

**10th International
Interdisciplinary Research
& Development Conference**



**Theme: Pathways to Good Governance,
Sustainable Development, Economic
Transformation & Security in Nigeria**

**CONFERENCE
PROCEEDINGS**

14TH - 15TH MAY, 2025





10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

VENUE: BENUE STATE UNIVERSITY, NIGERIA

THEME

Pathways to Good Governance, Sustainable Development, Economic Transformation & Security in Nigeria

DATE: Wednesday 14th - Thursday 15th May, 2025

TIME: 10:00am

CONFERENCE LOC

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Benue State University, Markudi, Nigeria

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10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

VENUE: BENUE STATE UNIVERSITY, NIGERIA

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DAY ONE: Wednesday 14th May, 2025

Conference Briefing via Google Meet	- 10:00am - 10:30am
Online Visual Presentation via Google Meet	- 10:30am - 1:00pm
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DAY TWO: Thursday 15th May, 2025

Conference Briefing via Google Meet	- 10:00am - 10:30am
Online Visual Presentation via Google Meet	- 10:30am - 1:00pm
WhatsApp Video Presentations	- 3:00pm - 4:00pm



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10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

BENUE STATE UNIVERSITY, NIGERIA | WED. 14TH - THU. 15TH MAY, 2025

IMPACT OF INFLATION ON ECONOMIC GROWTH IN NIGERIA

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Abstract

The persistent inflation issue in Nigeria has raised concerns about its impact on the country's economic growth. Understanding the relationship between inflation and economic growth is crucial for policymakers to design effective strategies that promote sustainable development. This study investigates the relationship between inflation and economic growth in Nigeria. Specifically, it seeks to determine the extent to which inflation impacts economic growth and to identify the key factors that mediate this relationship. The research employs a quantitative approach, utilizing time series data spanning from 2000 to 2023. The Consumer Price Index (CPI) is used as a proxy for inflation, while Gross Domestic Product (GDP) represents economic growth. The study applies the Ordinary Least Squares (OLS) regression method and Granger causality tests to analyze the data and establish the direction of the relationship between inflation and economic growth. The results indicate a statistically significant positive relationship between inflation and economic growth in Nigeria. The analysis reveals that moderate inflation levels can stimulate economic growth by encouraging spending and investment. However, high inflation rates are found to have a detrimental effect on economic growth, leading to uncertainty and reduced investment. The study concludes that while inflation can have a positive impact on economic growth at moderate levels, excessive inflation poses a threat to economic stability and growth. Policymakers should aim to maintain inflation within an optimal range to harness its growth-stimulating effects while avoiding the adverse consequences of high inflation. Based on the findings, the study recommends that the government implement monetary policies that target a moderate inflation rate to foster economic growth and promote policies that stabilize the exchange rate to support economic growth.

Keywords: Inflation, Economic Growth, Consumer Price Index, Gross Domestic Product, OLS.

JEL Classification: E31, O40

Introduction

Inflation is widely discussed in economic contexts, representing the overall rise in prices of goods and services, which diminishes money's purchasing power. Economic growth, conversely, refers to a country's increased economic productivity, typically gauged by its Gross Domestic Product (GDP). In Nigeria, inflation has remained a significant economic issue, with rates fluctuating due to various internal and external factors. As an oil-dependent nation, Nigeria's economy is highly vulnerable to global price shocks and exchange rate fluctuations that often lead to inflation (Abdullahi, 2023). Moreover, challenges such as inadequate infrastructure, reliance on imports, and inefficiencies in the agricultural sector further amplify inflationary pressures (Nwaonuma & Ebubechima, 2023).

Nigeria's economic growth has shown potential during oil boom periods; however, inflation has consistently posed obstacles. High inflation diminishes consumer purchasing power, discourages investment, and affects savings, critical elements for sustained economic growth. Understanding the complex relationship between inflation and economic growth in Nigeria necessitates a detailed exploration (Ezeanyagu et al., 2023). The persistent inflation in Nigeria threatens economic stability by devaluing the naira and increasing living costs, which exacerbates poverty levels. Businesses struggle with rising costs that often result in reduced profitability and constrained growth. These issues ripple through the economy, affecting employment rates and productivity (National Bureau of Statistics, 2023). Additionally, inflation interferes with the monetary policy objectives of the Central Bank of Nigeria, making it challenging to balance inflation control with economic growth initiatives.

Inflation in Nigeria stems from various sources, including government fiscal policies, exchange rate instability, and imported inflation, contributing to its volatility. Policymakers face the critical challenge of addressing these drivers while ensuring economic growth remains sustainable (Nnachi & Ugochukwu, 2023). This study aims to analyze the relationship between inflation and economic growth in Nigeria, focusing on the effects of inflation rate fluctuations on GDP and overall economic performance. Furthermore, it seeks to pinpoint key inflationary factors—such as fiscal dynamics, exchange rate shifts, and systemic inefficiencies—and evaluate their impact on economic growth. For Nigeria, this research is vital, as it provides insights to help policymakers tackle inflation while promoting robust economic development. By identifying and mitigating inflationary challenges without hindering growth, decision-makers can enhance the economic resilience and inclusivity of the nation, ensuring better living standards for its over 200 million citizens and boosting its global standing.

Literature Review

Inflation, a complex and multifaceted economic phenomenon, has been the subject of extensive theoretical exploration. Two widely recognized theories—Cost-push and Demand-pull inflation—provide valuable insights into its causes and implications. Cost-push inflation occurs when production costs, such as wages, raw materials, and energy prices, increase, leading to higher prices for goods and services. This type of inflation is often associated with supply-side constraints, including disruptions in production, import price fluctuations, and exchange rate volatility (Okon et al., 2023). For instance, Nigeria's dependence on imported goods makes it particularly vulnerable to cost-push inflation, as global price shocks and currency depreciation directly impact domestic production costs (Asekunowo, 2023).

Demand-pull inflation, on the other hand, arises when aggregate demand in an economy exceeds aggregate supply, driving prices upward. This phenomenon is typically linked to periods of economic expansion, where increased consumer spending, investment, and government expenditure create upward pressure on prices (Garba, 2023). In Nigeria, demand-pull inflation is often fueled by fiscal policies that prioritize large-scale government spending, as well as monetary policies that expand the money supply (Okeke et al., 2022). For example, during oil boom periods, heightened government expenditure has historically contributed to demand-pull inflation, exacerbating price instability (Morgan et al., 2023). Both theories are highly relevant in the Nigerian context, where inflation is driven by a combination of supply-side and demand-side factors. Cost-push inflation is frequently linked to structural inefficiencies, such as inadequate infrastructure and reliance on imported goods, which increase production costs and limit domestic supply capacity (Garba, 2023). Meanwhile, demand-pull inflation is often amplified by excessive government spending and monetary expansion, which stimulate aggregate demand beyond the economy's productive capacity (Okon et al., 2023).

Empirical Evidence

Numerous studies have investigated the impact of inflation on Nigeria's economic growth. Abdullahi (2023) employed time-series data spanning from 1990 to 2022 to examine this relationship. The study revealed a negative long-run relationship between inflation and economic growth, indicating that persistent inflation undermines economic performance. The findings also highlighted that inflation adversely affects investment and productivity, which are critical drivers of growth.

Similarly, Ezeanyagu et al. (2023) utilized econometric models to analyze the short-term and long-term effects of inflation on GDP. Their results corroborated Abdullahi's findings, showing that inflation negatively impacts economic growth by discouraging investment and reducing consumer purchasing power. The study emphasized the need for effective monetary policies to stabilize inflation and promote sustainable growth. In another study, Nnachi and Ugochukwu (2023) identified fiscal policies and exchange rate instability as significant contributors to inflation in Nigeria. Their research highlighted the role of government spending and currency depreciation in driving inflationary pressures. The authors recommended targeted interventions to address these issues, such as improving fiscal discipline and stabilizing the exchange rate. Further, Bello and Adebayo (2023) explored the sectoral impacts of inflation in Nigeria, focusing on agriculture and manufacturing. Their findings revealed that inflation disproportionately affects these sectors, leading to reduced productivity and higher production costs. The study called for sector-specific policies to mitigate the adverse effects of inflation and enhance economic resilience.

Globally, studies have highlighted the nonlinear relationship between inflation and economic growth. Kachanovich et al. (2023) found that moderate inflation can stimulate growth by encouraging spending and investment. However, high inflation disrupts economic stability, erodes consumer confidence, and hampers long-term growth. The study emphasized the importance of maintaining inflation within an optimal range to balance growth and stability. Akinsola and Odhiambo (2023) conducted a comprehensive review of international literature on inflation and economic growth. Their findings revealed that the impact of inflation varies across countries and depends on factors such as economic structure, policy frameworks, and institutional quality. The

study also noted that developing economies are more vulnerable to the adverse effects of inflation due to structural inefficiencies and weak policy implementation. In a multicountry study, Chowdhury (2023) examined the relationship between inflation, output growth, and uncertainty. The research found that inflation uncertainty significantly impacts economic growth, particularly in developing countries. The study recommended adopting inflation-targeting frameworks to reduce uncertainty and enhance economic performance.

