Local Government Area of Taraba State, Nigeria. The traditional law enforcement approach has not been effective in curbing this menace. The implementation of community policing is believed to be a viable solution to combat banditry in the area covering the period between 2016-2020. However, the effectiveness of community policing in addressing banditry in Takum LGA has not been adequately explored. Specifically this study attempts to use the following objectives.

- i. To find out the extent to which community engagement been able to combat Banditry in Takum Local Government Area of Taraba State.
- ii. To examine how effective has joint patrols been in preventing crime and promoting public safety in Takum Local Government Area.

Statement of Hypotheses

H₀₁: Community engagement has not been significant in combating Banditry in Takum Local Government Area of Taraba State.

H₀₂: Joint patrols has not been able to prevent crime and promote public safety in Takum Local Government Area.

Literature Review

Conceptual Framework

Concept of Community Policing

The term community policing has been conceptualized in different ways by different Scholars. To Ikuteyijo and Rotimi (2012), community policing entails a community partnership in which people take active parts in ensuring a safe and secure environment. Stipak (1994) view community policing as a management strategy that promotes the joint responsibility of citizens and the police for community safety, through working partnerships and interpersonal contact. While Okafor and Aniche (2018) refers to community policing as a shift from a military inspired approach to fighting crimes to one that relies on forming partnership with constituents. The United States Department of Justice has also defined Community Policing as a Philosophy that focuses on crime and social disorder through the delivery of police services that includes aspects of traditional law enforcement as well as prevention, problem solving, community engagement and partnership (Docobo, 2005). Whichever way it is defined, community policing can be viewed as collaboration between members of the society and the law enforcement agency. It emphasizes proactive policing rather than reactive policing. It also aims at decentralizing the powers of the police force for effective crime management (Gbenemene and Adishi, 2017). All community policing comprise of three key components:

- a. They create and rely on effective partnerships with the community and other public private-sector resources;
- b. Apply problem-solving strategies or tactics to fighting crimes; and
- c. Transform the police organization and culture to support the philosophy of community policing.

Concept of Banditry

Conceptually, banditry is a derivative of the term bandit meaning an unlawful armed group terrorising people and confiscating their properties. It is synonymous with the establishment of gang groups who use small and light weapons to carry out attacks against people. In this regard, banditry could mean a set-up criminal activity deliberately designed and carried out for personal gains. Due to the complex nature of bandits' activities, Egwu (2016) in a restricted manner, described banditry as a practice of stealing cattle and animals from herders or raiding of cattle from their ranches. In the same vein, banditry is reflected in criminal escapades like cattle rustling, kidnapping, armed robbery, drug abuse, arson, rape and the brazen and gruesome massacre of people of agrarian communities with sophisticated weapons by suspected herdsmen and reprisal attacks from surviving victims, a development that has been brought to the front burner of national security (Uche & Iwuamadi, 2018). The term "bandit" comes from the Italian word "bandito", which means "outlaw". Bandits are typically members of outlaw groups that operate in remote areas, such as forests, mountains, or deserts. They often use violence to intimidate their victims and to protect themselves from law enforcement.

Evolution and Historical Development of Banditry

The meaning of banditry has been changing over time, space and circumstances. A bandit in the 19th century Europe and Americas was a freedom fighter whose aim was partly to ensure the emancipation of the downtrodden from the upper class or colonised over the colonizer (Warto, 1994). Furthermore, bandits like Chucho el Roto, Herachio Bernel and Santanon were often celebrated as heroes of Mexican independence (Robinson, 2009). Therefore, Mexicans have warm regards and respect for those "social workers" termed bandits, while on the contrary, the State often considered them as nuisance and outlaws that need to be eradicated (Watts, 1987). Therefore, in some pre-industrial societies, peasants see bandits differently from the State not as outlaws, hoodlums and miscreants but as avengers and bread winners. However, a bandit in traditional African setting is entirely opposite to that of America and Europe. The former specialised in armed robbery and other related crimes (Curott & Fink, 2008). The most common feature of banditry in Africa has been maiming, killing and wanton destruction of property, hence, it has a direct relationship with cattle rustling (Rufa'i, 2018). Since most herdsmen could do anything possible to prevent the rustling of their herds, then the bandit also apply force with the aid of Small Arms and Light Weapons (SALWs) to effect the stealing of livestock (Addo, 2006). Hence, the application of force during livestock theft is what is herein considered cattle rustling and armed banditry (Murtala, 2018).

From historical perspective, however, banditry is not something novel to West Africa. Its origin and development are as old as the sub-region itself dating back to inter-tribal periods characterised by conflicts and wars over scarce economic resources and territorial expansion for political influence. Most parts of Africa experienced these forms of conflicts during the slave trading, colonial, and post-colonial periods. Though there have been remarkable changes on the nature and pattern of banditry and other forms of conflicts in West Africa, the socio-economic and political reasons remain significant in explaining the prevalence of the phenomenon in the sub-region (Abdullahi, 2019). Perhaps, this explains why the struggle for political independence and the subsequent establishment of the post-colonial state in West Africa were considered as some of the major events which shaped the pattern of banditry in the sub-region. It also suggests that socio-economic and political realities could be used to explain the intensity, prevalence, and the dynamics of banditry as evident in different parts of West Africa. For instance, in Tillaberi and Tahoua region of Niger Republic, banditry such as cattle and sheep rustling as well as the killing of innocent citizens in border communities has a strong connection with the general poverty situation of the people arising from poor governance of the country (Abdullahi, 2019).

In Mali, the evolution and development of banditry have been related to religious extremism by sectarian religious groups but further aggravated by weak state institutions as it relates to service delivery. According to United Nation Office for West Africa and the Sahel report (2018), weak state institutions, insurgency, and lawlessness have pushed more pastoralists into religious extremism, leading to rising in bandits' activities in northern Mali. The frequency of bandits' activities has created tensions between farmers and herders as well as exacerbated the proliferation of armed groups in different regions of Mali (Abdullahi, 2019).

However, in Mauritania, trans-border banditry by the local groups as well as challenges relating to resource management and distribution of pastoralists' lands explain the nature and pattern of rural banditry in the country. Unlike Mali and Niger, competition over resources, particularly water resources, pasture, and animal feeds led to a rapid increase of banditry in Mauritania (UNOWAS, 2018). Similarly, livestock theft is becoming a trans-border criminal activity affecting movement and relations along Burkina Faso and Ghanaian border. Local bandit groups mostly Burkinabe connived with traditional elites to rustle livestock and share the proceeds of their criminality (Abdullahi, 2019).

In Nigeria, it is pertinent to note that banditry is not novel. Anecdotal and scholarly accounts have it that the phenomenon predated Nigeria's emergence as a political entity. In this regard, Jaafar (2018) opines that there were recorded instances of banditry in the colonial Nigeria as far back as the 1930s. Putting this claim in a sort of historical perspective, Jaafar explains:

In those days, wayfarers and merchants travelling along our local economic roads usually faced the threats and dangers of ambush from nondescript bandits. Armed bandits and

criminals were known to be targeting goods ferried on the back of donkeys, camels and ox carts. Those bandits on our trade routes would forcefully take those goods and disappear into the bush. That is just one dimension of the problem then. In other instances, the bandits would sometimes raid farming communities and villages with the intent of willful killing and wanton destruction of property. During such raids, the bandits would destroy virtually everything in their path, including valuables, farm produce, etc. This subculture has been in existence even before the coming of colonialists to the territories of northern Nigeria (Jaafar, 2018, p.2).

In reference to the northwestern Nigeria, The Humanitarian (2018) avers that the region has a long history of banditry. The first recorded case occurred somewhere between western Hausaland and the Niger border in 1901, when a 12,000 strong camel train laden with assorted grains was attacked and 210 merchants killed. Although banditry is as old as Nigeria, it has nevertheless gradually transformed in scope and dimension overtime from its rudimentary phase, as affirmed by the foregoing Jaafar's citation, to a more complex and complicated pattern of criminality (Centre for Democracy and Development, 2015; Egwu 2016).

The modern transformation of banditry could be understood against the backdrop of the prevailing security dialectics in Nigeria. Accordingly, gangs of criminal, often youth from farming and herding communities and/or local bandits, take advantage of the growing insecurity, fear and cyclical attacks to loot villages, engage in highway robbery, and rustle cattle for personal gain. Both farming and herding communities often suffer from this criminality (Bagu and Smith, 2017; Okoli & Ugwu, 2019).

Community policing in Nigeria

In the Nigerian traditional setting, community policing has been existing prior to colonial era. This structure of policing is not new to Nigeria, for instance, pre-colonial Nigeria had its own form of community policing long before the advent of Colonial rule and trending even after Nigeria independence in 1960 (Inyang & Abraham, 2013). Community policing enhances cooperation between formal policing and informal policing and problem-solving approaches aimed at improving the relations between the security agencies and the community and to subsequently improve quality of police services, notably reduced crime levels. The Nigeria police in 2004 embraced community policing as a pragmatic approach to police reforms. The stage was indeed set for a clear departure from traditional policing, that was reactive and incident based, to a problem – solving oriented policing that is proactive with the community as the cornerstone of policing objectives (Alemika & Chukuma, 2007).

Like other nations of the world, community policing was adopted in Nigeria to overcome the inherent shortcomings of the purely reactive/traditional policing approach. Integrating many policing concepts into its operation, community policing had the mandate of conducting:

1. Massive onslaught against robbers, gruesome murder, assassination and other crimes.
2. Fast decisive crime/ conflict management.
3. Community partnership in policing and
4. Anti-corruption campaigns.

It also has the goal of conducting comprehensive training programme for officers of the police force and improve the conditions of service of officers (Gbenemene and Adishi 2017). The essence of this mandate was to ensure transparency and accountability in the fight against crimes, upgrade intelligence on crime and improve the public image and relations of the police.

Activities of Bandits in Takum Local Government Area

The activities of bandits in Takum Local Government Area of Taraba State have been a cause of concern for the local population and the government. Here are some of the activities of bandits in the area:

- i. **Kidnapping for ransom:** Bandits in Takum LGA have been known to kidnap people for ransom, targeting both locals and travelers passing through the area (Amos, 2021).
- ii. **The proliferation of small arms and light weapons:** This has contributed to the increase in banditry activities in Takum LGA and other parts of Nigeria (Lekwot and Yohanna, 2020).
- iii. **Cattle rustling:** The bandits engage in cattle rustling, stealing livestock from farmers and herders in the area. This has led to a significant loss of livelihood for many families (Idowu and Adekola, 2021).
- iv. **Armed robbery:** Bandits have been reported to carry out armed robberies on major roads and in villages, causing fear and insecurity among the residents (Abdulaziz and Usman, 2021).
- v. **Destruction of properties:** Bandits have also been involved in the destruction of properties, including homes, farms, and other infrastructure, which has contributed to the displacement of people in the area (Adejumo and Oguntola, 2021).
- vi. **Interference with economic activities:** The activities of bandits have disrupted economic activities in Takum LGA, including farming, trading, and other businesses, leading to poverty and unemployment (Youth Unemployment: The Cause of Ethnic Conflict and Criminal Activities in Takum LGA of Taraba State, Nigeria).

Effect of Community Policing on Banditry in Takum Local Government Area

Several studies have examined the effect of community policing on banditry in Takum Local Government Area. Community policing has been shown to have a positive impact on reducing banditry activities in Takum LGA, with community members playing a key role in identifying and reporting criminal activities (Abubakar, Usman, & Abdulaziz, 2021). A study found that the implementation of community policing in Takum LGA led

to a significant reduction in the number of reported banditry incidents, as well as an increase in public trust in the police (Usman & Abdulaziz, 2022).

Another study found that community policing initiatives in Takum LGA have helped to improve the relationship between the police and local communities, leading to increased cooperation and collaboration in addressing security challenges (Sadiq & Musa, 2022). Community policing has been shown to have a positive impact on reducing banditry in various communities, including Takum Local Government Area. In community policing, law enforcement agencies work closely with community members to prevent and address crime, build trust and partnerships, and improve overall safety and security.

One study by Bayley and Mendelsohn (2017) in their research on community policing in Nigeria found that community policing programs have been effective in reducing crime rates, including banditry, by enhancing collaboration between law enforcement agencies and communities. This collaboration helps to identify and address underlying issues that contribute to crime, such as poverty, unemployment, and lack of social services, ultimately leading to a decrease in banditry.

Another study by Okafor (2019) also highlighted the positive impact of community policing on reducing banditry in Nigeria. The study found that community policing programs were able to improve intelligence gathering, boost community participation in crime prevention activities, and enhance trust between law enforcement agencies and community members, leading to a decrease in banditry incidents.

Furthermore, a study by Olugbade and Ogunlade (2020) explored the effectiveness of community policing in curbing banditry in Nigeria. The study found that community policing initiatives have been successful in enhancing information sharing, increasing police visibility in communities, and strengthening crime prevention efforts, all of which contribute to a reduction in banditry activities.

However, some studies have also identified challenges in implementing community policing in Takum LGA, including limited resources, lack of training for police officers, and resistance from some community members (Bukar & Mohammed, 2021).

Community Policing Strategies in Takum Local Government Area

There are several community policing strategies that have been implemented in Takum Local Government Area. Here are some of the key strategies:

- i. Regular engagement with community members:** Police officers in Takum should regularly engage with community members through meetings, community forums, and outreach programs to build trust and establish positive relationships with residents (Greene, 2017).
- ii. Collaborative problem-solving:** Police officers should work together with community members to identify and address issues affecting the local area, such as crime, violence, and substance abuse (Saddler, 2019).

- iii. **Community patrols:** Police officers should conduct regular patrols in the community to deter crime and provide a visible presence to reassure residents (DeFrancesco, 2018).
- iv. **Youth engagement programs:** Takum Police Department should develop and implement programs that aim to engage young people in positive activities, such as sports, mentoring, and educational programs, to prevent juvenile delinquency and build relationships with the next generation of community members (Anderson, 2016).
- v. **Community policing partnerships:** Police officers should collaborate with local NGOs, government agencies, and community organizations to develop and implement effective crime prevention initiatives and promote community safety and well-being (Zhang, 2019).
- vi. **Community engagement:** One of the key strategies of community policing in Takum LGA is to engage with local communities to identify their security needs and priorities (Abubakar et al., 2021).
- vii. **Joint patrols:** The police in Takum LGA have implemented joint patrols with community members and other security agencies to deter and detect criminal activities (Sadiq & Musa, 2022).
- viii. **Community intelligence gathering:** The police in Takum LGA have established mechanisms for gathering intelligence from community members to identify potential threats and plan appropriate responses (Usman & Abdulaziz, 2022).
- ix. **Community education:** The police in Takum LGA have conducted community education programs to raise awareness about crime prevention and security (Bukar & Mohammed, 2021).
- x. **Community-based conflict resolution:** The police in Takum LGA have worked with community leaders and other stakeholders to resolve conflicts and prevent escalation of violence (Abdulaziz & Usman, 2021).

Empirical Review

Community policing has become an increasingly popular approach to addressing crime and insecurity in many parts of the world. In Takum Local Government Area, the implementation of community policing strategies has been seen as a potential solution to the problem of banditry, which has become a major security challenge in the area. This empirical review seeks to examine the available evidence on the effectiveness of community policing in combating banditry in Takum LGA.

From a review conducted by Usman & Abdulaziz (2022), on the impact of community policing on public trust in the police in Takum LGA. The theoretical framework of the study is the social capital theory and procedural justice theory while its methodology is the survey research design, using questionnaires and interviews with community members and police officers. After the data analysis, the findings of the study show that, community policing has a positive impact on public trust in the police in Takum LGA. Thus, the study recommends the need for improved communication, collaboration, and trust-building between the police and local communities.

Akinyeme, (2021), study on Community Policing in Nigeria: Implications for National Peace and Security using a systematic review of literature which he observed the community policing in Nigeria has only been adopted in principle as full implementation of its tenets is yet to be practiced. Secondly, the challenges that confront the formal security framework of the country are yet to be addressed such that the required level of trust and partnership between members of the society and the police is to be achieved. The study, therefore recommend that if peace and security is to be guaranteed in Nigeria, a community policing devoid of politics and corrupt practices must be in place. This will help build the confidence level required for information sharing and crime fighting.

Bukar & Mohammed (2021), conducted a study to identify the challenges and constraints of implementing community policing in Takum LGA. Using systems theory and organizational behavior theory. Qualitative research design, using in-depth interviews with police officers, community leaders, and government officials. Findings from the study shows that community policing initiatives in Takum LGA are hampered by inadequate funding, lack of trained personnel, poor infrastructure, and low levels of public awareness. Recommendations shows the need for increased government investment in community policing initiatives, improved training and capacity-building for police officers, and greater engagement with local communities.

Abdulaziz & Usman (2021), explore the role of community-based conflict resolution mechanisms in combating banditry in northern Nigeria. Conflict resolution theory and restorative justice theory. Case study research design, using participant observation and in-depth interviews with community leaders and stakeholders in selected communities was used. After data analysis the findings reveled that community-based conflict resolution mechanisms have the potential to reduce banditry activities in northern Nigeria by addressing underlying grievances, improving trust and communication between conflicting parties, and promoting social cohesion and reconciliation. Recommendations was on the need for greater investment in community-based conflict resolution initiatives, improved coordination between formal and informal justice systems, and greater support for civil society organizations involved in peacebuilding activities.

Olugbuo and Igbokwe (2021), examine the impact of community policing on crime prevention in Nigeria. Using social disorganization theory and routine activity theory. The methodology was based on the systematic review of empirical studies on community policing in Nigeria. After which the study finds out that community policing has been effective in reducing crime rates in some areas, but its effectiveness varies depending on local conditions. It further recommends greater investment in community policing initiatives, improved training for police officers, and greater engagement with local communities.

Chukwuma and Okoli (2022), explore the role of community policing in addressing insecurity in Nigeria. Its theoretical framework was the community policing theory and social capital theory. The study adopted qualitative research design, using interviews and focus group discussions with police officers and community leaders. After the analysis of the data, the study finds out that community policing has the potential to improve security in Nigeria, but its effectiveness is limited by factors such as corruption, inadequate resources, and lack of trust between police and local communities. Also, it recommends greater emphasis on community engagement and participation in policing initiatives, improved accountability and transparency in the police force, and greater investment in community policing initiatives.

Nwankwo and Ezeh (2021), examine the impact of community policing on crime reduction in Nigeria. Community policing theory and social control theory were used. Quantitative research design, using secondary data analysis of crime statistics, was equally used in the study. Findings from the study show that community policing has had a modest impact on reducing crime rates in Nigeria, but its effectiveness varies depending on local conditions and the quality of implementation. As a way forward, the study recommends greater investment in community policing initiatives, improved training and resources for police officers, and greater emphasis on evidence-based policing strategies.

Aremu and Adeyemo (2022), explore the role of community policing in addressing the problem of banditry in Nigeria. Community policing theory and conflict theory were used. The study adopted mixed-methods research design, using surveys and interviews with police officers and community members. Findings show that community policing has the potential to address the problem of banditry in Nigeria, but its effectiveness is limited by factors such as corruption, inadequate resources, and lack of trust between police and local communities. The study suggested greater investment in community policing initiatives, improved training and resources for police officers, and greater emphasis on community engagement and participation in policing initiatives.

Okereke and Eme (2021), examine the impact of community policing on public safety in Nigeria. Community policing theory and social capital theory were adopted as its theory, while qualitative research design, using interviews and focus group discussions with police officers and community members, was used as its methodology. Findings from the study show that community policing has the potential to improve public safety in Nigeria, but its effectiveness is limited by factors such as corruption, inadequate resources, and lack of trust between police and local communities. The study recommends that greater investment in community policing initiatives, improved training and resources for police officers, and greater emphasis on community engagement and participation in policing initiatives.

Daniel, (2020). Community Policing Relations and Partnership Among Law Enforcement in 21st Century Crime Regulation, Prevention and Management,

Nasarawa State. Community policing relations and partnership among law enforcement aim at crime regulation and management in Nigeria with reference to Nasarawa state, Obi Local Government Area. The study sought to identify community policing and law enforcement in crime prevention; combating and the problems solving associates with community policing in crime prevention and partnership among law enforcement. Survey design was adopted and Questionnaire were administered. Frequency and percentages were used to describe the responses from respondents which shows that 3.56% was targeted sample from the population, out of 46 of the respondents, representing 29.5% described community policing as very effective mechanism of crime prevention in the study area. As well out of 45 respondents, 28 of the respondents representing 62.22% agreed quality information determined law enforcement and community policing responses on crime prevention. This implies that community policing is an appropriate tool for crime regulation and management. Chi-square based measure was used to examine the relationship between and among the variables and test of hypotheses. Analysis of the study revealed that community policing and police law enforcement in crime prevention has strengthen relationships of the community and the police amongst others. Furthermore, community policing and law enforcement in crime prevention faces inadequate funding, lack of enough physical structures, poor management and logistics to be some of the major problems affecting community policing and police crime prevention. The study concludes and recommends that community policing and law enforcement should be strengthening to curb crime in the society. There should also be motivation to enhance effective management of crime and collaboration between the police and community.

From the reviewed empirical studies on the effect of community policing in combating banditry in Nigeria, several research gaps can be identified: Most of the reviewed studies are cross-sectional in nature, providing a snapshot of the situation at a particular point in time. There is a need for longitudinal studies to examine the long-term impact of community policing on banditry and public safety. None of the reviewed studies examined the effect of community policing strategy in combating banditry in Takum Local Government Area of Taraba State, thus the gap this study will fill. It will look at the community engagement and joint patrols strategy as a strategy in combating banditry in the State.

Theoretical Framework

This paper adopted Queer Ladder Theory (QLT) as its analytical frameworks. The origin of Queer Ladder Theory (QLT) is associated with an American sociologist, Daniel Bell (1919-2011), who coined the idea of 'queer ladder' in an attempt to explain the instrumental essence of organised crime as a desperate means of socio-economic empowerment and social climbing. This theoretical perspective has since fertilised into a popular theoretical framework widely used in contemporary crime studies. The basic assumptions of QLT are; organised crime is an instrumental behaviour, it is a means to an end; it is an instrument of social climbing and/or socioeconomic advancement; and it is a measure to accumulate wealth and build power (Mallory, 2007; Okoli & Orinya, 2013).

Often ascribed to Queer Ladder Theory is the notion that organised crime thrives in contexts where the government's capacity to dictate, sanction and deter crime is poor; where public corruption is endemic; and where prospects for legitimate livelihood opportunities are slim (Nwoye, 2000; Lyman, 2007). Under these circumstances, the incentive to indulge in crime is high, while deterrence from criminal living is low. In other words, the benefits of committing a crime surpass the costs and/or risks involved. This creates pretext for criminal impunity and franchise (Okoli & Orinya, 2013).

Applied to the context of this paper, QLT enables one to come to terms with the prevalence of organised crime in Northwest region of Nigeria. In this regard, it is observed that the phenomenon of banditry in Northeast Nigeria has been driven by criminal quest for economic accumulation in an environment. This has been worsened by the prevailing socio-economic discontent and attendant livelihood crisis in the state, in addition to the seeming indolence of relevant government agencies towards arresting the ugly situation. The concept of "Ladder" in QLT signifies untoward pattern of social mobility. Hence, those who take to organised crime, such banditry, do so as a desperate means of economic accumulation and socio-economic empowerment (Mustapha, 2019). Therefore, a necessary consequence of this trend is prevalence in crime rate and a state of insecurity (Okoli & Orinya, 2013).

Methodology

The method adopted for this study is therefore documentary and survey method. The study was carried out in Takum Local Government Area of Taraba. This LGA had a population of 135,349 persons from the 2006 Nigeria Census. The projected figures for this Local Government Areas as at 2023 at 2.9% was 211,700. The major economic activity is farming as over eighty per cent of the populations are engaged in farming (NPC, 2023). Thus, the population of this study is 211,700. The respondents were purposely sampled because of their participation and experience with the activities of the bandit and the community policing strategy in the selected local government area.

The technique used in drawing the sample size is Taro Yamane (1967) formula defined as:

$$n = \frac{N}{1+N(e)^2}$$

Where n = sample size

N = total population size

1 is constant

e = the assume error margin or tolerable error which is specified as 5% (0.05) in this study.

$$n = \frac{N}{1+N(e)^2} = \frac{211,700}{1+211,700.(0.05)^2} = \frac{211,700}{529.2525} = 399.9$$

The questionnaires were distributed in such a way that both the people in the community policing and the respondents from the various wards in Takum Local Government Areas of Taraba State were represented and captured. Bases on this distribution sample size, the questionnaires were distributed in such a way that the entire respondents were represented and the Purposive Sampling Techniques, was used to select the different categories of the respondents to include; 100 respondents each from three (3) wards of the Local Governments, 50 principal officers from the Local government Area while the remaining 50 respondents will be drowning from the various ward leaders of the selected communities.

For the purpose of this research study, data will be collected from two main sources which are primary and secondary source of data.

Table 1: Analysis of Questionnaire Administered

Questionnaires	Data of Respondent	Percentage %
Questionnaires returned	327	81.75%
Questionnaires not returned	73	18.25%
Total	400	100%

Source: Field Survey, 2024.

As shown on the table, the first threshold shows that out of the 400 questionnaires administer and interviews conducted only 327 were returned representing 81.75% of the targeted population, while 73 questionnaires were not returned representing 18.25% of the entire study population.

Table 2: Opinions of respondents on whether Community engagement has helped in addressing the root causes of banditry in Takum Local Government Area

Option	Number of respondent	Percentage%
Strongly Agree	61	18.6%
Agree	140	42.8%
Strongly Disagree	66	20.1%
Disagree	11	3.3%
Undecided	49	14.9%
Total	327	100%

Source: Field Survey, 2024.

From the table 2 above, 61 respondents, representing 18.6% strongly agreed that Community engagement has helped in addressing the root causes of banditry in Takum Local Government Area, 140 respondents representing 42.8% agree with this, that community engagement has helped in addressing the root causes of banditry in Takum Local Government Area. However, 66 respondents representing 20.1% strongly disagree, also, 11 respondents, representing 23.3% disagreed that Community engagement has not helped in addressing the root causes of banditry in Takum Local

Government Area whereas 49 respondents, representing 14.9% were undecided on the statement.

Table 3: Responses on whether the community engagement increased collaboration between the police and local communities in combating banditry in Takum Local Government Area.