The empirical evidence highlights several key drivers of inflation in Nigeria and globally. In the Nigerian context, fiscal policies, exchange rate instability, and structural inefficiencies are prominent contributors. For instance, excessive government spending and currency depreciation have been identified as major drivers of inflation (Nnachi & Ugochukwu, 2023). Additionally, supply-side constraints, such as inadequate infrastructure and reliance on imports, exacerbate inflationary pressures (Bello & Adebayo, 2023). Globally, factors such as monetary expansion, commodity price shocks, and geopolitical tensions influence inflation dynamics. Studies have shown that these factors can create inflationary spirals, particularly in economies with weak institutional frameworks (Akinsola & Odhiambo, 2023).

Gaps in the Literature

The identified gaps in research on inflation and economic growth in Nigeria include several crucial areas. First, there is limited exploration of how inflation uniquely impacts specific sectors, such as agriculture and manufacturing, which are vital to Nigeria's economy. Second, studies on the relative effectiveness of fiscal and monetary policies in managing inflation are insufficient, leaving uncertainties about which approach works best for Nigeria. Third, while the nonlinear relationship between inflation and growth is acknowledged, the specific inflation threshold beyond which growth is adversely affected remains undefined. Finally, regional disparities in how inflation impacts various areas in Nigeria, considering its diverse economic landscape, are largely overlooked. Addressing these gaps is essential for formulating targeted and effective policies to mitigate inflationary pressures and foster sustainable growth across all regions and sectors.

Methodology

The research employs a quantitative approach, emphasizing the use of numerical data to analyze and interpret patterns, relationships, and trends. This method ensures objectivity and produces measurable outcomes. Key components of the research design include conducting hypothesis tests, performing statistical analyses, and developing econometric models. The process begins with data collection, followed by preparation and cleaning, and concludes with thorough analysis to generate evidence-based conclusions and recommendations. The model of the study is specified as:

$$GDPPC_t = \beta_0 + \beta_1 CPI_t + \beta_2 GS_t + \beta_3 INTR_t + \beta_4 UNEMPL_t + \beta_5 TROP_t + \mu_t$$

Where:

GDPPC_t: Economic growth (dependent variable), Infl: Inflation rate, GS: Government spending, Intr: Interest rate, Unempl: Unemployment rate, and Trop: Trade openness.

β_0 : Intercept, $\beta_1, \beta_2, \dots, \beta_5$ Coefficients of the independent variables, μ Error term

This model assumes that the relationships between the independent variables and the dependent variable are linear and time-invariant. To maintain accuracy and credibility, the study will draw from well-established and trustworthy sources, including: **Central Bank of Nigeria (CBN)** and the **National Bureau of Statistics (NBS)**. Regression analysis and other econometric models will be employed to uncover trends, explore correlations, and determine causal relationships. Advanced techniques such as time-series analysis, hypothesis testing, and model validation will enhance the precision and reliability of the results.

Presentation and Discussion of Results

Descriptive Statistics

Descriptive statistics provide a comprehensive quantitative summary, elucidating the behavior and distribution patterns of the variables within the model. Table 4.1 systematically presents these statistics for all the variables utilized in the study, offering insights into central tendencies, dispersion, and the overall data structure. This preliminary analysis is crucial as it highlights the disparity and variability among the variables, which can significantly impact the subsequent regression estimations. By meticulously analyzing these descriptive statistics, the researcher ensures a robust foundation for the model estimation, paving the way for more accurate and reliable analytical outcomes.

Table 4.1: Descriptive Statistics Results

	LNGDPPC	CPI	LNGS	INTR	UNEMPL	TROP
Mean	7.453931	160.4944	10.68505	12.14156	3.990625	0.427147
Median	7.646982	117.6000	10.81322	11.83253	3.765000	0.421154
Maximum	8.071204	524.9054	11.23828	19.62560	5.710000	0.536989
Minimum	6.333363	29.60007	9.727997	8.084343	3.070000	0.349164
Std. Dev.	0.507547	131.7155	0.467436	3.340637	0.623260	0.052633
Skewness	-1.105535	1.273705	-0.708448	0.785126	1.381386	0.293459
Kurtosis	2.975084	3.865589	2.202921	2.974187	4.160900	1.936843
Jarque-Bera	4.889453	7.238545	2.642928	2.466358	8.980595	1.474777
Probability	0.086750	0.026802	0.266744	0.291365	0.011217	0.478362
Sum	178.8943	3851.867	256.4413	291.3973	95.77500	10.25154
Sum Sq. Dev.	5.924883	399026.7	5.025424	256.6768	8.934416	0.063714
Observations	24	24	24	24	24	24

Source: Researcher's computation (2025) using E-views 10.0

The descriptive statistics in Table 4.1 outline key economic indicators, including GDP per capita, inflation, government spending, interest rates, unemployment, and trade openness. The mean and median values show overall economic stability, although inflation is highly volatile, indicating economic fluctuations. Interest rates vary moderately, affecting financial decisions, while unemployment generally remains steady but occasionally experiences spikes. The data distribution reveals that GDP per capita and government spending are primarily high but sometimes decline, whereas inflation and unemployment tend to cluster at lower values with occasional surges. The statistical normality test confirms that inflation and unemployment are influenced by external factors, making them unpredictable. In summary, the dataset reflects an economy with moderate stability, occasional fluctuations in inflation and employment, and variations in interest rates that impact growth.

Correlation Matrix Analysis

In an attempt to explore the relationship between the dependent variable and the explanatory variables used in the study, a correlation analysis was conducted using Pearson Product-Moment Correlation (PPMC). The correlation analysis provides insights into the strength and direction of linear relationships between pairs of variables. Table 4.2 presents the correlation matrix, illustrating the pairwise correlation coefficients between LNGDPPC and the explanatory variables.

Table 4.2: Correlation Matrix Results

	LNGDPPC	CPI	LNGS	INTR	UNEMPL	TROP
LNGDPPC	1.000000	0.465794	0.933825	0.523722	0.216808	-0.006147
CPI	0.465794	1.000000	0.587457	0.426256	0.187185	0.372499
LNGS	0.933825	0.587457	1.000000	0.550493	0.137875	0.214334
INTR	0.523722	0.426256	0.550493	1.000000	-0.087005	0.145033
UNEMPL	0.216808	0.187185	0.137875	-0.087005	1.000000	0.090147
TROP	-0.006147	0.372499	0.214334	0.145033	0.090147	1.000000

Source: Researcher's computation (2025) using E-views 10.0

The correlation matrix in Table 4.2 shows the relationships between key economic variables. GDP per capita strongly correlates with government spending, indicating that increased public expenditure aligns with economic growth. Inflation and interest rates show moderate connections with spending, suggesting that fiscal policies influence price stability and borrowing costs. Trade openness has weak correlations, implying minimal impact on economic trends. Unemployment also exhibits weak relationships with other factors, indicating that external forces largely drive employment changes.

Unit Root Tests

The Augmented Dickey-Fuller (ADF) unit root test is a widely used statistical test for assessing the stationarity of a time series. The ADF test is an extension of the Dickey-Fuller test and accounts for higher-order autoregressive processes by including lagged differences of the series in the test equation. This helps to address potential autocorrelation issues in the residuals, enhancing the robustness of the test results.

Table 4.3: Stationarity Test Results

Variables	Levels		First Diff.		Order of Int.
	ADF Stat.	Prob.	ADF Stat.	Prob.	
GDPPC	-1.91	0.32	-3.34	0.02	I(1)
CPI	-1.11	0.15	-6.11	0.00	I(1)
GS	-1.55	0.49	-4.16	0.00	I(1)
INTR	-2.27	0.18	-3.08	0.04	I(1)
UNEMPL	-3.39	0.06	-6.01	0.00	I(1)
TROP	-2.53	0.12	-4.98	0.00	I(1)

Source: E-Views Output, 2025.

The Augmented Dickey-Fuller (ADF) test in Table 4.3 examines whether economic variables maintain consistent statistical properties over time. The results indicate that all six variables—GDP per capita (GDPPC), inflation (CPI), government spending (GS), interest rates (INTR),

unemployment (UNEMPL), and trade openness (TROP)—are initially non-stationary, meaning they exhibit trends or fluctuations. However, after first differencing, all variables become stationary, as shown by their probability values dropping below 0.05. All variables are integrated at order I(1).

OLS Regression Results

Table 4.4: OLS Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.450503	0.936713	-3.683630	0.0017
CPI	-0.210302	0.050315	-0.959569	0.0500
LNGS	1.056740	0.091019	11.61006	0.0000
INTR	0.009378	0.011593	0.808973	0.4291
UNEMPL	0.098691	0.052233	1.889445	0.0751
TROP	-1.980808	0.638108	-3.104190	0.0061
R-squared	0.932164			
Adjusted R-squared	0.913321			
F-statistic	49.46934			
Prob(F-statistic)	0.000000			
Dubin-Watson	2.535388			

Source: Researcher's computation (2025) using E-views 10.0

The Ordinary Least Squares (OLS) regression results in Table 4.4 show how various economic factors impact the dependent variable. The coefficients indicate the direction and magnitude of influence, while the p-values determine statistical significance. Government spending (LNGS) shows the strongest positive effect, meaning increased public expenditure significantly contributes to economic performance. Trade openness (TROP) has a strong negative impact, suggesting that a more open economy might reduce domestic output. Inflation (CPI) has a weak negative effect, while interest rates (INTR) and unemployment (UNEMPL) show minimal influence, indicating that these factors may require additional variables for stronger predictability. The model is highly reliable, with an R-squared value of 0.93, meaning it explains 93% of the variations in the dependent variable. The F-statistic confirms overall significance, and the Durbin-Watson value suggests minimal autocorrelation, making the findings robust for forecasting and policy decisions.