Option	Number of respondent	Percentage%
Strongly Agree	47	14.3%
Agree	40	12.2%
Strongly Disagree	66	20.1%
Disagree	153	46.7%
Undecided	21	6.4%
Total	327	100%

Source: Field Survey, 2024.

From the table 3 above, 47 respondents, representing 14.3% strongly agreed that community engagement increased collaboration between the police and local communities in combating banditry in Takum Local Government Area., 40 respondents representing 12.2% agree with this. However, 66 respondents representing 20.1% strongly disagree, also, a majority of 153 respondents, representing 46.7% disagreed that community engagement has not increased collaboration between the police and local communities in combating banditry in Takum Local Government Area whereas 21 respondents, representing 6.4% were undecided on the statement.

Table 4: Responses on the weather Community engagement has improved security and safety in Takum Local Government Area

Option	Number of respondent	Percentage%
Strongly Agree	117	35.7%
Agree	74	22.6%
Strongly Disagree	49	14.9%
Disagree	57	17.4%
Undecided	30	9.2%
Total	327	100%

Source: Field Survey, 2024.

From the above table 4, 35.7% of the respondents which are made of 117 respondents are of the view that community engagement has improve security and safety in Takum Local Government Area, 74 respondents, representing 22.6% agreed that community engagement has improve security and safety in Takum Local Government Area. On the other hand, 49 respondents, representing 14.9% strongly disagreed, 57 respondents representing 17.4% disagree while 30 respondents, representing 9.2% said were undecided on the issues.

Table 5: Record of documents showing the number of attacks by the bandit in Takum Local Government environs before and after the implementation of Community Policing in the LGA

S/N	Years Before	No. of Attacks	Years After	No. of Attacks
1	2016	19	2018 After July	5
2	2017	17	2019	13
3	2018 before July	8	2020	10

Source: Premium Times, 2024.

The data suggests that there has been a decrease in the number of bandit attacks in Takum Local Government Area and its environs following the implementation of community policing, although there are still ongoing security challenges.

Table 6: Record of documents produced by the Takum Local Government to show the level of collaboration between the Police and the Community in the Local Government Area before and after the implementation of Community Policing in the LGA

S/N	Years Before	No. of collaboration	Years After	No. of applicants
1	2016	4	2018 After July	18
2	2017	9	2019	35
3	2018 before July	2	2020	57

Source: Field Survey, 2024.

The data presented in Table 6 highlights the significant increase in collaboration between the Police and the Community in Takum Local Government Area (LGA) after the implementation of Community Policing. The table compares the number of collaborations between the Police and the Community in three years before Community Policing (2016-2018) and the subsequent three years following its implementation (2018-2020). In 2016, there were only 4 recorded collaborations, while in 2017 and 2018 (before July), there were 9 and 2 collaborations, respectively. After the introduction of Community Policing in July 2018, the number of collaborations began to increase significantly. In 2018 after July, there were 18 collaborations, followed by 35 in 2019, and 57 in 2020.

This data suggests that the implementation of Community Policing in Takum LGA has had a positive impact on fostering collaboration between the Police and the Community, with a notable increase in the number of collaborations over the three years following its introduction.

Table 7: Opinions of respondents on whether Joint patrols have been effective in reducing banditry rates in Takum Local Government Area.

Option	Number of respondent	Percentage%
Strongly Agree	40	12.2%
Agree	55	16.8%
Strongly Disagree	61	18.6%
Disagree	109	33.3%
Undecided	62	18.9%
Total	327	100%

Source: Field Survey, 2024.

From the table 7 above, 40 respondents, representing 12.2% strongly agreed that Joint patrols have been effective in reducing banditry rates in Takum Local Government Area, 55 respondents representing 16.8% agreed. However, 61 respondents representing 18.6% strongly disagree, also, a majority of 109 respondents, representing 33.3% disagreed that Joint patrols have not been effective in reducing banditry rates in Takum Local Government Area. whereas 62 respondents, representing 18.9% were undecided on this question.

Table 8: Opinions of respondents on whether Joint patrols have increased police visibility and public safety in Takum Local Government Area

Option	Number of respondent	Percentage%
Strongly Agree	51	15.5%
Agree	103	31.4%
Strongly Disagree	70	21.4%
Disagree	43	13.1%
Undecided	60	18.3%
Total	327	100%

Source: Field Survey, 2024.

From the table 8 above, 51 respondents, representing 15.5% strongly agreed that Joint patrols have increased police visibility and public safety in Takum Local Government Area, 103 respondents representing 31.4% agreed that Joint patrols have increased police visibility and public safety in Takum Local Government Area. However, 70 respondents representing 21.4% strongly disagree that Joint patrols have not increased police visibility and public safety in Takum Local Government Area, also, 43 respondents, representing 13.1% disagreed whereas 60 respondents, representing 18.3% were undecided on this question.

Table 9: Indices used to measure whether Joint patrols were effective in deterring potential banditry activities in Takum Local Government Area before and after the implementation of Community Policing in the LGA

S/N	Before Community Policing implementation	After Community Policing implementation
1.	Poor records of banditry incidents in the LGA	Strong and fast administrative process
2.	Poor response time to banditry incidents	Quick response time to banditry incidents
3.	Poor arrests and convictions related to banditry	Fast arrests and convictions related to banditry
4.	No resource allocation for joint patrols	Strong resource allocation for joint patrols
5.	So many Incident Hotspots	Few Incident Hotspots

Source: Field Survey, 2024.

Table 9 presents a comparison of various indices used to measure the effectiveness of joint patrols in deterring potential banditry activities in Takum Local Government Area before and after the implementation of Community Policing. The table highlights significant improvements across all indices following the introduction of Community Policing:

- i. **Record-keeping:** Before Community Policing, there were poor records of banditry incidents. After its implementation, there has been a notable improvement in administrative processes, leading to stronger and more efficient recordkeeping.
- ii. **Response time:** Prior to Community Policing, response times to banditry incidents were poor. After its introduction, response times have improved significantly, allowing for quicker action against potential threats.
- iii. **Arrests and convictions:** Before Community Policing, arrests and convictions related to banditry were inadequate. With the implementation of Community Policing, there has been a marked increase in the efficiency of apprehending and prosecuting offenders.
- iv. **Resource allocation:** Prior to Community Policing, there was a lack of resource allocation for joint patrols. After its implementation, there has been a notable improvement in allocating essential resources, such as personnel and equipment, to support joint patrol efforts.
- v. **Incident hotspots:** Before Community Policing, numerous banditry incident hotspots were present in the area. Following its implementation, the number of hotspots has decreased, indicating a reduction in banditry activities.

In summary, this suggests that Community Policing has been an effective strategy in enhancing the effectiveness of joint patrols and promoting overall safety and security within the region.

Test of Hypothesis

In this research work, chi-square statistics is model was used to test the hypothesis.

H₀₁: Community engagement has not been significant in combating Banditry in Takum Local Government Area of Taraba State.

H₀₂: Joint patrols has not been able to prevent crime and promote public safety in Takum Local Government Area.

In testing the hypothesis table 3 and 6, was used to test the stated hypothesis.

(A) Observed Frequently.

Variable	Strong Agree	Agree	Strong Disagree	disagree	Undecided	Total Responses
Responses on whether Community engagement has helped in reducing banditry activities in Takum Local Government Area.	69	168	45	34	11	327
Opinions of respondents on whether Joint patrols have been effective in reducing crime rates in Takum Local Government Area	40	55	61	109	62	327
Grand Total	109	223	106	123	73	654

Source: Underlying data from field survey 2024.

$$Fe = \frac{\text{Row total} \times \text{Column total}}{\text{Grand total}}$$

$$Fe = \frac{327 \times 109}{654} = 54.5$$

$$Fe = \frac{327 \times 123}{654} = 61.5$$

$$Fe = \frac{327 \times 223}{654} = 111.5$$

$$Fe = \frac{327 \times 73}{654} = 36.5$$

$$Fe = \frac{327 \times 106}{654} = 53$$

(B) Computation of (Chi-Square)

Fo	Fe	Fo- Fe	(Fo - Fe) ²	$\frac{E(-)^2}{}$
109	54.5	54.5	2970.25	54.5
223	111.5	111.5	12432.25	111.5
106	53	53	2809	53
123	61.5	61.5	3782.25	61.5
73	36.5	36.5	1332.25	36.5

Source: Field Survey 2024

$$DF = (Nr-1) (NC-1)$$

Where DF = Degree of freedom

Nr = Numbers of rows in contingent table

NC = Numbers of column in contingent table

DF = (Nr-4) (NC-6)

= (4-1) (6-1)

= 3 (5)

10 under 0.5 (level of significance)

=24.996

Decision Rule

The chi-square calculated above value is 317 On the other hand, using 0.05 level of significant tabulated chi-square value with 15 degree of freedom is 24.996. Therefore, we accept (Ho) and reject (Hi) The researcher can conclude that, the community engagement has been significant in combating Banditry, Joint patrols has been able to prevent crime and promote public safety in Takum Local Government Area.

Summary of Findings

From the data presentation and analysis, the following are the research findings:

- i. The study reveals that community engagement has helped reduce banditry activities, address root causes of banditry, empower local communities, and improve security and safety in Takum Local Government Area.
- ii. It was revealed by this study that joint patrols have increased police visibility, improved community-police relations, and contributed to the apprehension of criminals and reduction of banditry activities in Takum Local Government Area.

Conclusions

In light of the findings from the study, it is evident that community-driven strategies play a crucial role in addressing the challenges of banditry and promoting public safety in the Takum Local Government Area of Taraba State, Nigeria. The effectiveness of community engagement, joint patrols, community intelligence gathering, and community-based conflict resolution underscores the importance of fostering collaboration and active participation among community members, law enforcement agencies, and other stakeholders.

Community engagement empowers local communities and enhances security by encouraging residents to take an active role in identifying and addressing the root causes of banditry. This approach not only reduces criminal activities but also strengthens social bonds within the community. As such, continued support and investment in community engagement initiatives are essential to maintain and improve security in the region. Joint patrols, though demonstrating moderate success, offer opportunities for improvement in crime prevention and public safety. Enhancing police visibility and nurturing positive community-police relations contribute to a safer environment for all residents. By addressing the concerns of community members and refining joint patrol strategies, law enforcement agencies can foster greater trust and collaboration with the community, thereby further reducing banditry activities. The significance of community intelligence gathering cannot be overstated. By involving community members in the intelligence-

gathering process, law enforcement agencies can access accurate and actionable information, enabling them to take targeted action against criminal elements. This collaboration leads to improved security and fosters mutual trust between the community and law enforcement.

Lastly, community-based conflict resolution has shown promise as a sustainable solution to banditry-related conflicts. By addressing the underlying causes of conflict and fostering peaceful resolution, these initiatives promote social cohesion, peacebuilding, and an overall safer community. It is crucial to continue investing in community-based conflict resolution programs and adapt them to the specific needs of the region. In conclusion, the success of community-driven strategies in combating banditry and improving security in Takum Local Government Area highlights the importance of fostering collaboration and active participation among community members, law enforcement agencies, and other stakeholders. Continued support, investment, and enhancement of these initiatives will be vital in ensuring lasting improvements in the region's security and stability.

Recommendations

Based on the findings of the study, the following recommendations were made:

- i. It is recommended that local authorities and law enforcement agencies should establish or strengthen existing community-led security forums. These forums can serve as platforms for residents to actively participate in identifying security challenges, brainstorming solutions, and working collaboratively with law enforcement agencies to implement these solutions. This approach not only empowers community members but also fosters trust and collaboration between the community and law enforcement, ultimately leading to a safer and more secure environment.
- ii. Based on the study, it is recommended that law enforcement agencies and community stakeholders should collaborate to plan and execute regular, targeted joint patrol operations in areas identified as hot spots for banditry activities. This approach not only enhances police visibility and deterrence but also strengthens community-police relations by involving community members in the planning process. Additionally, regular evaluations of joint patrol operations can help identify successes, areas for improvement, and strategies to adapt to changing security challenges.

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FOREIGN DIRECT INVESTMENT, OIL SECTOR AND ECONOMIC GROWTH IN NIGERIA

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Abstract

The study examined the extent to which foreign direct investment in the oil sector influence economic growth in Nigeria. Although, it has been difficult to ascertain why foreign direct investment FDI in oil sector has not been able to measure up relative to other oil rich countries of the world. Nigeria has not been able to efficiently benefit adequately in these regards, it is on this premise that the work offers a practical means of addressing the phenomenon. The study covers the period 1970 -2022; the study is descriptive and quantitative in nature using statistical tools, trends, the Structural Vector Autoregression (SVAR), among other econometric models. The findings of the study showed a relationship among gross domestic Product, Foreign direct investment, oil exports, index of openness, employment and oil price. Finding showed that the lag value of gross domestic product has a positive but a statistically insignificant effect on economic growth in Nigeria. Oil exports have a positive and statistically significant impact on economic growth in Nigeria in the short-run. The analysis implies that a 1% increase in oil exports will lead to a 0.18% increase in economic growth in the economy. The paper concluded by recommended that Pragmatic mechanisms should be put in place to properly channel domestic technology, improve on local technology and co-engage foreign and local technology for on-the-job training among others.

Keywords: Oil export, Economic growth, foreign direct investment, exchange rate, inflation, employment.

Introduction

Foreign direct investment (FDI) is an important factor in the globalization process and in recent years has outpaced trade (Almsafir et al, 2011); It is also a vital component of the global economic system and a significant catalyst for the transfer of capital and human resources from one nation to another (OECD, 2017). Thus, foreign direct investment is a component of the economic system that promotes economic growth and infrastructural development. Developed and developing nations have in one way or the other provided incentives to encourage foreign direct investment in their economies (Melnyk, Kubatko, & Pysarenko, 2014); and many academics and policy makers report that foreign direct investment (FDI) can have significant favorable effects on the growth of a host economy along with doestic investment In addition to the funds it provides, foreign direct investment can be a source of useful technology and technical know-how that can improve links with local businesses, which can support economic growth.

Furthermore, it has been observed that since the early 1980s a number of nations have implemented regulations meant to promote foreign direct investment and loosen financial flow restrictions and as a result foreign direct investment rose to prominence as one of the key sources of cash flow and a driving force behind economic growth by improving the balance of payments and increasing cash flows, which add more money to the current account and may be used to fund regional projects that are expected to have a favorable impact on the host country's economic performance. In same vein foreign direct investment is seen as a way to improve the people's welfare through stimulating economic growth, extending employment possibilities, and increasing trade (Asiedu, 2018). According to Egolum (2011) He posts that in efforts to encourage the inflow of foreign direct investments (FDI), the Federal Government has adopted a variety of policies and measures which have allowed foreign investors to be almost treated in same vein as local investors with tax breaks and incentives. The National Investment Promotion Commission Act, 1995) was established with the purpose of promoting and facilitating investment in Nigeria with a one-stop investment center that brings together and streamlines administrative processes for new firms and investments; this center is supported by cooperation from 27 governmental and parastatal entities by promoting suitable investment climate; with the intention that incentive programs will encourage the inflow of foreign private investments and the government has demonstrated awareness of macro-policy and institutional framework particularly on macro-economic policies which are considered important in influencing investment decisions; eliminated restrictions and ceilings on FDI and permitted 100 percent foreign ownership in all sectors, with the exception of those that are illegal under local and international law (Emudainohwo, 2015).Economic potential is well recognized to be the biggest economy in the West African sub region given the country's considerable resource endowment and coastal location it is clear that it posses potential for strong growth, But yet Nigeria has realized very little because the previous efforts at planning and visioning were not sustained (Onyali & Okafor, 2014).

Background to the Study

Economic openness is widely acknowledged to increase economic growth in both rich and developing countries. The oil and gas industry in Nigeria draw the greatest FDI inflows, according to a sector-by-sector examination of FDI inflows. \$20.83 million and \$203.9 million dollars in foreign capital were invested in the oil and gas industry during the first quarter of 2016, and the second quarters respectively. A total of \$171.63 million and \$227.3 million were reported in the third and fourth quarters, respectively. In the first six months 2017, foreign investment inflows into Nigeria's oil and gas sector climbed to US\$291.47 million. Compared to the 21.21% inflows saw in the first half of 2016, inflows grew by 31.76%. (NBS, 2017) Beginning in 2020, Nigeria's primary trade partner for crude oil was Europe. In the fourth quarter of 2020, crude oil shipments to Europe were worth roughly N853 billion, which is about US\$2 billion. However, in the fourth quarter of 2020, exports from Nigeria exceeded N880 billion and reached over US\$2.2 billion, making Asia the top destination for Nigerian crude oil. A total, shipments of crude oil drastically declined in the second quarter of 2020. Nigeria's export value is mostly derived from crude oil exports. The Nigerian economy has been significantly impacted by the Covid-19 pandemic epidemic, Due to declining demand, crude oil prices fell precipitously, and the nation continuously reduced daily crude oil output. About 9% of Nigeria's GDP comes from the country's petroleum industry. However, due to the decreased in demand which was occasioned by the COVID-19 epidemic, Nigeria's oil output and exports decreased. The oil sector's share of this total real GDP in 2020 between October and December was roughly 5.9%, which is a decrease of about 3% from the prior quarter. Finally, the oil sector's share of the nation's GDP increased to 9.25% in the first quarter of 2021. The mineral fuels, petroleum, and distillate products industry contributed more than 80% of Nigeria's export value in 2019, totaling about \$45 billion (NBS, 2021). A downturn in FDI into Nigeria during the past years, coupled with a drop-in oil price on the global market, has slowed Nigeria's oil exports, which has had an adverse effect on economic growth. The government's pursuit of an expansive fiscal policy through public expenditure was simplified as a resultant effect. This decline in her FDI influx will have an impact on employment possibilities, consumption levels, investment levels, and employment growth. Given that global uncertainties decreased net FDI inflows from 1996 to 2019 and that oil exports were influenced by declining oil prices, the current epidemic on FDI is particularly concerning. Majority of the time, rising economies like Nigeria and those in the Asia-Pacific region experience severe shocks brought on by GDP uncertainty (Ho and Gan, 2021). Because of the loss in FDI coming in, host nations like Nigeria may see a drop-in oil output and exports, which would cause the economy to contract. This has made it necessary to conduct research of this kind, which look at how oil exports affect economic growth in Nigeria.

Statement of the Problem

Nigeria receives a higher proportion of FDI in the petroleum sector than in other industries, similar to other Sub-Saharan African countries. UNCTAD (2020) stated that FDI inflows to Nigeria surged by 71% from \$2 billion in 2018 to \$3.4 billion in 2019, led by resource-seeking inflows in the petroleum sector. Capital from Nigeria's petroleum

sector accounted for the majority of a 17% increase in capital flows to around \$11 billion in West Africa. This demonstrates how cash flows to Nigeria's petroleum industry are distorted. Nigeria's oil exports and FDI have a favorable correlation, according to empirical literature (see Adereni, Azeez, Elufisan and Awomailo 2019; Afolaya and Jimoh 2019; Hussain and Ahmed 2017; Makuchukwu, Salami; Fatimah, Gazi and Oke 2012). Despite an increase in oil exports fueled by FDI inflows, oil money in Nigeria has not had the desired effects, notably in the aspect of economic progress and development. There is no conclusive evidence that the increase in oil exports brought on by FDI inflows has had any direct or indirect effects on economic growth in Nigeria, unlike other oil-rich nations that have frequently exchanged their oil for fixed capital, leading to enormous capital formation and, consequently, economic growth and development. The development and expansion of Nigeria's economy are gravely threatened by this.

Although it is possible that the export of oil would have a direct impact on Nigeria's economic welfare, it is also very likely that this impact will only be indirect. With an increase in oil export profits, the government may decide to spend more or conserve more. Increased government expenditure may be directed toward developing fixed capital or human capital, both of which support economic growth and development. Furthermore, increased government savings add to general savings, which when used can boost the economy. This study aims to conduct an empirical assessment of how foreign direct investment through oil exports affects Nigeria's economic prosperity.

Research Questions

This study seeks to solve the following puzzles

- i. What is the effect of FDI on Oil export in Nigeria?
- ii. How has FDI through oil Export impacted Economic growth in Nigeria?

Objectives of the Study

The objective of this study is to examine the relationship between FDI, Oil export, economic growth in Nigeria. The specific objectives are to:

- i. Examine how FDI impact on Oil export in Nigeria;
- ii. Ascertain the effect of FDI on economic growth through Oil export in Nigeria

Research Hypotheses

This study is guided by the following hypotheses:

- H₀₁:** There is no significant relationship between FDI and Oil export in Nigeria;
H₀₂: FDI through oil export has no significant impact on economic growth in Nigeria.

Significance of the Study

Oil export has unsurprisingly been extremely important to Nigeria's political economy. The transmission channels oil sales towards achieving economic growth in Nigeria have not been adequately subjected to any empirical details, despite the fact that these contributions to economic growth in Nigeria have been enormous and have each been the subject of empirical investigation separately. The relationship and nature of

transmission between FDI, through oil export to economic growth in Nigeria have not been adequately documented in empirical literature. Additionally, this research will serve as a resource for decision-makers and aspiring researchers on related subjects, which will incite profound and innovative thoughts that are practically applicable to help improve the management of oil export for the achievement of capital formation for the purpose of achieving real economic prosperity and development in Nigeria and other resource-rich countries.

Review of Related Literature

Despite several empirical works on oil export, there is little conceptual literature on oil exports. The entire amount of oil exported, including both crude oil and refined oil products, is measured in barrels per day (bb/day). According to Eche E. (2024) and Akighir and Kpoghul (2020), oil exports include semi-finished and unfinished petroleum products, liquid fuel, lubricating oils, solid and semi-solid goods made from distillate and cracking of crude petroleum, and solid and semi-solid products made from liquid fuel. Oil and gas extraction is a key source of export income and, to a lesser extent, source of employment in many developing economies. However, the most significant benefit that a nation may get from its growth is arguably the fiscal role that the oil and gas industry play in generating tax revenue and other government funds. To ensure that the state, as the owner of the resource, receives a fair share of the economic rent generated by oil and gas development, export strategies and the tax system must be properly established (Sunley, Baunsgaard and Simard, 2002).

Economic Growth

The expansion of a nation's capacity to produce goods and services from one period to the next is referred to as economic growth. It is also referring to as the gradual rise in the quantity of goods and services an economy generates. Ogunleye (2014). The World Bank (2019) sees economic growth as an increase in the production of goods and services over a specific time period. For precision, the measurement of economic growth must take the effects of inflation into account. Business profits increase as a result of economic growth. The effect is a rise in stock prices. Businesses can invest and increase employee numbers as a result. As more employment opportunities are created, income rises. The consumers have sufficient funds to purchase extra goods and services. Purchases stimulate economic growth at a higher rate. This is why good economic growth is the goal of all nations. As a result, one of the important economic indicators is economic growth.

The most reliable growth metric is the Real Gross Domestic Product (RGDP). It eliminates the detrimental effects of inflation. The World Bank uses Gross National Income (GNI) as a growth indicator rather than GDP. It includes cash sent home by Americans working overseas. It is a key source of revenue for many developing countries like Nigeria. While growth rates are important, the World Bank (2019) Group emphasizes that growth patterns that prioritize increasing opportunities for the disadvantaged and excluded, especially women and youth, can result in more strong and sustainable growth.

Comparisons of GDP by nation will understate the full magnitude of these nations' economies. The GDP does not include unpaid services. This excludes daycare, unpaid volunteer labor, and illegal black-market activities. Environmental expenditures are not included in. For instance, plastic is cheap since disposal fees are not included in. However, the impact of these costs on social wellbeing is not taken into consideration by GDP. A nation's level of living can be improved when environmental costs are considered. Only the values of a society are measured. The gross domestic product is the most reliable measure of economic growth (GDP). It considers the whole nation's economic output, which includes all goods and services produced for export by local businesses whether they are sold domestically or overseas. A measure of output is the GDP. The parts that are created to make a product are not included, though. Because they are made domestically, exports are considered. Imports are taken into consideration while adjusting economic growth.

Since 2015, the pace of economic growth has been moderate. After averaging 1.9% in 2018, growth was constant at 2% in the first six months of 2019. Internal demand is still hedged as a result of low private spending and high inflationary episodes (11% in the first six months of 2019). From the perspective of output, the services sector, particularly the telecoms, was the primary engine of development in 2019. The North-East insurgency and ongoing farmer-herdsmen disputes are to blame for the continued underperformance of the agriculture sector. Industry performance is inconsistent due to a worse power sector performance in 2019, manufacturing production is slowing down, while GDP growth is steady. It was predicted that output of food and beverages would rise in response to import restrictions. The construction sector, on the other hand, is still performing well as a result of continuing megaprojects, increased public spending in the first half of the year, and import restrictions. The growth rate is too slow to eradicate poverty among the poorest 50 percent of the population. The agriculture sector's failure harms the chances of poor rural inhabitants, while excessive food inflation has a detrimental effect on the poor in urban regions. Oil production is slowing in 2019 as a result of a poorer power sector performance, GDP growth is constant. In reaction to import limitations, an increase in food and beverage production was anticipated.

On the other hand, the construction industry is still doing well thanks to ongoing megaprojects, increased public expenditure in the first half of the year, and import restrictions. The growth rate is too slow to eradicate poverty among the poorest 50 percent of the population. The agriculture sector's failure harms the chances of poor rural inhabitants, while excessive food inflation has a detrimental effect on the poor in urban regions. Despite growth in some industries, employment growth is still slow and insufficient to keep up with the labor force's rapid expansion, leading to a high unemployment rate (23% in 2018) and 20% of the work force being underemployed. The high rate of poverty in the country's North-East area was also a result of the instability in the Northern region and the resulting population relocation.