Granger Causality Results

Null Hypothesis:	Obs	F-Statistic	Prob.
CPI does not Granger-cause LNGDPPC	22	1.43369	0.2658
LNGDPPC does not Granger-cause CPI		0.09652	0.9085
LNGS does not Granger-cause LNGDPPC	22	3.73225	0.0453
LNGDPPC does not Granger-cause LNGS		1.30658	0.2966
INTR does not Granger-cause LNGDPPC	22	0.33302	0.7213
LNGDPPC does not Granger-cause INTR		4.57760	0.0257
UNEMPL does not Granger-cause LNGDPPC	22	0.23422	0.7937
LNGDPPC does not Granger-cause UNEMPL		0.32443	0.7273
TROP does not Granger-cause LNGDPPC	22	0.19211	0.8270
LNGDPPC does not Granger-cause TROP		0.44983	0.6451

Source: Researcher's computation (2025) using E-views 10.0

The Granger causality test assesses whether past values of one economic variable can help predict another. The results show that government spending (LNGS) significantly predicts GDP per capita ($p = 0.0453$), supporting Keynesian theory, which emphasizes fiscal policy as a key driver of economic growth. Additionally, GDP per capita Granger causes interest rates ($p = 0.0257$),

suggesting that monetary policy responds to economic performance. However, inflation (CPI), unemployment (UNEMPL), and trade openness (TROP) do not show significant predictive relationships with GDP per capita, implying that these variables may be influenced by external factors rather than directly linked to economic growth.

Discussion of Regression and Granger Causality Findings

The Ordinary Least Squares (OLS) regression results provide critical insights into economic relationships, particularly the role of government spending in driving growth. The analysis confirms that LNGS (government spending) is the strongest positive factor, aligning with Keynesian economic theory, which highlights public expenditure as a tool for stimulating economic activity. This suggests that fiscal policies focusing on increased government investment can significantly boost GDP per capita. On the other hand, trade openness (TROP) has a significant negative impact, meaning higher economic openness may reduce domestic output. This result aligns with the Stolper-Samuelson theorem, which explains how liberalized trade can disadvantage certain sectors of an economy, particularly those exposed to foreign competition. The findings suggest that while trade openness can encourage global integration, it may also require balanced policies to protect vulnerable industries.

Inflation (CPI) exhibits a weak negative influence, indicating that rising consumer prices slightly reduce economic output. This follows monetarist theory, which argues that inflation diminishes purchasing power and can create economic uncertainty. While the effect observed in the regression is small, it highlights the need for inflation control to ensure sustainable growth.

Interest rates (INTR) and unemployment (UNEMPL) show minimal effects, implying that their impact on economic output may depend on additional factors. Classical economic theory often suggests that interest rates influence investment and spending decisions, but the weak significance in this model indicates that GDP per capita does not heavily depend on borrowing costs. The Granger causality test further explores predictive relationships between variables. The results indicate that government spending significantly predicts GDP per capita ($p = 0.0453$), reinforcing the Keynesian viewpoint that fiscal policy is a major economic driver. Additionally, GDP per capita Granger causes interest rates ($p = 0.0257$), showing that monetary policy decisions respond to economic performance. However, inflation, unemployment, and trade openness do not significantly predict GDP per capita, suggesting these variables are influenced by broader economic forces rather than directly impacting growth.

Conclusion and Recommendations

The findings emphasize that government spending plays a crucial role in economic growth, while trade openness needs careful management to avoid negative impacts on domestic output. Inflation requires strategic control to prevent economic distortions, and interest rates and unemployment may rely on other factors for stronger predictability. Policymakers should leverage fiscal policies to enhance GDP growth, while monitoring trade policies and monetary interventions to ensure balanced economic stability.

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10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

BENUE STATE UNIVERSITY, NIGERIA | WED. 14TH - THU. 15TH MAY, 2025

SMART WORK-HARD WORK; A CHOICE ON WORK EFFICIENCY AMONG ACADEMIC STAFF FEDERAL UNIVERSITY OTUOKE, NIGERIA

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Abstract

The study investigates the preferences of academic staff at the Federal University Otuoke towards hard work and smart work strategies to enhance their work efficiency. Using the Job Demand Resource Model as a framework, a mixed-method approach was adopted, involving quantitative surveys and qualitative interviews with a sample of 171 academic staff members. The findings reveal that a significant portion of staff members value a balanced approach between hard work and smart work, highlighting the importance of efficiency, work-life balance, and adaptability for improved job performance. Particularly, 45.5% of respondents emphasized work-life balance as the leading factor influencing their performance, while adaptability and motivation followed. Interviews provided deeper insights, illustrating how staff members are increasingly recognizing that a combination of both work methods can lead to better educational outcomes and personal well-being. In conclusion, the study emphasizes the need for university management to cultivate a supportive work environment that encourages both strategies. Recommendations include promoting a work culture that rewards innovative teaching practices, investing in training for digital tools, and implementing flexible scheduling options to enhance staff satisfaction and productivity.

Keywords: Hard work, smart work, academic staff, job performance.

Introduction

Work is a fundamental part of human life and is shaped by specific strategies that guide how tasks are completed. The way we choose to work, whether through smart strategies or hard work, can impact our performance. In organizations lacking a strategic approach, performance can suffer. Ross and Kami (2011) note that without a clear strategy, operational inefficiencies emerge, leading to unproductive activities. In the academic world, universities are unique because they not only create knowledge through research but also share it through teaching (Romainville, 1996, as cited in Bersin, 2023). Furthermore, Jenkins (2004) describes the commitments of academic staff as complex and multifaceted. He emphasizes that the relationship between teaching, research, and other roles requires clear strategies to prevent negative effects that can arise from conflicting demands. When it comes to hard work and smart work approach in any organization, including academic institutions, it is important to understand the balance between the two. Hard work refers to putting in a lot of effort and time into tasks, while smart work focuses on efficiency and effectiveness, using strategies to achieve the same results with less effort. In many cases, hard work is necessary. For instance, in several academic settings, hard work is often a fundamental requirement. Academic staffs are frequently called upon to devote long hours not only to teaching but also to researching and fulfilling various administrative responsibilities. This dedication is essential for maintaining the standards of education and ensuring that students receive a quality learning experience. (Bribebe, Zibokifi & Michael-Olomu, 2024)

At a global level, recognizing the importance of work strategies is more crucial now than ever. Reports highlight a trend where organizations are becoming more focused on effective work strategies that enhance performance, especially in an age where technology is rapidly changing the landscape of work (World Economic Forum, 2023). This shift shows that investing in employee training to develop smart work skills is on the rise. Specifically, many organizations expect to improve their employees' hard work performance as well (World Economic Forum, 2023). In academic settings, the situation can be different. While non-academic sectors might lean towards hard work, academic institutions like FUO often blend both hard work—defined by long hours and determination—and smart work, which prioritizes efficiency and strategic planning (Nag, 2024). This blending is essential as universities face unique challenges related to their dual commitment to teaching and research.

In Nigeria, the understanding of hard work is traditionally linked with the amount of time and effort spent on tasks. Hard work reflects qualities such as resilience and a strong work ethic. In contrast, smart work focuses on efficiency and using strategies to achieve more with less effort (Adeniyi & Adeyemi, 2020). An effective mix of both types of work is believed to enhance job performance for academic staff. Afolabi and Ogunleye (2018) argue that balancing these approaches leads to better outcomes in Nigerian higher education. Research also highlights that heavy workloads can negatively affect academic staff's performance, with studies indicating that excessive traditional hard work can lead to burnout and decreased job satisfaction (Adeyemi & Akanbi, 2018). This point reflects the need for institutions to cultivate strategies that balance both hard and smart work, resulting in higher productivity and job satisfaction among staff.

At the Federal University Otuoke, the balance between hard and smart work is crucial due to the unique demands faced by academic staff. Many challenges, such as work overload, power failure, mobility strain, and the need to balance academic and administrative responsibilities, require

thoughtful strategies to navigate effectively as academic staff need to device between working smart or hard to survive the realities in the system. Previous studies suggest that traditional hard work practices are still prevalent but may not be ideal for long-term performance (Abdullah & Shah, 2014; Olu-Akinawo & Ayodele, 2017). Despite various studies addressing aspects of academic performance, very few have focused specifically on the preferences of academic staff between smart work and hard work. This study aims to fill that gap by exploring which working strategy is adopted by the academic staff at the Federal University Otuoke and why the choice.

Objectives of the Study

- i. To investigate the choice of smart work-hard work towards work efficiency among academic staff at the Federal University Otuoke.
- ii. To identify the factors influencing the academic staff's preferences for smart work or hard work and their perceived impact on job performance.

Literature Review

When discussing hard work or smart work in any organization, it is important to find the right mix of both. Hard work means putting in a lot of time and effort into tasks, while smart work means working efficiently and effectively, using strategies to get the same results with less effort. In many educational settings, hard work is often necessary. Academic staff are usually required to spend long hours teaching, researching, and managing various administrative tasks. This commitment is essential especially in maintaining educational standards and ensuring students receive a good learning experience. Olaniyan (2016) points out that many educators go the extra mile, spending additional time on lectures, research, and grading assignments. Such dedication is admirable and plays a key role in creating a high-quality academic environment. The effort educators put in is closely linked to their students' success and the institution's reputation (Olaniyan, 2016).