Nigeria's medium-term growth is forecast to stay constant at roughly 2% in the absence of major fundamental policy adjustments. As a result, it is anticipated that the economy would expand more slowly than the population and that living standards will decline. Growth is also constrained by a weak macroeconomic environment, high persistent inflation, several exchange rate windows, restrictions on foreign exchange, distorting actions of the central bank, and a lack of revenue-driven fiscal consolidation outcomes. The increase of private sector credit is constrained by increasing public debt as well as more complex central bank policy measures. Nigeria's economy is vulnerable to external risks because fiscal buffers have been exhausted and external balances are unstable due to hot money flows. The opportunity exists for the incoming administration to quicken the pace of structural changes in order to create an institutional and regulatory framework capable of controlling the volatility of the oil industry and fostering long-term expansion of the non-oil economy. The abolition of trade and forex restrictions, the elimination of subsidies, enhanced domestic tax mobilization, and more openness and predictability of monetary policy are all bold measures that might have a substantial influence on the economy's trajectory. While raising spending on much needed public services, such measures would help enhance the standard of life for low-income populations. After much consideration, the signing of the Africa Continental Trade Agreement may also provide the economy a boost in the medium run. Economic indicators from the World Bank.

Data Presentation and Analysis of Results

Method of the Study

Data was analyzed using descriptive statistics and econometric analytical tools, the unit root test, ADF, KPSS, the SVAR and Variance decomposition tests were carried out. The IRF was also used to track the responsiveness of the regressands in the SVAR to the shocks in the other variables. The variance decomposition explained the extent of movement in the dependent variables explained by their own shock's vis-avis shocks from other factors.

Model specification and Discussion

In tracing the indirect effect of foreign direct investment on the economy, the employment channel will be used as specified. Foreign direct investment inflows create employment avenues in an economy and thus affect economic growth positively. Thus, the transmission which is the pass-through effect of foreign direct investment to economic growth via employment is given as follows:

$$FDI \longrightarrow EMP \longrightarrow GDP \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad 1$$

Where *FDI* is foreign direct investment inflows, *EMP* is employment, and *GDP* is economic growth (proxy by gross domestic product).

Transposing the transmission yields,

$$GDP_t = f(GDP_{t-1}, EMP_{t-1}, FDI_{t-1}, EMP_t, FDI_t) \quad - \quad - \quad - \quad (2)$$

$$EMP_t = f(GDP_{t-1}, EMP_{t-1}, FDI_{t-1}, GDP_t, FDI_t) \quad - \quad - \quad - \quad (3)$$

$$FDI_t = f(GDP_{t-1}, EMP_{t-1}, FDI_{t-1}, GDP_t, EMP_t) \quad - \quad - \quad - \quad (4)$$

Therefore, the exposition of the normalized SVAR (4.7) system of equation yields the following,

$$GDP_t = \alpha_{11}'GDP_{t-1} + \alpha_{12}'EMP_{t-1} + \alpha_{13}'FDI_{t-1} + \alpha_{14}'EMP_t + \alpha_{15}'FDI_t + \varepsilon_{1t} \quad - \quad - \quad (5)$$

$$EMP_t = \alpha_{21}'GDP_{t-1} + \alpha_{22}'EMP_{t-1} + \alpha_{23}'FDI_{t-1} + \alpha_{24}'EMP_t + \alpha_{25}'FDI_t + \varepsilon_{2t} \quad - \quad - \quad (6)$$

$$FDI_t = \alpha_{31}'GDP_{t-1} + \alpha_{32}'EMP_{t-1} + \alpha_{33}'FDI_{t-1} + \alpha_{34}'GDP_t + \alpha_{35}'EMP_t + \varepsilon_{3t} \quad - \quad - \quad (7)$$

Collecting the contemporaneous effects to the Left-Hand Side (LHS) turns,

$$GDP_t - \alpha_{14}'EMP_t - \alpha_{15}'FDI_t = \alpha_{11}'GDP_{t-1} + \alpha_{12}'EMP_{t-1} + \alpha_{13}'FDI_{t-1} + \varepsilon_{1t} \quad - \quad (8)$$

$$-\alpha_{24}'GDP_t + EMP_t - \alpha_{25}'FDI_t = \alpha_{21}'GDP_{t-1} + \alpha_{22}'EMP_{t-1} + \alpha_{23}'FDI_{t-1} + \varepsilon_{2t} \quad - \quad (9)$$

$$-\alpha_{34}'GDP_t - \alpha_{35}'EMP_t + FDI_t = \alpha_{31}'GDP_{t-1} + \alpha_{32}'EMP_{t-1} + \alpha_{33}'FDI_{t-1} + \varepsilon_{3t} \quad - \quad (10)$$

In order to estimate the appropriate model, the minimum Schwarz criterion was estimated to select the optimal model as shown in Figure 1.

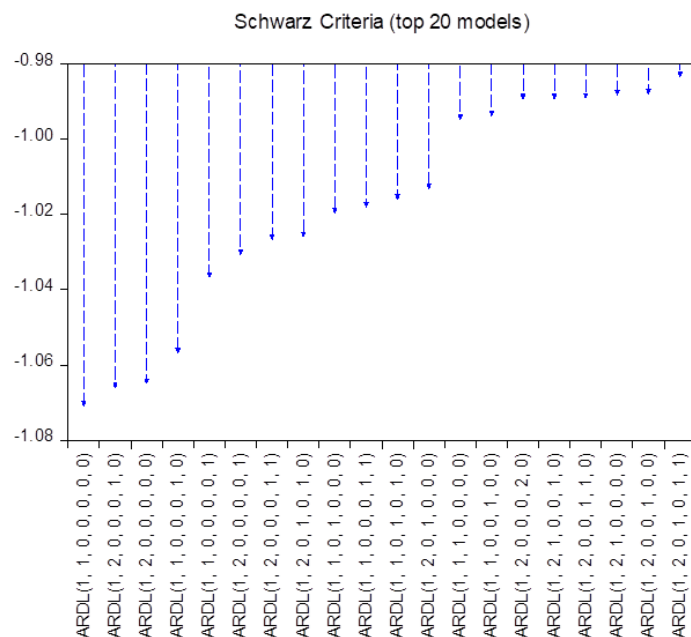


Figure 1: Schwarz Criteria

Source: Author's Estimation Using E-views 10

Figure 1 indicates that ARDL (1,1,0,0,0,0,0) is the optimal ARDL model to be estimated among the top 20 ARDL models. In order to determine the long-run relationship among the variables of interest, Autoregressive Distributed Lag (ARDL) bounds test was estimated and is presented in Table 1.

Table 1: Autoregressive Distributed Lag Bounds Test

Test Statistic	Value	Sign.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.602159	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

Source: Author's Estimation Using E-views 10

Table 1 indicates that the F-statistics value of 4.60 is higher than the upper bound value of 3.28 at a 5% level of significance. This implies that there is a linear long-run relationship among the variables in the model. Thus, the short-run and the long-run estimates were estimated as shown in Tables 2 and 3.

Table 2: Short-Run Estimate of the ARDL (1,1,0,0,0,0,0) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.703868	1.489319	0.472611	0.6389
GDP(-1)*	0.245443	0.098059	2.503004	0.0162
FDI(-1)	0.133153	0.031899	4.174206	0.0001
INFL**	0.000261	0.001654	0.157763	0.8754
EXR**	-0.002209	0.000454	-4.865638	0.0000
EMP**	0.009120	0.027763	0.328513	0.7441
OPN**	-0.000901	0.002135	-0.422076	0.6751
INTR**	-0.007390	0.004772	-1.548557	0.1288
D(FDI)	0.172684	0.046452	3.717430	0.0006
ECM(-1)	-0.245443	0.063577	-3.860545	0.0004
Adjusted R-squared	0.821392			
F-statistic	30.31777			
Prob(F-statistic)	0.000000			
Durbin-Watson stat	1.068381			

Source: Author's Estimation Using E-views 10.

Table 2 indicates the short-run relationship among gross domestic Product, foreign direct investment, inflation, exchange rate, employment, index of openness, and interest rate. From the table, the lag value of gross domestic product has a positive and statistically significant effect on economic growth in Nigeria. The lag and the current values of foreign direct investment indicate positive and statistically significant impact on economic growth in Nigeria in the short-run. This suggests that a 1% increase in foreign direct investment will lead to a 0.13% and 0.17% increase in economic growth respectively in the economy. Inflation has a positive but statistically insignificant impact on economic growth in Nigeria in the short-run. Exchange rate has a negative and

statistically significant impact on economic growth in the short-run in Nigeria. This implies that a 1% increase in exchange rate will lead to a reduction by 0.002% in economic growth in Nigeria in the short-run. Employment indicates a positive but statistically insignificant impact on economic growth in Nigeria in the short-run. The index of openness has a negative and statistically insignificant impact on economic growth in the short-run in Nigeria. Similarly, interest rate has a negative and statistically insignificant effect on economic growth in Nigeria in the short-run.

The speed of adjustment [ECM (-1)] which explains the speed of adjustment of variables to equilibrium in the long-run is negative (-0.245443) and statistically significant. Meaning that disequilibrium among gross domestic product, foreign direct investment, inflation, exchange rate, employment, index of openness, and interest rate will readjust to equilibrium in the long-run. The Adjusted R-squared value of 0.82% suggests that, foreign direct investment, inflation, exchange rate, employment, index of openness, and interest rate have explained short-run variation in economic growth by 82% in Nigeria. Also, the F-statistic value of 30.31777 is statistically significant, implying that, the explanatory variables have a strong joint effect on economic growth in Nigeria. Finally, the Durbin-Watson statistic value of 1.068381 shows the absence of autocorrelation in the model. Furthermore, the long-run estimates for the model were estimated and presented in Table 5.17.

Table 3: Long-Run Estimates of the ARDL (1,0,0,0,0,0) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	0.135072	0.053265	2.535849	0.0231
INFL	0.001063	0.006717	0.158274	0.8750
EXR	-0.080850	0.032046	-2.522935	0.0298
EMP	0.037159	0.109038	0.340788	0.7349
OPN	-0.003672	0.009418	-0.389837	0.6986
INTR	-0.030110	0.014641	-2.056488	0.0458
C	2.867744	6.191154	0.463200	0.6456

Source: Author's Estimation Using E-views 10.

Table 3 shows the long-run relationship among the variables in the model. Foreign direct investment has a positive and statistically significant impact on economic growth Nigeria. This implies that a 1% increase in foreign direct investment inflow in the long-run will lead to a 0.14% increase in economic growth in the country. Inflation has a positive but a statistically insignificant impact on economic growth in Nigeria in the long-run. Exchange rate has a negative but statistically significant impact on economic growth in the economy. This suggests that a 1% increase in exchange rate in Nigeria will lead to a reduction in economic growth by 0.08% in the long-run. Employment has a positive but statistically insignificant impact on economic growth in Nigeria in the long-run. The index of openness has a negative and statistically insignificant impact on

economic growth in the long-run in Nigeria. Interest rate has a negative but statistically significant impact on economic growth in Nigeria. This suggests that a 1% reduction in interest rate will lead to increase in economic growth in Nigeria by 0.03% in the long-run.

Diagnostic Tests

In order to ensure the validity of the results, diagnostic tests were estimated and presented in the following tables.

Table 4: Results of Ramsey Reset Test

	Value	df	Probability
t-statistic	0.742171	42	0.4621
F-statistic	0.550818	(1, 42)	0.4621

Source: Author's Estimation Using E-views 10

The t-statistic and F-statistic of the Ramsey Reset tests are both statistically insignificant. This means that, the model is correctly specified in terms of its functional form and inclusion of relevant explanatory variables. Furthermore, the normality test of the residuals was estimated and the results are presented in the following figure.

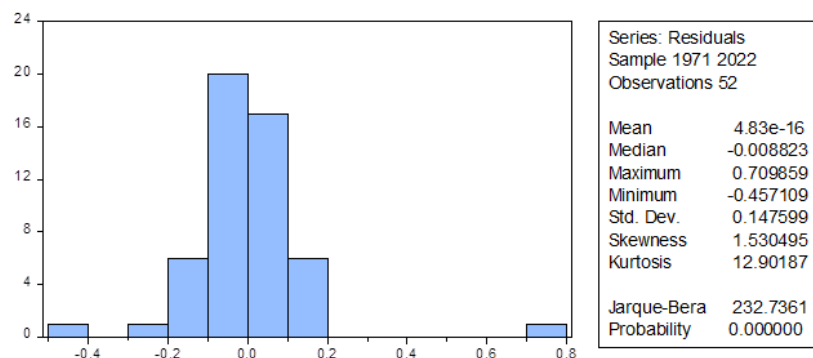


Figure 1: Normality Test

Source: Author's Estimation Using E-Views 10

The normality histogram and the Jarque-Bera statistics have both shown that, the residuals of the model are not normally distributed. However, the violation of the assumption of normality in a distributed lag model does not have serious consequences on the validity of the estimates. Also, the serial correlation test was estimated using the Breusch-Godfrey Serial Correlation LM Test and the result is presented in the following table.

Table 5: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.811038	Prob. F(2,41)	0.2303
Obs*R-squared	1.951605	Prob. Chi-Square(2)	0.3170

Source: Author's Estimation Using E-views 10

The result of both F-statistics and Chi-Square (2) are statistically insignificant indicating the absence of serial correlation among the residuals of the model. Also, the Heteroskedasticity test was estimated using the Breusch-Pagan-Godfrey and the results are presented in Table 6.

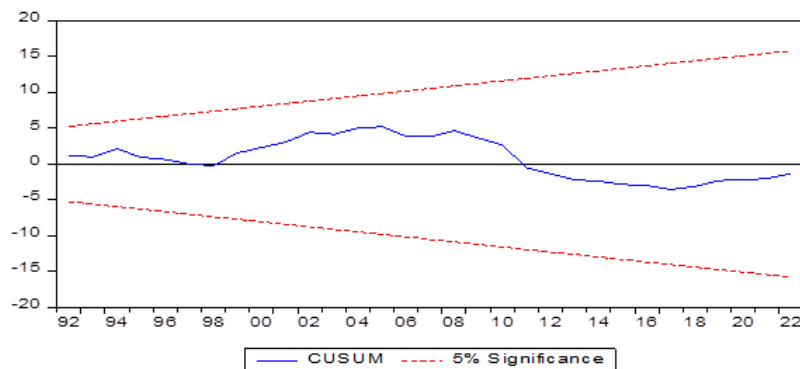
Table 6: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.647437	Prob. F(8,43)	0.1397
Obs*R-squared	12.19900	Prob. Chi-Square(8)	0.1425

Source: Author's Estimation Using E-views 10

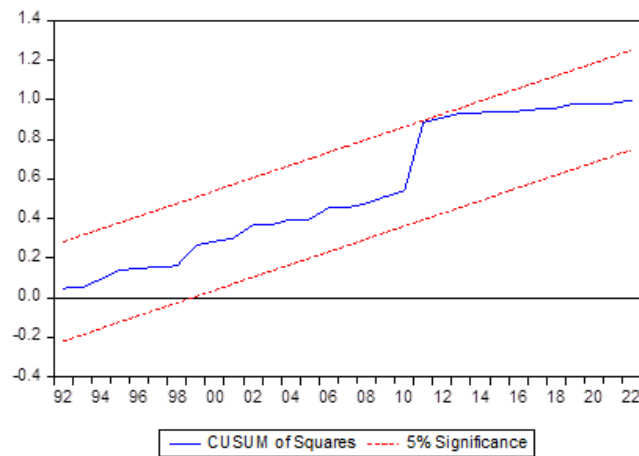
Both the F-statistics and Chi-Square (2) are statistically insignificant indicating that the residuals are homoscedastic. Finally, stability test was conducted and the results are presented in the following figures.

Figure 3: The CUSUM Test for Stability



Source: Author's Estimation Using E-Views 10

Figure 4: The CUSUM of Squares Test for Stability



Source: Author's Estimation Using E-Views 10

Both the CUSUM and CUSUM of Square tests have shown the presence of stable estimates, since all the graphs are within the 5% significance critical bounds.

Discussion of Findings

The study found long-run relationship among oil exports, foreign direct investment, and index of openness, exchange rate, oil prices, OPEC quota, and foreign demand. Specifically, the study found that FDI oil and gas had positive and statistically significant impact on oil export both in the short- and long-run. This finding is in line with Eche, E. (2024) who found that FDI had positive impact on oil exports. This means that increase in the inflow of foreign investment in the oil and gas will exert positive impact on the volume of oil exports in the country. This could be through huge capital investment, innovations and efficient production techniques in the oil and gas sector.

Also, the study found that oil export had positive and statistically significant impact on economic growth in both the short and long-run in Nigeria. This finding is in tandem with Ugwu et al. (2019); Sultan and Haque (2018) who found positive impact of oil exports on economic growth. This suggests that the export of oil provides revenue for the funding of the economy in diverse ways such as critical infrastructures, welfare services and direct investments in the economy which has a multifaceted impact on the aggregate economy. Furthermore, the study found that foreign direct investment in the oil and gas sector had positive and statistically significant impact on economic growth in both the short and long-run in Nigeria. This finding collaborates Idris and Usman (2022); Udi et al. (2021); Obinne et al. (2020); Alabi (2019); Okey and Amba (2018); and Akinyemi et al. (2018) who found that foreign direct investment positively impacts on economic growth. This suggests that the inflow of foreign direct investment in the oil and gas sector affect oil production, exports and revenue which has multiplier effect on the Nigeria economy.

Summary

The study investigated the nexus among foreign direct investment, oil export and economic growth in Nigeria from 1970 to 2021. Specifically, the study examined the pass-through effects of foreign direct investment to economic growth via oil exports. The study utilized the Autoregressive Distributive Lag (ARDL) model and the Structural Vector Autoregressive (SVAR) model in the investigation. Findings of the study revealed that, first, foreign direct investment in oil and gas industry has positive and statistically significant relationship with oil exports both in the short and long-run in Nigeria. Second, the study found that oil exports have positive and statistically significant impact on economic growth in Nigeria. Third, findings indicated that, there is positive and statistically significant relationship between foreign direct investment in oil and gas sector and economic growth of the Nigeria both in the short and long-run.

Conclusion

On the basis of the findings of this study, it is concluded that, directly, foreign direct investment in oil and gas exerts strong positive impact on oil exports. Also, oil exports impact positively on economic growth in Nigeria. Again, foreign direct investment in oil and gas exerts strong positive impact on economic growth in Nigeria. Indirectly, foreign direct investment in oil and gas through employment, foreign reserves and exchange rate channels transmits weak spillover effects to economic growth; but through oil exports, there is a strong pass-through effect to economic growth in Nigeria.

Recommendations

On the basis of the findings and conclusion the study recommends the followings:

1. The Government through the Ministry of Industry, trade and investment in collaboration with the ministry of petroleum and gas should make concerted efforts in attracting and retaining foreign direct investment in the oil and gas sector. This can be done by improving on the investment climate in the country through control of rising insecurity and economic policies that can ensure economic stability.
2. Pragmatic mechanisms should be put in place by the Ministry of Defense and Interior to forestall oil theft and bunkering. Also, efforts should be made to forestall pipeline leakages. These efforts will go a long way in increasing the volume of oil exports that will guarantee sustained economic growth.
3. To improve on the positive potentiality of employment transmission effect as a spillover of foreign direct investment in the oil and gas industry, there should be adaptation of indigenous technology and indigenous manpower engagement to acquire skills from the expatriates on the job.
4. To improve on the positive potentiality of the foreign reserves channel as a spillover of foreign direct investment in the oil and gas industry to the economy, the Central Bank of Nigeria and the Ministry of Finance should develop effective mechanisms that will track the receipts of foreign exchange from multination's and ensure the remittance of same to the Federal government.
5. To ensure exchange rate reduction potentiality as a spillover of foreign direct

investment in the oil and gas industry to the economy, the Central Bank of Nigeria should potentially manage foreign exchange supply from foreign direct investment by prudent utilization in terms of allocation to critical sectors of the economy that can in turn attract further inflows of foreign direct investment in to the economy.

Contribution to Knowledge

This study has contributed to knowledge by its novelty in literature. First, it considered the direct impact of foreign direct investment on oil exports and oil exports on economic growth and foreign direct investment on economic growth within a single framework. Second, it unearths the indirect effects of foreign direct investment on economic growth in two folds. First, it unraveled three transmissions channels: namely the employment, foreign reserves and exchange rate channels as spillover effects of foreign direct investment on economic growth in Nigeria. Secondly, it examined the pass-through effect of foreign direct investment in oil and gas industry to economic growth via oil exports in Nigeria.

Limitations of the Study

The major limitation of this study was the inability to get available data that will allow for disaggregation of inflows of foreign direct investment separately in oil and gas. However, the challenge was circumvented by using aggregate data on foreign direct investment in to the oil and gas sector that guarantee the internal and external validity of the results.

Suggestion for further Studies

Further studies should explore other spillover channels of foreign direct investment in the oil and gas sector such as technological diffusion and human capacity development. Also, further studies may consider the possibility of disaggregating foreign direct investment in the oil and gas sector.

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ANALYSING THE IMAGE OF ENVIRONMENTAL CRISIS IN IDRIS AMALI'S POETRY WITH IN THE CONTEXT OF CLIMATE CHANGE DISCOURSE IN NORTHERN NIGERIA

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Abstract

The paper analyses the nuanced thematic aspects and creative tactics used by poets to depict the environmental issue. The study examines the representation of the environmental, using qualitative research methods and ecocritical frameworks. The purpose of environmental literature in Nigeria is to grow ecological understanding and consciousness among the populace regarding the nation's many environmental concerns, encompassing air, water, and noise pollution, as well as oil spills, deforestation, erosion, and floods. Amali's poem, titled "Efeega War of Ants," examines the environmental catastrophe in Northern Nigeria and the resulting ecological harm. Moreover, the study examines the socio-political consequences of climate poetry by assessing its ability to shape public perceptions and influence discourses. The research emphasises the enduring significance of climate poetry in fostering comprehension, compassion, and tangible measures in response to urgent environmental concerns.

Keywords: *Environmental, distaste, Ecological, climate poetry, Catastrophe*

Background to the Study

Northern Nigeria like other regions of the world faces environmental effects of global warming. Scholars and researchers (Michael 2001, Umair 2015, Ezegwu 2014, Ojekunle et al 2014), in different fields, engage in expressing their views and findings with reference to their environmental experiences and research outcomes. Poets all over the globe among them are Stoneman (2022) who wrote on *Losing Ground*, Jess (2016) *Last Word of the Horney Bees*, Brittney (2023) who on *Bipolar Solastalgia*. They express their poetic views on environmental effects and set background for young researchers to work on. With the growing concern on environmental hazards that attract global annual submits since 1995

Londono et al (2019), and national effort Olaniyi et al (2013) to implement the resolutions of the various submits Idowu et al (2011), academic research is called to further bring to light the nature, effects, and possible dangers and solutions which this work plan to do through contextual analysis of selected Nigerian poems that reflect northern region.

As Sule, sees the Nigerian ecocriticism shies away from global debates on ecological issues, such as climate change and the Anthropocene. Sule, (2022) says:

It is not that the writers are not aware of such debates. They are, in fact, aware and a few of them have thematised the debates and their intricacies at the local levels. What appears to be the case is that they are often overwhelmed by the realities of their immediate localities – realities, on the one hand, defined by the condition of extreme poverty and helplessness and, on the other, characterised by incredible human-caused eco-destruction. A crucial factor in framing eco-destruction, whether human or climate caused, in Nigeria is the pervasive consequence of failed leadership in Nigeria. (12)

The field of literature and environment studies has undergone substantial development over the years, as evidenced by the prominence of ecocritical collections that are regularly referenced (17–19). The initial scholarship of the 1990s primarily associated the concept of environment with nature. It emphasized the portrayal of the natural world in various forms of literature, such as poetry, fiction, and nonfiction, as a means of evoking and encouraging engagement with nature. This scholarship placed importance on the depiction of nature and the human connection to specific places at a local, communal, or bioregional level.

This research focuses on environmental contents of poetry from Northern Nigeria as an important consequence of environmental degradation on social existence, its tendency to disturb the socio-economic livelihood of human populations who rely directly on natural resources for their survival Chima, (2008). The primary consequences of environmental degradation include the reduction in the economic resource foundation, the escalation in the frequency and severity of droughts and floods, and the exacerbation of poverty levels. The depletion of biodiversity is the last stage in the sequence of deterioration of natural resources. The decline of biodiversity mostly relies upon illicit activities. The primary challenges to the preservation of forests, fisheries, coastal and marine ecosystems, pastures, and farmlands are logging, overfishing, and poaching.

The existence of the Earth can be attributed to its divine creation, which serves the purpose of fulfilling the necessities of humans and imbuing their existence with significance. Given that the planet plays a vital role in sustaining our life, encompassing both our inherent traits and external influences, it is incumbent upon humanity to reciprocate by actively safeguarding the world from any form of deterioration or harm. The coordination of human interactions with the environment is of paramount

importance for the well-being and long-term sustainability of humankind. Due to this circumstance, researchers of Environmentalism have undertaken the task of emphasising the peril associated with the disregard of the biosphere in their eco-critical discourse.

In 1978, William Rueckert, a prominent figure in the field of ecocriticism, published a seminal work entitled *Literature and Ecology: An Experiment in Ecocriticism*, which is widely recognised as one of the pioneering contributions to this academic discipline. Rueckert's article did not hold the distinction of being the initial work to express legitimate apprehensions regarding the interplay between humans and their natural surroundings. However, he is widely acknowledged as the individual responsible for establishing the copyright of the etymology pertaining to the term "ecocriticism." Building upon the foundational work of Rueckert, a notable scholar in the field of ecocriticism, Cheryll Glotfelty further contributed to the discipline with her publication, *The Ecocriticism Reader* (1996). In this seminal work, Glotfelty posited that ecocriticism entails the examination of the interconnection between humanity and the natural environment. In addition to delivering a verdict of, in alignment with Glotfelty's perspective, he further asserts that the topic holds significant historical importance. Buell (2005) observes in his scholarly publication, *The Future of Environmental Criticism: Environmental Crisis and Literary Imagination*, that the language of environmental criticism may be traced back to ancient times" (p. 2). Glotfelty's perspective entails a modest adjustment, wherein ecocriticism is defined as an academic discipline that examines the interplay between literature and the environment, guided by a dedicated commitment to environmental praxis.

Efeega: Efeega, derived from the Idoma language, translates to "the conflict of the soldier ants." The inclusion of the terms "war" and "ants" significantly contributes to the overall atmosphere and potential readings of this Amali's collection. Firstly, there is an issue over the selection of "ants" as the primary catalysts for insurrection or rebellion. Is this option appropriate? Why is that the case? However, the solution become evident upon scrutinizing the fundamental characteristics of this organism. As an individual, a solitary ant is unassisted, visually impaired, diminutive, and vulnerable against the bulk of its opponents. However, when considered as a group, the ants consistently demonstrate a powerful and effective ability to overpower and defeat any mammal, regardless of its size or strength. Thus, the symbolic depiction of the ants exemplifies the concept of collective power. In the poetry "EFEEGA: War of Ants" on page 108, it is evident that the "ants" symbolize both the power of a large group and their shared determination. Furthermore, the poem reinforces the idea that lasting success is achieved by mutual comprehension and capability.