However, relying only on hard work can lead to problems like burnout. Uche (2018) notes that while hard work is requisite, putting in too much effort without corresponding efficient methods can hurt effectiveness. Interestingly, in academic environment where deadlines, evaluations, and administrative jobs can become overwhelming, relying solely on hard work can be risky (Uche, 2018). Staff who work excessively may feel stressed, which can reduce their enthusiasm for teaching and hinder their productivity. Therefore, it is important for academic staff to blend hard work with smarter strategies to maintain their effectiveness in the long run (Nwafor, 2017).

Suffice to say that finding a balance between hard work and smart work can help academic staff manage their workloads better. Smart work focuses on working intelligently rather than just hard. It includes using technology and creative teaching methods to improve learning without putting too much pressure on staff (Uche, 2018). For instance, using online platforms for lectures can save time and make materials more accessible for students. This approach not only enhances student learning by offering flexible options but also helps relieve some of the stress on academic staff (Nwafor, 2017).

Additionally, a smart work approach also involves careful planning and prioritizing tasks. Nwafor (2017) mentions that tools like calendars and project management software can be very helpful for academic staff. By using these tools, educators can better organize their responsibilities, focus on priorities, and manage their time effectively. When they can see their tasks and deadlines clearly,

they can concentrate on what is most important, which boosts their productivity. This organized approach helps reduce stress, allowing staff to put their energy into significant projects while efficiently handling routine tasks (Nwafor, 2017).

Theoretical Framework

This study adopted the Job Demand Resource Model developed by Bakker and Demerouti in 2007 as a theoretical framework. This theory is anchored on the assumption that every job has both demands and resources. Job demands are the physical, psychological, social, or organizational aspects of a job that require effort and can lead to negative outcomes, such as burnout, when they are high. As posited by Aliyu and Salami (2018), these demands can include heavy workloads, time pressure, and emotional challenges. On the other hand, job resources are those aspects that help individuals achieve their goals, reduce job demands, and promote personal growth, such as support from colleagues, autonomy, and opportunities for development (Balogun, 2020).

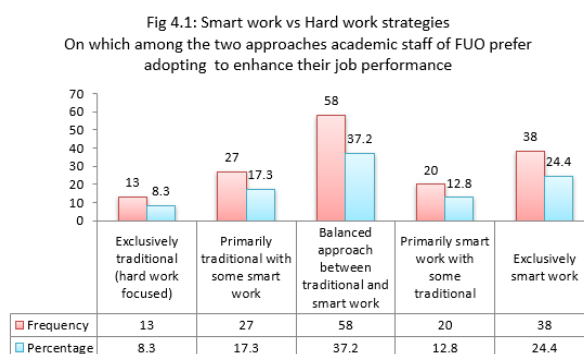
One key assumption of the Job Demand Resource Model is that high job demands lead to stress and negative health outcomes when they are not balanced with adequate job resources. This means that if an academic staff member faces significant demands—like a heavy teaching load or extensive research responsibilities—without enough support, they may experience fatigue or burnout (Bersin, 2023). Conversely, having ample resources can help mitigate these demands, leading to better well-being and performance. Another important assumption of the model is the concept of motivational processes. When employees have access to the necessary resources, they are more likely to engage in their work, feel energized, and be motivated to perform better. This motivational aspect emphasizes the positive effects that resources can have, making people more resilient in the face of job demands. It's crucial to recognize that the interplay between demands and resources creates a dynamic environment that influences employees' well-being and productivity (Chen & Zhang, 2020).

Following these propositions, the theory is considered suitable and useful for this study as it provides a comprehensive lens to understand the experiences of academic staff in universities. Academic staff often juggles multiple responsibilities, such as teaching, research, and administrative tasks, which can be overwhelming. The Job Demand Resource Model allows us to analyze how these job demands impact their work life while considering the resources available to them.

Through the adoption of this model, we can identify specific demands that academic staff face, such as the pressure to publish research or manage large classes. We can also examine the resources that may alleviate these pressures, including support from colleagues, institutional resources, and personal coping strategies. Understanding this balance helps us to propose solutions that can improve the work environment for academic staff. For example, if we find that teaching loads are excessive and support is lacking, universities could consider reducing workloads or enhancing support systems. Furthermore, applying this model facilitates a closer examination of how academic staff can be empowered through resources. By nurturing strengths, such as professional development opportunities and strong mentorship programs, universities can help academics thrive even in demanding environments. Additionally, this model underscores the importance of creating an optimal balance, where job resources are harnessed to counterbalance job demands, thereby promoting enhanced engagement and well-being.

Methods

This study adopted a mixed-method approach as its research design. The mixed method design is a combination of quantitative and qualitative methods. Quantitative methods provides a systematic analyses using numerical and statistical data to elicit and quantify behaviours and attitudes of people while qualitative methods offers a detailed insights into people's perception, thought, and experiences using focuss group discussion (FDGs), key interviews, images, text and observations. The population of this study consists of the entire population of Federal University Otuoke academic staff. According to FOU (2023) Bulletin; the total number of academic staffs of the University stood at (590) five hundred and ninety, spread across eight faculties and Departments. The sample size for this study is 156 for the academic staff. This was arrived at through the use of Taro Yamane sample size determination formula $\{TY = N \div (1 + N(e)^2)\}$. To select the respondents, the the simple random sampling and stratified sampling techniques were employed to select academic staff members across the faculties and departments. In addition to the above, 15 key persons made up of senior academic staff members were drawn purposively for the KPI sessions. This raised the total sample size to 171. The primary and secondary methods of data collection were used. The data analysis was done using descriptive methods for quantitative data while verbatim quotations were used to present the qualitative data concurrently with the quantitative data.



Results and Discussion

The findings from the questionnaire shall be done based on the research objectives since the charts clearly reflect them. All questionnaire distributed were duly completed and collated.

Objective 1: To investigate the preferences of academic staff at the Federal University Otuoke between smart work strategies and hard work approaches in their daily tasks.

Source: Field Survey, 2024.

Fig 4.1 presents data regarding the Smart work vs Hard work strategies, showing which approach respondents prefer to use to enhance their job performance. The chart reveals some interesting insights into how academic staff view these two work methods. Firstly, a small percentage of respondents, 8.3%, indicated that they rely exclusively on traditional hard work strategies. This suggests that very few people believe solely in putting in long hours without any modern adaptations. Next, we see that 17.3% of the respondents lean towards a primarily traditional approach but also incorporate some smart work strategies. This group seems to recognize the

benefits of balancing old and new methods, even if they still favor hard work. The largest group, making up 37.2%, adopts a balanced approach between traditional and smart work. This indicates that a significant number of respondents see value in both methods and strive to find a middle ground to enhance their productivity. Additionally, 12.8% of respondents fall into the category of primarily using smart work strategies while still using some traditional methods. This shows that there are people who strongly prefer smart work but acknowledge the need for some of the tried-and-true practices from the past. Finally, 24.4% of respondents indicated that they rely exclusively on smart work strategies. This group recognizes the potential of modern techniques and tools to optimize their work without the need for traditional efforts.

Suffice to say that while these quantitative findings are concise, the qualitative insights provide more in-depth knowledge of these two approaches. For instance, to understand importance of each approach better, one of our respondent noted;

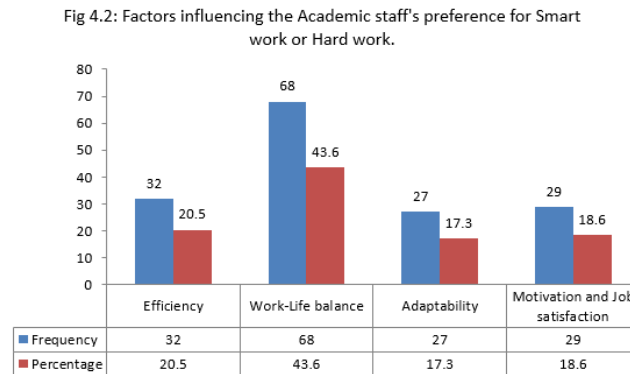
I believe that smart work is way more effective than just hard work. In the classroom, I can spend hours lecturing, but let us say I use engaging tools like videos and group activities, the students learn better. For example, instead of talking for an hour, I might set up a project where students work in teams. They get to collaborate, and I can see how much they understand. This way, I feel like I'm truly teaching and not just filling time with my voice. These are approaches that other civilized societies are already making us of, but lack of such facilities hamper these ideas. (KII Participant, Male, Senior lecturer, aged undisclosed).

This goes further to prove that using smart strategies, like engaging methods, is more beneficial for learning than simply working hard by lecturing for long periods. This shows that academic staff can actually enhance their students' learning experiences and their job performance by being thoughtful about how they teach. If more teachers adopt smart approaches, it could lead to better student performance and deeper understanding of the subject matter, making lessons more enjoyable for everyone involved and project overall better job performance ratings. Similarly, another participant noted;

For me, balancing hard work and smart work is important. I used to think that staying in the lab late hours showed dedication. But that often meant I was too tired to think clearly. Now, I work hard on my projects, but I also make time to plan and think through my experiments during regular hours. That way, I put in the effort where it really counts, and I actually getting better results without feeling overwhelmed. (KII Participant, Male, Senior lecturer, aged undisclosed).

This opinion as was with the quantitative data reflects a balanced approach between hard work and smart work. The fact that the respondent recognizes that simply putting in long hours does not guarantee success is encouraging. This also justifies the simple notion that the combination of hard work with careful planning can lead to better outcomes. The perspective also suggests that for anyone in research or similar fields, finding a balance can improve both the quality of work and personal well-being, ultimately leading to more meaningful achievements.

Objective 2: To identify the factors influencing the academic staff's preferences for smart work or hard work and their perceived impact on job performance.



Source: Field Survey, 2024.

Fig 4.2 presents data pertaining to the factors influencing academic staff's preference for smart work or hard work. The chart shows that various elements play an important role in how staff choose to approach their work. Amongst the key factor is efficiency, with 20.5% of respondents highlighting this as important. This suggests that many academic staff recognize the value of working smarter to get tasks done more quickly and effectively. They may believe that using smart work strategies can help them achieve better results with less effort. Another crucial factor is work-life balance which stood out as the most important factor, mentioned by 43.6% of respondents. This indicates that a significant majority of academic staff in FUIO prioritize having a good balance between their work and personal lives. They likely value flexible work methods that allow them to manage their time better and reduce stress, suggesting that finding harmony in life is a top priority. Adaptability became another identified factor, with 17.3% of respondents identifying this as influencing their preference. This indicates that some staff members appreciate the need to adjust and change their work methods to meet new challenges. They may feel that being open to new ways of working is crucial in the ever-evolving academic environment. The final factor identified is, motivation and job satisfaction which were noted by 18.6% of respondents. This shows that many academics consider how their work strategies impact their overall happiness and engagement at work. In other words, they might believe that smart work allows them to feel more fulfilled in their roles.

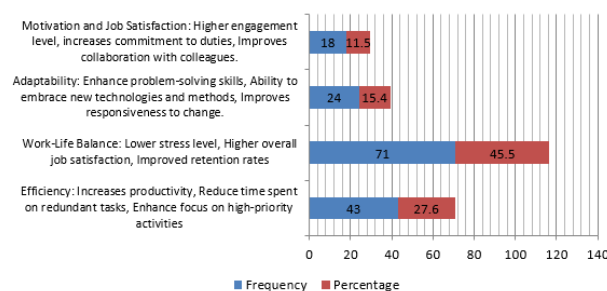
To corroborate these quantitative findings, the interview insights reveal affirming perspectives, confirming that there are notable factors that impact the choice of any of the approaches. For instance, one interviewee highlighted some social conditions that may necessitate the adoption of a given strategy at a given time. According to this participant;

Deciding on any one of these approaches is not an easy one. Firstly, I believe in both hard work and smart work, there are times that you have to employ the hard work approach and there are times that smart work can be employed. For instance, let us say I decide to go digital with my lessons or homework, there are some students who may be constrained by one social condition or the other and may not be able to meet up with the requirements for digital platform lessons or

assignment. So that kind of situations would warrant the lecturers to go for physical lessons and also engage in classroom continuous assessment. (KII Participant, Female, Senior lecturer, aged undisclosed).

This perspective or factor involving students' consideration reflects the need for flexibility in teaching methods. The opinion stresses the importance of recognizing that not all students have the same resources or circumstances. Therefore, balance is key; lecturers must adapt their strategies to ensure that every student can engage with the material, whether through online or in-person learning. This flexibility can lead to better learning outcomes because it meets students where they are, allowing for both hard work and smart work to play a role in their learning outcomes.

Fig 4.3: On how the identified factors impact job performance of Academic staff



Source: Field Survey, 2024.

Fig 4.3 presents data regarding how the identified factors impact the job performance of academic staff at FUO. The chart shows that several elements play essential roles in enhancing how effectively staff can perform their roles. Beginning with efficiency, which was emphasized by 27.6% of respondents, the data indicates that many academic staff believe that being efficient leads to better productivity. When they can reduce time spent on repetitive tasks, they can focus more on what truly matters, such as important projects and student engagement. This prioritization of efforts through efficiency can help staff members achieve more in less time, which is essential in the academic environment.

Next, the most significant factor reported was work-life balance, noted by 45.5% of respondents. These respondents believe that maintaining a good balance between their work and personal lives greatly benefits their performance. They mentioned that when staff experience lower stress levels and higher job satisfaction, they are likely to be more committed to their roles and stay longer in their duties, indicating that a healthy work-life balance clearly contributes to a happier and more productive workforce.

Moving on to adaptability, which was considered impactful by 15.4% of respondents suggests that some academic staff see the ability to adapt as important for their job performance. This means that staff who can embrace new technologies and methods tend to be better problem solvers and can adjust more easily to changes. This adaptability can help them respond effectively to the evolving demands of their roles. Motivation and job satisfaction were noted by 11.5% of respondents as the least factor that impact their job performance. This indicates that while it is a crucial factor, it ranks

lower compared to the others suggesting that higher levels of motivation and job satisfaction can lead to greater engagement among staff. When they feel motivated, they are more likely to take responsibility for their duties and work well with their colleagues. Interestingly, qualitative insights from the interviewees also corroborate the findings presented in Fig 4.3 above pointing out efficiency, Work-Life Balance, adaptability and motivation/job satisfaction as ways through which their job performance has been impacted irrespective of any approach they adopt. According to a respondent;

From the moment I discovered the importance of efficiency within the academic environment, I have been able to manage my duties and responsibilities, ensuring that I do not spend more time on redundant duties, instead I now pay close attention to important activities that are primary responsibilities of an academic staff. Though we remain role models, mentors, counselors, educators, teachers, guardian and so on to our students, but this is without forgetting our primary obligation. (KII Participant, Female, Senior lecturer, aged 39years)

Another participant noted;

The motivation that I get from employing smart tools to aid my lecturing has greatly impacted my job performance. Before now I get discouraged coming to class to dictate notes to the students. The thoughts of even losing my voice while speaking to a class of over a hundred students in a GES class further escalated my displeasure. However, contemporary tools such as the use of digital platform to share lesson notes and the use of public address system while teaching a crowded class has motivated me in some ways, thereby improving my performance outcomes. (KII Participant, Male, Senior lecturer, aged undisclosed).

These insights present how different factors play a role in influencing job outcomes within the academic space. The first participant stressed on the importance of being efficient in their work by paying attention to what truly matters—like teaching and mentoring students—so as to avoid wasting time on tasks that do not contribute to their main responsibilities. This awareness helps them balance their many roles as educators while ensuring they fulfill their essential duties effectively. The second participant emphasizes how using smart tools has made a significant difference in their teaching experience noting how they used to feel overwhelmed by the idea of talking for long periods to a large class, which made them less excited about teaching. However, with the help of digital platforms for sharing notes and tools like a public address system, the process has become easier and more enjoyable. This not only makes teaching more manageable but also boosts their motivation and performance.

Conclusion and Recommendations

In conclusion, this study has illuminated the preferences of academic staff at the Federal University Otuoke regarding their working strategies, balancing between hard work and smart work to enhance work efficiency. The findings reveal that most staff members value a blend of both approaches, with an emphasis on strategies that lead to efficiency, work-life balance, adaptability, and overall job satisfaction. These factors significantly influence their performance and job outcomes, portraying the necessity for academic staff to adopt a flexible mindset that can adapt to varying demands. Based on this, the study offers the following recommendations;

- i. The university management should encourage a culture that values both hard work and smart work strategies. This can be achieved by recognizing and rewarding staff who demonstrate effective time management and innovation in their teaching methods, thereby fostering a more productive environment.
- ii. The university should invest in training and providing resources for academic staff to effectively use digital tools and smart teaching strategies. This will not only improve their teaching experience but will also lead to more engaging and efficient learning environments for students.
- iii. Academic staff should be encouraged to adapt their teaching strategies based on students' needs and circumstances. This flexibility can include a mix of traditional and modern teaching methods, catering to diverse learning styles and situations.
- iv. The university management can implement policies and programs that promote work-life balance for academic staff. This could include flexible scheduling, mental health support, and wellness programs that help reduce stress and enhance job satisfaction, thereby leading to better overall performance.

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10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

BENUE STATE UNIVERSITY, NIGERIA | WED. 14TH - THU.15TH MAY, 2025

EFFECT OF PLANT GROWTH REGULATORS ON THE PERFORMANCE OF VEGETABLE AMARANTH (AMARANTHUS CAUDATUS L.) IN MUBI NORTHERN GUINEA SAVANNAH ZONE OF NIGERIA

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Abstract

*Low crop productivity is a general problem facing most farming systems in Nigeria. Due to the increase in demand in urban areas where people are not involved in the primary production, the demand for vegetable amaranths has increased. Field trial was conducted during 2022 cropping season, under rain fed condition at Department of Crop Science Teaching and Research Farm, Food and Agricultural Organization/Tree Crop Program (FAO/TCP) farm, Adamawa State University, Mubi. The treatments consisted of four Plant Growth Regulators (Gibberellins, Cytokinins, Indole butyric acid and Water as the control). The treatments were laid in a Randomized Complete Block Design (RCBD) replicated three (3) times. Data were collected on plant height, number of leaves, fresh plant weight, leaf area index, absolute growth rate, relative growth rate and fresh vegetable yield. Data collected were subjected to Analysis of Variance (ANOVA), Least Significant Differences (LSD) was used to separate the means at 5 % level of probability. The result shows that foliar application of gibberellins recorded the highest mean values in all the growth parameters measured. Higher fresh vegetable yield (79.07 tones ha⁻¹) was also obtained in the application of gibberellins. For the best growth and yield of vegetable amaranth (*Amaranthus caudatus* L.), foliar application of gibberellins was found to be realistic and is hereby recommended for the farmers in the study area.*

Keywords: *Amaranthus caudatus*, plant growth regulators, growth and vegetable yield.