Discussion

Idris Amali, a scholar specializing in spoken literature, is a contemporary of Niyi Osundare, Okimba Launko, Tanure Ojaide, Ezenwa Ohaeto, and other Nigerian poets who emerged in the second generation. The poetry book, *EFEEGA (War of Ants)*, is

organized into seven (7) distinct parts, each with a designated title: "Desert of Needs," "Pride in Filth," "Restless Abodes," "Struggle," "Exchanges," "Dine with the Past," and "War of Ants." The collection has a total of sixty-five (65) poems. The cover page of the collection conveys a significant amount of information regarding its central theme. Beneath a crimson and disordered moon, a lifeless elephant rests as ants leisurely traverse the colossal carcass, tearing through its resilient hide with fierce jaws. Professor Bello Bada, in his support of the poetry collection, states that in the book "EFEEGA: War of Ants," the poet reveals the true nature of the elephant, a powerful entity that has to be removed from power in order to restore morality and rationality. Undoubtedly, in a tone of lamentation, the poet expresses sorrow at the destruction of the country's finances and natural assets by the voracious and avaricious governing class.

The majority of the poems are infused with depictions of filth, suffering, and destitution, all of which are carefully arranged to highlight the lack of effective leadership. The poem "From the Pond" is a vivid portrayal of a youthful herdsman. The man crouches next to a contaminated pond, where his cows are vigorously spraying polluted water into the air, and proceeds to consume it. This natural specimen, impervious to the progress of mankind, will eventually ascend to the throne and seize leadership tomorrow. The poets lament in this manner: 'He now resides in a body of water with his livestock, and from this bovine reservoir he exerts control over our minds and manages our well-being' (19).

In the poem "The Hyenas are Here," the author expresses his profound disappointment with the current generation of leaders by using unbridled rage. He expresses his dissatisfaction with the governing elites by comparing them to predatory animals such as hyenas, leopards, jackals, wolves, rodents, and plutocrats. Their contributions to the nation are limited to exploiting and depleting its resources, with no positive offerings. Nevertheless, the poets argue that as long as these wealthy individuals are not held accountable and face the consequences of their actions, our food reserves will remain vulnerable to the threat of hunger and destruction caused by greedy animals. In the poem "These People," the author laments that our leaders possess the ability to see yet are unable to perceive the agony endured by the people. They possess auditory organs but are capable of perceiving the lamentation and profound despair emitted by the individuals. They exhibit savage and cruel behavior. In the poem "Our People," they are also characterized as "agents of national unrest" and "emissaries of national unrest." Due to the control that a small number of people have over the commonwealth, the poet refers to them as vampires because they figuratively consume the life force of the innocent people who are dying.

"Watching Gaza" and "Gaza: A Breakfast" are poetic expressions that mourn the cruel and immoral use of deadly force by Israel in the Gaza region. This suggests that the poet serves as a representative not just of his particular community but also of mankind as a whole. The poems are infused with many layers of imagery. The town of Gaza is

personified in the film "Watching Gaza." The phrases "the amputated city of Gaza" and "Gaza must bleed the orphan blood" attribute alive characteristics to Gaza, evoking sympathy for the city that is afflicted. In "While in Gaza: A Breakfast," we are presented with images of mortality and devastation. Children, women, and men who are innocent are trapped in a catastrophic disaster that was orchestrated by humans.

The poet uses the concept of shedding tears to draw the world's attention to inequities in human interactions. Additionally, the poet suggests a different approach, known as the art of revolution, as a solution to socio-political and economic injustices in both national and international affairs. The poet presents the poetics of liberation struggle as essential in countering the threat of tyranny in the poems included in the section titled: "War without Arms." Poems such as "Ants and Flies," "EFEEGA: War of Ants," "Rise!" and "When Shall We Rise?" are characterized by a profound sense of anxiety and unease, but they provide a confrontational resolution to the issue of class conflict. In the poem "EFEEGA," the poet encourages us to confront the formidable hill that we have built with our efforts and hard work. This uphill battle is a metaphorical conflict where we strive to regain the rewards and achievements of our existence, even if we are unarmed.

Idris Amali's poetry collection reaffirms his position as a prominent socialist realism poet. He sees struggle as the one path to escape the stagnant state in which the subaltern class now resides. The poet urges nonviolent resistance against those who are armed. This kind of evangelism becomes necessary due to the progress of democracy in the modern era. Nevertheless, this conclusion reveals the underlying rage that runs throughout the fabric of the poetry. Therefore, the main flaw of the collection is that it promotes warfare without weapons. Nigerians have organized several protests, although these demonstrations have not resulted in a shift in power dynamics or the emancipation of the marginalized class from persistent exploitation and oppression. Arms play a crucial role in the conflict between social classes. It is important to remember the quote from Moa Zedong, which states that power originates from the use of force. The oppressors experience oppression due to the advantage of possessing superior weaponry. What would be the level of equilibrium if the individuals who are being oppressed were equipped with weapons to confront the colossal entity that has impenetrable protection?

Climate Changes in Northern Nigeria

The changes occurring in the environment in Northern Nigeria is depicted in Idris Amali's *Efeega: The War of Ants*. The conflict includes both people and animals, and it extends beyond using symbolic representation to depict changing climates. Amali's *Efeega: The War of Ants* focuses on the interdependence of all things, particularly human life. The poet's analysis is on the environmental deterioration of Northern Nigeria's terrain and the government's involvement in it; the security agencies in their fight across the Nigerian forest with bandits, kidnapers and so on.

In Amali's *Efeega: The War of Ants*, one may discern the presence of ecocritical elements that have the potential to influence human behaviour in response to perceived environmental degradation. Amali's collection is composed in the manner of free verse, with the poet's ideas seamlessly transitioning from one line to the next by use of enjambment. The poem "Efeega: The War of Ants" uses rural vistas, landscapes, streets, and the natural world as settings to effectively depict the physical and psychological challenges experienced by individuals of all genders and ages, as well as animals.

*The gao tree had stood here
Before the bulldozers, tree hewers of machine tech
Before the teeming crowd surged through
The nerves of the hearts of the sand dunes
With scattered gao and baobab trees
The gao tree had stood here
Before the surging and trampling crowds came*

The canopies of baobab trees also provide shelter, making them an appropriate site for a marketplace in many rural communities. Moreover, the trade of baobab tree products acts as a significant income source for indigenous communities. Baobab trees are essential elements of the dry African savannas, serving both practical use for humans and playing a critical ecological function. Importantly, baobab trees have a crucial role in preserving soil moisture, facilitating nutrient recycling, and mitigating soil erosion, as shown in this particular instance, despite their long-standing resistance. However, deforestation has caused a lot. For example:

*But today without
The wind, heat, rain and storm
The bulldozer
And fire
The huge withered gao tree of decades past
Lies flat from the watchful night
To block the route of life
As the paskares clamour for life
Clamour to devour the pains of the gao tree
To live a life*

In exploring issues about the deforestation of the Nigerian environment, the above stanza presents all evidences that people and the negligence of the government are responsible, ignoring the need to guide the populace on how to manage the environment and no concrete strategic policies to ensure a sustainable landscape. On this note, Moran (1) avers that "yearly, the earth continues to be treated with little thought for the future as... the story goes on, giving cause for considerable alarm." The increase in Nigeria's government's negligence on policies to sustain the environment has brought about many alterations in the Nigerian environmental balance, being that nature now lies in subjection to man's powers.

Amali's *Efeega: The War of Ants* provides a literary foundation for strengthening the environment, perhaps guiding human behaviour away from causing harm to ecological balance. As a result, the poem "Fallen Gao Tree" effectively conveys vivid imagery of the Nigerian landscape, leaving a lasting impact. The poet thinks that technology/modernisation has had a detrimental influence on Nigeria's natural environment, as expressed by the poet below:

*...Harmattan fires
Tree trimming environmentalist axes
Only for a fire.*

Deforestation and forest fires are two (2) major factors that lead to the occurrence of the syndrome referred to as 'solastalgia'. In essence, an unstable environment may lead to substantial and long-lasting hardship for the inhabitants of that area. Events that might cause solastalgia include occurrences such as droughts, forest fires, floods, deforestation, mining, air pollution, extreme weather, and other factors that lead to the harm or alteration of property. These incidents have been recorded in several areas of northern Nigeria, with mining being particularly prevalent across the region. Forest fires and deforestation are prevalent over the whole region. Moreover, it is essential to recognise that people who experience the same environmental traumas, such as a flood or fire, may have different responses and endure diverse impacts on their mental health. Similarly, Arne Naess and George Sessions express similar views, asserting that "humans lack the entitlement to diminish the abundance and variety of nature, unless it is done to fulfil essential need".

"Efeega: The War of Ants" portrays the natural world as a chaotic and bewildering story, as shown by many events. This is reflected in the lyrical lines: The wind decided to come

*Uprooting our trees and roots of life
Tearing roofs apart and with his mighty axe
Beheading trees of life.
(13-14).*

Furthermore, the poet used striking imagery such as "tearing roofs apart," "our trees and roots of life," and "wind decided" to effectively depict the significant repercussions of environmental devastation on the Nigerian landscape, particularly in North Eastern Nigeria, and the survival of its residents. The poet emphasises the sombre truth of humanity's detrimental deeds, which undermine the sanctity of the natural world. Ynestra King (1987) underscores the need for us to "champion the rights of those who are silent, such as nature, since they are unable to articulate their needs within the political domains of our society" (3).

Effects of Climate Changes in Selected Poems

The climate change which occurs as a result of damages to physical and social infrastructure, physical health effects, food and water shortages, conflict, and displacement from acute, subacute, and chronic climatic changes. One of the most well-

documented climate hazards in Nigeria is soil degradation, Deforestation, as a result of oil exploration.

Deforestation is one among the problems most often impacting those living in rural and remote communities in Northern Nigeria. This subsequently affect the economic and mental wellbeing of people in most communities. In a quantitative analysis of distress in northern Nigeria, Amali, found that rural dwellers especially the Borno communities experience more distress due to the deforestation than their urban counterparts.

Minor Effects

Changes in precipitation patterns: Climate change can lead to changes in the frequency and intensity of precipitation, resulting in altered rainfall patterns in certain regions. Shifts in ecosystems: Changes in temperature and precipitation can cause shifts in the distribution and composition of plant and animal species, potentially leading to ecosystem imbalances. Increased frequency of extreme weather events: Climate change is expected to lead to more frequent and intense extreme weather events, such as hurricanes, heat waves, and heavy rainfall, which can have localized, short-term impacts.

The poet's description of the tremendous heat wave in Maiduguri portrays the city as having scorching temperatures that reach a boiling point of 100 °C, symbolising the severity of the city's unfavourable climate. This is how the poet has it in "Maiduguri"

*This city that boils up
With tsunami of heat waves
Melting down mounting hopes
To 150^oC
That offer no hiding abodes
For the poor
As the gods we placed
Pass in heat and heat wave proof
..... (27)*

In this poem, the city of Maiduguri and its surroundings are vividly depicted as a sun-drenched, sandy, desert-like metropolis with an always elusive expectation of rainfall. The poet highlighted a significant depletion of the natural resources, which resulted in the unfavourable condition of the inhabitants in this region of Nigeria. The poem highlights several aspects including as Removing the vast amounts of dust from the Sahara Desert, Dispelling the vast clouds during the early morning hours, Dispelling the anticipation of rainfall. These can be part of the effects of changing climate.

Major Effects

Rising sea levels, as global temperature rises, polar ice caps and glaciers melt, causing sea levels to rise. This has the potential to inundate coastal areas, displacing populations and leading to loss of land and infrastructure.

Threats to food security: Changes in temperature and precipitation patterns can affect crop yields, leading to food shortages and potential conflicts over resources. Public health impacts: Climate change can have a range of public health impacts, including the spread of vector-borne diseases, increased heat-related illnesses, and impacts on air and water quality. Economic consequences: Climate change can have significant economic impacts, including damage to infrastructure from extreme weather events, loss of property value in coastal areas, and disruptions to industries such as agriculture and tourism.

*He lives today in a pool with cows
Tomorrow to gulp the alluvial
Tomorrow next to live a life...
From the cow pond to govern out thoughts
And administer out welfare
As our brothers from the swamps and fortified vegetation
Mourn for a change whether right or wrong*

Displacement of populations: Rising sea levels, extreme weather events, and changes in agricultural productivity can lead to the displacement of populations, both within and across national borders, contributing to potential refugee crises. It's important to note that while some of these effects may be considered "minor" or "major," they can all have significant and far-reaching implications for both human and natural systems. Addressing climate change and mitigating its impacts is a critical global challenge.

These effects may rise in the number of 'climate migrants' These consequences may include things like a diminishment in community cohesion, the loss of community identity, threats to a sense of continuity and sense of belonging as people are forced to move in and out of communities because of environmental stressors, and an undermining of cultural integrity if people have to leave their homelands the poem bring example of that in his poem "Maiduguri of peace" evidence of Solastalgia is vivid as the major effect of changing climate.