Introduction

Vegetables are essential in the diet for humans as they provide plant fibre, mineral elements, vitamins, carbohydrates and proteins, (Hollingsworth, 2017). *Amaranthus caudatus* L. is a leafy vegetable commonly cultivated in Nigeria and other West African countries (Olorode, 2015). Aphane et al. (2016) reported that foods of animal origin which are known was the major source of vitamins and proteins are very expensive for poor households. Fruits and vegetables could alternatively play a major role in alleviating problems associated with malnutrition due to their ability to supply proteins, vitamins, calories and other nutrients needed in a balanced diet (Wehmeyer and Rose, 2018). Laker (2007) observed that of more than 100 different indigenous leafy vegetable species in Africa, amaranth is the most widely consumed. Amaranth, a C₄ plant, is one of a few dicots in which the first product of photosynthesis is a four-carbon compound. Mabulu and Chalamila (2005) reported that the average leaf yields of amaranths in Sub-Saharan Africa are less than 1.2 t ha⁻¹, against the potential yield of 32-40 t ha. Most of existing cultivars of amaranth in Africa are generally much smaller, up to 50 cm, strongly branched and prostrate with many flowers and small leaves which creates difficulties during harvest particularly *A. blitum* and *A. graecizans* (Mabulu Chalamila, 2005). Amaranth requires 40-50% less moisture than maize and survives better than most crops under dry and hot conditions because of its extensive root system and use of C₄ photosynthesis mechanism (Stallknecht et al., 2018).

African indigenous vegetables play significant role in the food security of the under-privileged in both urban and rural settings (Schippers, 1997). Many communities used vegetables as source of energy and micro nutrients in their diets. Vegetables are usually picked fresh, used as greens in salads or blanched, steamed, boiled, fried in oil, and mixed with meat, fish, cucurbit seeds, groundnut or palm oil. Cooked greens can be used as a side dish, in soups or as an ingredient in sauce and baby food etc. (Grubben and Denton, 2004). Improved vegetable productivity and resources use efficiency could only be achieved, when appropriate planting technique and seed density, adequate application of fertilizer and use of Plant Growth Regulators (PGRs) are available.

For sustainable food production to meet the increasing population in Nigeria, the production of vegetable amaranths needs to be increase through proper application of plant growth regulators that can give maximum output because most vegetable amaranth growers in Nigeria do not apply PGRs. Vegetables can be grown all year round and can be produced even on marginal soils. Most of the important indigenous vegetables including amaranth have been identified as having potential for commercial exploitation and production for human consumption (Taylor and Moss, 2020). Most indigenous plants are adapted to the prevailing conditions and require few agricultural inputs and perform well in areas unsuitable to introduced vegetables (Aphane et al., 2016).

Amaranth is considered as underutilized crop (NRC, 1984) and has, until recently, received little research attention. Low crop productivity is a general problem facing most farming systems in Nigeria. Due to the increase in demand in urban areas where people are not involved in the primary production, the demand for this vegetable crop has increased (Schippers, 1997); this has made the vegetable amaranths to become an important commodity in the market and its production an important economic activity for the rural people. However, yield per hectare of this crop is low (7.6 t/ha⁻¹) when compared to that of United States of America (77.6 t/ha⁻¹) and world average (14.27 t/ha⁻¹) (FAO, 2014). This may be due to poor cultural practices such as fertilizer application, timely

planting, pests and disease control and non-use of plant growth regulators that can give maximum growth and yield. Even though much work has been done on the performance of vegetable amaranth, but at the moment not much work has been done on the effect of plant growth regulators on the performance of vegetable Amaranth in Mubi environment. Therefore, the right plant growth regulators that can give maximum growth and vegetable yield of amaranths needed to be identified, and this could be achieved through the use of different plant growth regulators.

The objectives of this study are to evaluate the effect of plant growth regulators on the performance of vegetable amaranth and to identify the best plant growth regulators that can give maximum yield of vegetable amaranth in the study Area. This research will facilitate understanding of the plant growth regulators and its effect on vegetable amaranths. The finding of this study will also be of great importance to researchers, farmers and policy makers as a guide to help in solving the issue of low yield among vegetable farmers in Nigeria.

Materials and Methods

Experimental Site

Field experiment was conducted at the Department of Crop Science, Food and Agricultural Organization/Tree Crop Program (FAO/TCP) Teaching and Research farm, Adamawa State University, Mubi, under rain fed condition in 2022 cropping season. Mubi is located in the Northern Guinea Savannah zone of Nigeria, situated between latitude 10°11" and 10°30" North of the equator and between longitude 13°10" and 13°30" East of the Greenwich meridian and at altitude of 969 m above mean sea level (MSL). The mean rainfall of Mubi is 969 mm and a minimum temperature of 18°C during harmattan period and 40°C as maximum in April (Adebayo, 2020).

Treatments and Experimental Design

The treatments consisted four (4) different plant growth regulators viz: Gibberellins, Cytokinins, Indole butyric acid (IBA) and Water. The experiment was laid out in a Randomized Complete Block Design (RCBD) replicated three times. The gross plot size was 2 m × 2 m (4m) and the net plot size 1.5 m × 1 m (1.5 m²), 2 meters was left between replicates and 1 m between plots to check the effects of one treatment on the other.

Application of Plant Growth Regulators (PGRs)

The plant growth regulators were foliage applied at 20 and 30 days after sowing. Gibberellins (5 %) was sprayed at the rate of 600 ml per ha (60 ml was diluted in clean water per knapsack), Cytokinins (0.4 %) was sprayed at the rate of 300 ml per ha (30 ml was diluted in clean water per knapsack), Indole butyric acid (IBA 0.6 %) was sprayed at the rate of 300 ml per ha (30 ml was diluted in clean water per knapsack). The clean water used in the dilution of the PGRs was sprayed to the control plots.

Harvesting

Vegetable amaranth was harvested at 6 weeks after sowing when all the vegetative parts have reached their maximum. The *Amaranthus caudatus* L. was harvested just before flowering in order to maintain quality.

Data Collection

Ten (10) plants were tagged in each plot and data were collected on the following parameters at 3 and 6 WAS: Plant height (cm), Number of leaves, Fresh plant weight (g), Leaf area index (cm), Absolute growth rate (g/d), Relative growth rate (RGR) (g/day), and Fresh vegetable yield (kg ha⁻¹) at harvest.

Data Analysis

Data obtained were subjected to analysis of variance (ANOVA) appropriate to RCBD, least significance difference (LSD) was used to separate the means at 5 % level of probability using SAS, version 9.2 (2008).

Results

Effect of Plant Growth Regulators on Plant Height Plant⁻¹ of Amaranth (*Amaranthus caudatus* L.) at 3 and 6 WAS in Mubi during 2022 Growing Season.

The result of effect of plant growth regulators on plant height Plant⁻¹ of Amaranth (*Amaranthus caudatus* L.) at 3 and 6 WAS during 2022 growing season is presented in Table 1. The result showed a highly significant ($P < 0.001$) difference between the treatments at both 3 and 6 weeks. At 3 weeks after sowing, foliar application of gibberellins recorded the highest value (31.23 cm), followed by cytokinins (24.20 cm) though statistically the same with Indole butyric acid (21.87 cm) and the shortest plants were recorded from the control (13.60 cm). Similarly, at 6 WAS, gibberellins recorded the tallest plant (105.07 cm), followed by cytokinins (90.57 cm) and the least value was recorded from control (50.93 cm).

Effect of Plant Growth Regulators on Number of leaves Plant⁻¹ of Amaranth (*Amaranthus caudatus* L.) at 3 and 6 WAS in Mubi during 2022 Growing Season.

The result of effect of plant growth regulators on number of leaves per plant of amaranths (*Amaranthus caudatus* L.) at 3 and 6 WAS during 2022 growing season is presented in Table 1. The result showed a highly significant ($P < 0.001$) difference between the treatments at both 3 and 6 WAS. At 3WAS, application of gibberellins recorded the highest value (12.67), followed by cytokinins (11.00) which is statistically similar with Indole butyric acid (10.67) and the least value was recorded from the control (8.00). Similarly, at 6WAS, gibberellins recorded the highest number of leaves (26.00), followed by cytokinins (21.67) also statistically the same with Indole butyric acid (21.67) and the least value was recorded from control (17.00).

Effect of Plant Growth Regulators on Fresh Plant Weight (g) of Vegetable Amaranths (*Amaranthus caudatus* L.) at 3 and 6 Weeks After Sowing in Mubi during 2022 Growing Season.

The result of effect of plant growth regulators on fresh plant weight per plant of vegetable amaranth (*Amaranthus caudatus* L.) at 3 and 6 WAS during 2022 growing season is presented in Table 1. The result showed a highly significant ($P < 0.001$) difference between the treatments at both 3 and 6 WAS. At 3 WAS, gibberellins recorded the highest value (43.83 g), followed by cytokinins (35.17 g) though statistically the same with Indole butyric acid (34.27 g) and the least value was recorded from control (18.40 g). Similarly, at 6 WAS, gibberellins recorded the highest value (89.50 g), followed by cytokinins (74.67 g) which is statistically the same with Indole butyric acid (74.200 g) and the least value was recorded from control (42.40 g).

Effect of Plant Growth Regulators on Leaf Area Index (cm²) Plant⁻¹ of Vegetable Amaranths (*Amaranthus caudatus* L.) at 3 and 6 Weeks After Sowing in 2022 Growing Season.

The result of effect of plant growth regulators on leaf area index of vegetable amaranth (*Amaranthus caudatus* L.) at 3 and 6 WAS during 2022 growing season is presented in Table 1. The result showed a highly significant ($P < 0.001$) difference between the treatments at both 3 and 6 WAS. Application of gibberellins recorded the highest value (0.343 cm²), followed by cytokinins (0.263 cm²) though statistically the same with Indole butyric acid (0.233 cm²) and the least value was recorded from control (0.1500 cm²). Similarly, at 6 WAS, gibberellins recorded the highest value (2.270 cm²), followed by cytokinins with (1.563 cm²), the least value was recorded from control (0.777 cm²).

Effect of Plant Growth Regulators on Absolute Growth Rate Growth Rate (g/day) of Vegetable Amaranth (*Amaranthus caudatus* L.) at 6 Weeks After Sowing in Mubi during 2022 Growing Season.

The result of effect of plant growth regulators on Absolute Growth Rate of vegetable amaranth (*Amaranthus caudatus* L.) at 6 WAS during 2022 growing season is presented in Table 1. The result shows that there was highly significant ($P < 0.001$) difference between the treatments. Application of gibberellins recorded the highest value (1.05 g/day), followed by cytokinins (0.697 g/day) though statistically the same with Indole butyric acid (0.6300 g/day) while control recorded the least (0.050 g/day).

Effect of Plant Growth Regulators on Relative Growth Rate (g/day) Plant⁻¹ of Vegetable Amaranth (*Amaranthus caudatus* L.) at 6 WAS in Mubi during 2022 Growing Season.

The result for effect of plant growth regulators on relative growth rate of vegetable amaranth (*Amaranthus caudatus* L.) at 6 WAS during 2022 growing season is presented in Table 1. The result shows a highly significant ($P < 0.001$) difference between the treatments. Application of gibberellins recorded the highest mean value of (0.072 g/day) though statistically the same with cytokinins (0.069 g/day) and Indole butyric acid (0.068 g/day), while control recorded the least (0.041 g/day).

Effect of Plant Growth Regulators on Fresh Vegetable Yield (tons/ha) of Vegetable Amaranth (*Amaranthus caudatus* L.) at 6 WAS during 2022 Growing Season

The result of effect of plant growth regulators on fresh vegetable yield of amaranth (*Amaranthus caudatus* L.) at 6 WAS during 2022 growing season is presented in Table 1. The result shows a highly significant ($P < 0.001$) difference between the treatments. Application of gibberellins recorded the highest value (79.07 tones ha⁻¹), followed by cytokinins (71.30 tons/ha) which is statistically the same with Indole butyric acid (70.87 tons/ha) and the least value was recorded from control (26.20 tones ha⁻¹).

Discussions

Effect of Plant Growth Regulators on Growth and Yield of Vegetable Amaranth (*Amaranthus caudatus* L.) at 3 and 6 WAS during 2022 Growing Season

The significant influenced of gibberellins in all the growth and yield parameters measured (plant height, number of leaves, fresh plant weight, leaf area index, absolute growth rate, relative growth rate and fresh vegetable yield) over the rest of the treatments may be due to the positive influence of gibberellins in cell division and elongation. This result is in line with the findings of Mc (2009) who

reported that, application of gibberellins enhances the growth and yield of vegetable crops. Similarly, Mandava, (1979) reported that gibberellins are important in seed germination, affecting enzyme production that mobilizes food production, used for growth of new cells, they promote flowering and cellular division. This also agree with the findings of Surendra et al. (2006) who observed that application of gibberellins at different concentrations (25 and 50 ppm) significantly increases plant heights of amaranths. Singh et al. (2005) also reported that as gibberellins rates increased, the plant height, stem girth, leaf area, and yield per plant and yield per hectare increased in amaranthus. Medina (2005) reported that gibberellins has been used to increase leaf area, leaf area index, height of plants, increase the number of leaves and induced flowering in vegetables crops.

Conclusion and Recommendations

Based on the findings from this study, it is concluded that plant growth regulators significantly influenced vegetable amaranth (*Amaranthus caudatus* L.) and application of gibberellins produced the highest values in all the characters measured followed by cytokinins. From the forgoing, application of gibberellins on vegetable amaranth is hereby recommended for adoption by farmers in the study area in view of the highest growth and vegetable yield recorded.

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Table 1: Effects of Plant Growth Regulators on the Growth and Vegetable Yield of Amaranth (*Amaranthus caudatus* L.) in Mubi during 2022 Growing Seasons

Treatments	Plant height (cm)		Number of leaves		Fresh plant weight (g)		Leave area index (cm ²)		AGR (g/m ² /day)	RGR g/day	FVY t ha ⁻¹
	3 WAS	6 WAS	3 WAS	6 WAS	3 WAS	6 WAS	3 WAS	6 WAS	6 WAS	6 WAS	6 WAS
PGRs											
Gibberellins	31.23	105.07	12.67	26.00	48.83	89.30	0.3433	2.2700	1.050	0.072	79.07
Cytokinins	24.20	90.57	11.00	21.67	35.17	74.67	0.2633	1.5633	0.697	0.069	71.30
Indole butyric acid	21.87	79.70	10.67	21.67	34.27	74.20	0.2333	1.0767	0.630	0.068	70.87
Control	13.60	50.93	8.00	17.00	18.40	42.40	0.1500	0.7767	0.503	0.041	26.20
P of F	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
LSD	3.3479	6.8040	1.5737	2.0337	5.4416	7.9183	0.09780	0.2754	0.1237	0.0080	3.4419

AGR= Absolute growth rate, RGR= Relative growth rate, FVY= Fresh vegetable yield, PGRs= Plant growth regulators, WAS= Weeks after sowing



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GROWTH, FLOWERING AND YIELD OF MAIZE (*Zea mays*L) AS AFFECTED BY PLANT GROWTH REGULATORS AND VARIETY IN YOLA ADAMAWA STATE NIGERIA

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Abstract

The world is faced with rising demand of maize for food, animal feeds and industrial needs, and the production could not meet up with these increased demands due to low yield obtained in farmer field as a result of poor varietal selection and non-use of plant growth regulators. The field experiments were conducted at the Department of Crop Production and Horticulture Teaching and Research Farm, Modibbo Adama University Yola, Adamawa state Nigeria during 2019, 2020 and 2021 rainy seasons to evaluate the effects of varieties and plant growth regulators on the growth, flowering and yield of maize (*Zea mays* L.). The treatments consisted of three varieties of maize (M12M, SAMMAZ-37 and Admiral Improved Seeds) and seven plant growth regulators (Cytokinins, Super-gro, Growth force, Boostract, Nanomix, Vitalon and Water as control). The treatments were laid out in a split plot design with three replications. Maize varieties were assigned to the main plot and plant growth regulators to sub plot. Data were collected on establishment count, number of leaves, days to 50 % tasseling, days to 50 % silking and grain yield. Data collected were subjected to analysis of variance using statistical analysis software (SAS) system version 9.1 and least significant difference was used to separate the means at 5 % level of probability. The results indicated that varieties had significant effects on establishment count, number of leaves and number of days to 50 % tasseling, while plant growth regulators significantly affect number of leaves, days to 50 % tasseling, days to 50% silking and grains yield. Higher grains yield (5.23 tones ha⁻¹) was obtained in variety M12M, while cytokinins recorded the highest grains yield of 5.73 tones ha⁻¹ though statistically similar with other growth regulators except with vitalon, and control recorded the least (4.06 tones ha⁻¹).

¹). There were no significant interactions between the varieties and plant growth regulators in all the parameters measured. For higher grains yield, variety M12M and Cytokinins were found to be promising and are hereby recommended as the best variety and plant growth regulators respectively for farmers to adopt in the study area.

Keywords: Maize varieties, Plant growth regulators, Flowering, Growth and Yield

Introduction

Maize (*Zea mays* L.) is the third most important cereal crop in the world after wheat and rice (FAO, 2011). It is an important cereal crop in Nigeria with a total production of about 7.3 million tons in 2009 (FAO, 2011). It is an important crop grown in commercial quantities and supply raw materials to many agro-based industries (Iken and Amusa, 2014). The global demand for maize almost hit 3 billion metric tons in 2019. This is because of its wide variety of uses industrially, serves as major staple food for families and because of its importance in producing livestock feed, while the global production was about 1,112.01 million MT leaving about a deficit of 1.9 million MT. Nigeria averaged production volume is about 11 million MT making it the 2nd largest producer in the continent, after South Africa with 16 million MT and Ethiopia the 3rd with 8.4 million MT (FAO, 2011). However, FAOSTAT (2021) reported that Nigeria is the largest producer of maize in Africa with about 11 million MT followed by South Africa, Egypt and Ethiopia.

The local demand in Nigeria is as high as 13 million MT excluding exports leaving a deficit of over 2 million MT (FAOSTAT, 2021). This is one of the many reasons why it is keen on farmers having all the quality inputs and agrochemicals needed to increase production. Research has forecasted that the world population will reach 9.1 billion in 2050. To meet the demand of this growing population, production has to increase by 2.4% in yield (Alexandratos and Bruinsma, 2012). Therefore, maize should be considered one of the main pillars for global food security (FAOSTAT, 2021). Besides, the use of traditional varieties may not be able to sustain production that can meet up with the ever-increasing population of globally.