*Yes the ants carry each other carefully
Triumphant from the battle of life
Each with mouthful of white object
Across the door-steps of my house
Deep below the Dogon Dutse*

Even the ants move migrate in search for another place. Migration challenges the identity, sovereignty and heritage of people who have to leave their homelands. It also challenges the integrity and continuity of people's traditional ways of life. Threats to community health also include an increased likelihood of criminal behavior, violence and aggression as community members experience various stressors related to climate change.

Conclusion

The poetry of Idris O. Amali emphasizes the importance of enhancing Indigenous communities' representation and viewpoints in discussions about climate change. Climate change emphasises the need to recognise and deal with the emotional impact of environmental degradation, in addition to the pressing necessity of acting to combat climate change. Recognizing the interdependence of ecological and cultural devastation, we can strive for a fairer and more enduring future that places importance on biocultural customs and ancestral territories.

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TECHNOLOGY AND CLIMATE RESILIENCE STRATEGIES FOR IMPROVED MAIZE YIELD IN GOMBE STATE

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Abstract

This study explored how technology helps reduce climate change's effects on maize yields in Gombe State. The Fully Modified Ordinary Least Squares (OLS) method was used as the estimation approach with a dataset covering the period from 1996 - 2022. The result revealed that in the long run, rainfall and technology have a positive impact on maize yield. In contrast, relative humidity and temperature have a negative effect on maize yield in the state. To further validate the results, other estimation methods, such as Dynamic OLS and Canonical Cointegration Regression (CCR), were estimated to enhance the robustness and accuracy of the results. The results affirmed that relative humidity and temperature negatively impact maize yield, while rainfall and technology showed positive long-term effects. The study recommends encouraging the use of heat- and drought-resistant maize varieties.

Keywords: *Technology; Variability in climate; Maize yield; Sustainability*

Introduction

Statistics from the Nigerian Meteorological Agency revealed a warming trend over the past few decades, with average temperatures increasing by approximately 1°C between 1961 and 2010 (NiMet, 2018). This trend aligns with global climate change patterns. Additionally, data from the Food and Agriculture Organization (FAO) indicates that maize yields in Nigeria have shown fluctuations over the years, influenced by climatic factors and other agricultural practices within these periods (FAO, 2020). Thus, climate variability associated with changes in temperature and rainfall patterns can significantly

impact maize yield in Nigeria, particularly in maize-producing states like Gombe. Hence, temperature changes can affect the growth and development of maize plants, and irregular rainfall patterns or droughts can lead to water stress and reduced yields (Benmehaia, 2023).

Understanding factors influencing the adoption of several Climate-Smart Agricultural practices that support policy intervention to reduce the detrimental effects of climate change has become a source of concern (Erekalo and Yadda, 2023). Farmers in Gombe often have to adopt several Climate-Smart agricultural practices to cope with changing climate conditions. This involves selecting maize varieties that are more resilient to temperature extremes or water scarcity, adjusting planting and harvesting times, and implementing irrigation systems to mitigate water shortages. The adoption of such practices is not only strange and stressful to farmers, but the lack of specialization and scarcity of such varieties also lead to low maize yields.

This study is inspired by the need to achieve sustainable development goals of zero hunger and alleviating poverty, use of technology innovation to reduce the effect of climate change on maize yield, which could not be utilized efficiently due to financial, infrastructural and educational barriers and; the gap in extant studies of paucity of studies in the study location. In addition, the a need for food security and sustainability. However, food productivity has been seen as the cornerstone of achieving global food security. However, its sustainability is intricately linked to the evolving climate. Crop yields face unprecedented challenges when climate change accelerates, altering temperature and precipitation patterns. Ascertaining the link between climate change and crop yield is crucial, particularly in regions heavily reliant on agriculture in Nigeria (IPCC, 2014).

Methodology

The Study area

Gombe State is situated in the northeastern part of Nigeria, positioned between latitudes 9°30' and 12°30'N of the Greenwich Meridian and longitudes 8°45' and 11°45'. It shares its borders with Bauchi State to the West, Adamawa and Taraba States to the South, Borno to the East, and Yobe State to the North. In 2022, the population of Gombe State stands at 3,960,100 based on projections of the National Population Commission (NPC) Census of 2006. The state comprises eleven local government areas and is divided into three senatorial districts: Gombe Central, Gombe North, and Gombe South. The predominant occupation of the residents is agriculture, making Gombe primarily an agrarian state. Figure 1 presents the map of Gombe state.



Figure 1: Map of Gombe state

Source: Sule (2019)

Data sources

Data collection involves systematically gathering information to address research questions and achieve study objectives (Smith & Johnson, 2020). Researchers have employed various methods to collect data, selecting approaches that align with the research's scope and goals (Jones et al., 2018). Thus, temperature, rainfall, relative humidity, and crop yield data were collected from various sources, including the Gombe State Meteorological Weather Station, the Upper Benue River Basin Development Authority at Dadin-Kowa, and the Gombe State Agricultural Development Programme (GDP). However, a dummy variable was created to measure technological innovations and their influence on climate variables against maize yield. This is because data in the study area were not readily available as Gombe state was created in 1996. Hence, the time frame for the data used for this study spans from 1996 to 2021. Data on temperature, rainfall, and relative humidity constitute the main variables that measure and define changes in any region's climate. Hence, this study opted to use such variables as previously used in a study by Muhammad et al. (2022).

Model Specification

The modelling method of this study was adopted and modified from the work of Zhang et al. (2022) and Oparinde and Okogbue (2018), which investigated the connection between agricultural production and climate factors. The modification in this study includes focusing on maize yield and the innovation of creating a dummy variable to measure the presence of technology and its effect on climate change towards influencing variability in maize yield. Thus, the functional and econometric specifications of the models are presented in models 1 and 2.

$$MAYD = F(TEMP, RAIN, RHMD, TECH) \quad (1)$$

$$\ln MAYD = \theta_0 + \theta_1 \ln TEMP + \theta_2 \ln RAIN + \theta_3 \ln RHMD + \theta_4 \ln TECH + \mu \quad (2)$$

Where \ln represents natural logarithm, $MAYD$ represents maize yield, which is the dependent variable, while $TEMP$ indicates temperature, $RAIN$ denotes rainfall, $RHMD$ represents relative humidity, $TECH$ represents technology are the explanatory variables, 0_0 is the intercept of the model, while u is the error term. Unit root and cointegration were performed on the data before estimating the long-run results using these models.

Results

The summary statistics (mean, maximum, minimum, standard deviation, skewness, kurtosis, Jargue-Bera and probability values) and correlation matrix of the data set considered are displayed in Table 1. As indicated, the probability values computed for the Jargue-Bera distribution are higher than the conventional statistical significance levels, which signifies that all the variables were normally distributed. In terms of skewness of the distribution, only Temp was negatively skewed, whereas the other variables ($MAYD$, $RAIN$, $RHMD$, and $TECH$) were found to be positively skewed. Also, the Kurtosis statistics of the series showed that all the variables ($MAYD$, $RAIN$, $TEMP$, $TECH$) were platykurtic, except $RHMD$, which was found to be leptokurtic.

We further estimated the dependent variable (maize yield) and the explanatory variables (relative humidity, rainfall, temperature, and technology) using Pearson's correlation coefficients to reduce the impacts of multicollinearity in the data set. According to Tabachnick et al. (2007), the relationship between two explanatory variables must be more than 0.9 for multicollinearity to occur. The estimated result in Table 1 revealed a negative correlation between $RHMD$, $TEMP$ and $MAYD$. At the same time, a positive correlation exists between $RAIN$ and $MAYD$. Thus, this makes them more relevant to our estimation model. Additionally, the highest correlation coefficient of our explanatory variables is between $MAYD$ and $TECH$ (0.83), which is slightly below 0.9. Thus, multicollinearity cannot be considered a significant threat to our regression analysis.

Table 1: Summary of Statistics and Correlation

	MAYD	RHMD	RAIN	TEMP	TECH
Mean	284889.0	47.7765	908.58	34.36	0.4615
Max.	534050.0	55.0800	1119.30	35.92	1.0000
Min.	78940.00	41.2300	724.80	31.67	0.0000
Std. Dev.	186980.8	3.0421	97.0859	1.24	0.5084
Skew.	0.4146	0.1673	0.3149	-0.5644	0.1543
Kurt.	1.2626	3.4737	2.5513	2.1233	1.0238
J-B Test	4.0147	0.3644	0.6479	2.2132	4.3339
Prob. Value	0.1343	0.8334	0.7233	0.3307	0.1145
Sample (n)	26	26	26	26	26
	LMAYD	LRHMD	LRAIN	LTEMP	TECH
LMAYD	1.0000				
LRHMD	-0.3316	1.0000			
LRAIN	0.4867	0.0799	1.0000		
LTEMP	-0.1834	0.0132	0.0755	1.0000	
TECH	0.8359	-0.3830	0.3621	-0.2629	1.0000

Haven presented the descriptive and correlation results; unit root (stationarity) tests using ADF and PP were conducted on the datasets, and the result reveals that most of the series are stationary at first difference. In addition, a cointegration test was conducted to ensure the variables were in a long-run relationship before applying the Fully Modified estimation method and other robustness methods.

The long-run results are presented in Table 2. The results reveal that relative humidity has a negative impact on maize yield. This outcome is consistent across all estimation methods but is significant when using canonical ones. An increase in relative humidity by 1% will decrease maize yield by 0.02%. On the other hand, the finding suggests that rainfall positively affects maize yield. This outcome is consistent across the applied estimation approaches and statistically significant except for the dynamic OLS method. Concisely, a 1% increase in rainfall will increase maize yield by about 0.03%. The long-run test has also been performed between temperature and maize yield, and the result suggests that temperature has an adverse effect on maize yield, as a 1% increase in temperature will reduce maize yield by about 0.05%. We have also estimated the relationship between technology and maize yield, and the result indicated that a positive statistical relationship exists between technology and maize yield. For example, % increase in technological innovations by 1% can improve maize yield by 0.01% in the long run. These outcomes of the relationship between relative humidity, rainfall, temperature, technology and maize yield were consistent with the work of Zakari et al. (2019), Rosenzweig et al. (2021), Muhammad et al. (2022) and Benmehaia (2023).

Table 2: Results for FMOLS, DOLS, CCR long-run relationship

Variables	FMOLS		DOLS		CCR	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Inrhmd	-1.1489	-1.3200	-2.2562	-1.2948	-1.7988*	-1.7983
Inrain	1.6472**	3.1026	0.2092	0.1944	2.3533**	3.1675
Intemp	0.3538	0.6428	-5.4388*	-1.9469	1.9187	1.1389
Tech	1.1279***	8.9737	1.0472***	4.6775	1.0731***	8.1962
C	1.8502	0.2910	38.4632**	2.3760	-4.0267	-0.4944
R ²	0.7098		0.9878			
Adjusted R ²	0.6822		0.9553			
	0.6518					
	0.6186					

Note: (***), (**), and (*) indicates the significant level at (1%), (5%), and (10%).

Source: Author's Computation (2023)

Additionally, the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of recursive residuals of Square (CUSUM of Squares) were used to assess the stability of the estimated model. The coefficient of CUSUM of Square, as indicated in figure 2a&b, are within the model's upper and lower critical bounds at the 5% level. As a result, it was concluded that the model estimated was reasonably stable during the study period.

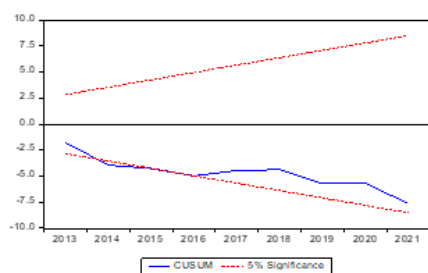


Figure 2a: Plot of CUSUM Test

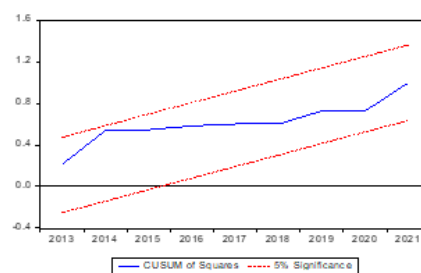


Figure 2b: Plot of CUSUM of Squares Test

Conclusion and implications

This study investigates technology and climate resilience strategies for improved maize yield in Gombe state, using annual data from 1996 to 2021. The fully modified estimation method was employed and supported by dynamic and conical estimation approaches. The result shows that relative humidity has an inverse effect on maize yield, which is consistent across all estimation methods but significant when using the canonical estimation method. Moreover, the result indicates that rainfall has a positive and important impact on maize yield. This result is consistent across the applied estimation methods and significant except for the dynamic OLS method. Estimation has been performed equally between temperature and maize yield, and the result indicates that temperature has a negative impact on maize yield. The relationship between technology and maize yield has been estimated, and the result shows that a positive and statistical connection exists between technology and maize yield. The policy implication of the study recommends that stakeholders seeking to promote innovation and green development in agriculture should encourage the development and usage of heat- and drought-resistant maize varieties because extreme weather events can be tolerated by these varieties of seed, which also yield greater consistency in outputs.

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