Therefore, in the search for sustainability, plant biostimulants can be used as growth promoters for crops (Panfiliet *al.*, 2019). Biostimulants are mixtures of natural or synthetic plant regulators, chemical compounds (vitamins and nutrients), algal extracts, microorganisms, and amino acids (Frascaet *al.*, 2020; Araújoet *al.*, 2021) that can improve crop quality and yield (Collaet *al.*, 2021; Vendruscoloet *al.*, 2021). Biostimulants containing auxin, cytokinins, and gibberellin may favor an increase in the absorption of water and nutrients by plants, thus allowing resistance to water stress. Vitamins such as nicotinamide can alleviate biotic and abiotic stresses by acting on electron transport and cellular and respiratory metabolism (Kirkland and Meyer, 2018), indirectly assisting in vegetative growth and development through cell elongation, leading to an increase in yield traits, especially under adverse conditions, as it acts directly on plant tissues (Berglund *et al.*, 2017).

Maize production in Nigeria is limited by several factors including inadequate use of improved varieties, poor soil fertility management, ignorant of selecting proper varieties and none use of plant growth regulators for maize production that can give maximum yield. The above challenges are justification for a need to improve yields by making agriculture more efficient, profitable and sustainable, particularly for small holders.

Objective of the Study

The objectives of the study are to evaluate the effects of variety on the growth and yield of some maize varieties in the study area; evaluate the effects of plant growth regulators on the growth and yield of some maize varieties in the study area; and determine the best interaction of plant growth regulators and varieties that can give maximum growth and yield of maize in the study area.

Materials and Methods

Experimental Site

The research was carried out at the Teaching and Research Farm of the Department of Crop Production and Horticulture, Modibbo Adama University, Yola during the 2019, 2020 and 2021 growing seasons. Yola, located within the Northern Guinea Savannah zone of Nigeria lies between latitude 9°13' to 9°19' N and longitude 12°19' to 12°28' E, with annual mean temperature of 28°C and rainfall of 700mm-1000mm (Adebayo and Tukur, 2020).

Treatments and Experimental Design

The treatments consisted of three maize varieties (M12M, SAMMAZ-37 and Admiral Improved Seed) and seven (7) Plant Growth Regulators (PGRs): (Cytokinins, 0.4%, Super-gro, Brassinolide 0.01 %, Boostract, Nanomix, Vitalon 2000 and Water as a control). The treatments were laid out in split plot design replicated three times. The gross plot size is 4.5mx3m (13.5m²) and net plot size is 3mx2 m (6 m²). Maize varieties were assigned to the main plots and plant growth regulators to sub-plots.

Application of Plant Growth Regulators

All the plant growth regulators were foliar applied at 2, 4, and 6 WAS. Cytokinins 0.4 % was applied at the rate of 300 ml per ha⁻¹ (30 ml was diluted per knapsack of clean water), brassinolite 0.01 % was applied at the rate of 80 g per ha⁻¹ (8 g was dissolved per knapsack of clean water) while Super-gro, Boostract, Nanomix, and Vitalon were applied at the rate of 200 ml per ha⁻¹ each (20 ml was diluted per knapsack of clean water). And the control plots received no plant growth regulators were sprayed with water.

Data Collection

The following data were collected:

- I. Establishment count (%)
2. Number of leaves per plant
3. Number of days to 50 % tasseling
- ii. Number of Days to 50 % silking
5. Grain yield (kg ha⁻¹).

Data Analysis

Analysis of variance (ANOVA) was carried out on each of the observation recorded as described by Gomez and Gomez (1984) for each year of study using SAS version 9.2 (2008). Mean values were separated using the least significant difference (LSD) at 0.05 level of probability.

Results

Effect of Variety and Plant Growth Regulators on establishment count (%) of Maize (*Zea mays* L.) during 2019, 2020 and 2021 Growing Seasons

The result of the effects of variety and plant growth regulators on establishment count (%) of maize during 2019, 2020 and 2021 is presented in Table 2. Effect of variety on the establishment count was only significant ($p \leq 0.05$) in 2019. SAMMAZ-37 recorded the highest establishment count of 72.06 %

which is statistically the same with M12M (70.26 %) and the least establishment count of 68.40 % was record in Admiral Improved Seed. Effect plant of growth regulators was not significant ($P \geq 0.05$) on establishment count during the three years of study and there was no significant ($P \geq 0.05$) interaction between variety and growth regulators on establishment count of maize during the period of the study.

Effect of Variety and Plant Growth Regulators on Number of Leaves Plant⁻¹ of Maize (*Zea mays* L) in Yola during 2019, 2020 and 2021 Growing Seasons

The results on the effect of variety and plant growth regulators on number of leaves perplant of maize in 2019, 2020 and 2021 is presented in Table 1. The result showed that effect of variety on number of leaves per plant of maize was significant ($p \leq 0.05$) at 2 WAS and highly significant ($p \leq 0.001$) at 4 WAS in 2019, significantly ($p \leq 0.05$) at 12 WAS in 2020 and 4 WAS in 2021. In 2019 at 2 WAS, Admiral Improved Seed recorded the highest number of leaves (4.93) per plant while SAMMAZ-37 recorded the least (2.78) which are at par with M12M variety (2.80). At 4 WAS, SAMMAZ-37 recorded the highest number of leaves (5.32) and statistically similar with M12M variety (5.25) while Admiral Improved Seed recorded the least (4.85). In 2020 12 WAS, Admiral Improved Seed recorded the highest number of leaves (11.13) which is statistically similar with SAMMAZ-37 (10.78) while M12M variety recorded the least (10.41). In 2021 4 WAS, SAMMAZ-37 recorded the highest number of leaves (9.36) which is statistically similar with M12M variety (8.80) while Admiral Improved Seed recorded the least (8.25).

However, effect of plant growth regulators was significant ($p \geq 0.05$) at 2 WAS in 2019, significant at 4 WAS in 2020 and highly significant ($p \leq 0.001$) at all the sampled period of 2021 except at 8 WAS. In 2019 4 WAS, application of Super-gro recorded the highest number of 4.04 leaves which is statistically similar with all the rest of the plant growth regulators and control recorded the least (2.33). In 2020 at 4 WAS, application of Vitalon recorded the highest number of 5.53 leaves which is also statistically similar with all the rest of the plant growth regulators and control recorded the least (4.71). In 2021 at 2 WAS, application of Cytokinins recorded the highest number of leaves per plant (5.28) though statistically similar with all the rest of the plant growth regulators and control recorded the least (4.56). At 4 WAS, application of Vitalon recorded the highest number of leaves (9.20) which is also at par with all the rest of the plant growth regulators and control recorded the least (7.88). At 6 WAS, Cytokinins recorded the highest number of leaves per plant (11.69) which is also statistically similar with all the rest of the similar except with Nanomix (10.82), and control recorded the least (9.51). Similarly, at 10 and 12 WAS application of Cytokinins recorded the highest number of leaves per plant (14.22 and 14.76) which are also similar statistically with all the rest of the similar and control recorded the least (12.07 and 12.38). There was no significant ($p \geq 0.05$) interaction between the varieties and plant growth regulators on number of leaves per plant of maize during the period of the study.

Effect of Variety and Plant Growth Regulators on Number of Days to 50 % Tasseling of Maize (*Zea mays* L) in Yola during 2019, 2020 and 2021 Growing Seasons

The result of the effects of variety and plant growth regulators on number of days to 50 % tasseling of maize during 2019, 2020 and 2021 growing seasons is presented in Table 2. Effect of variety on number of days to 50 % tasseling was highly significant ($p \leq 0.01$) in 2021. SAMMAZ-37 recorded the least number of days to 50% tasseling (60.43) while Admiral Improved Seeds recorded the highest mean value of 63.66 days which is statistically the same with M12M (63.38 days).

Effect of plant growth regulators on number of days to 50% tasseling was highly significant ($p \leq 0.01$) in 2019. Application of Super-gro recorded the least number of days to 50 % tasseling (57.11) while control recorded the highest number (59.33) days to 50% tasseling. There was no significant ($p > 0.05$) interaction between variety and plant growth regulators on number of days to 50 % tasseling in Yola during the period of study.

Effect of Variety and Plant Growth Regulators on Number of Days to 50 % Silking of Maize (*Zea mays* L) in Yola during 2019, 2020 and 2021 Growing Seasons

The result of the effects of variety and plant growth regulators on number of days to 50 % silking of maize in 2019, 2020 and 2021 growing seasons is presented in Table 2. Varietal differences did not significantly ($p > 0.05$) affect number of days to 50 % silking. However, effect of plant growth regulators was significant ($p \leq 0.05$) in 2019. Application of Super-gro recorded the least number of days to 50 % silking (61.11) which are at par with the rest of the plant growth regulators and control recorded the highest number of days (63.11). There was no significant ($p > 0.05$) interaction observed between variety and growth regulators on number of days to 50% silking.

Effect of Variety and Plant Growth Regulators on Grains Yield (kg ha^{-1}) of Maize (*Zea mays* L) in Yola during 2019, 2020 and 2021 Growing Seasons.

The result of the effects of variety and plant growth regulators on grains yield (kg ha^{-1}) of maize in Yola during 2019, 2020 and 2021 growing seasons is presented in Table 2. Effect of variety was significant ($P \leq 0.05$) on grains yield in 2020. Variety M12M recorded the highest grains yield of 5,239 kg ha^{-1} , followed by SAMMAZ-37 (4,034 kg ha^{-1}) and Admiral Improved Seeds recorded the least grains yield (3,903 kg ha^{-1}). However, effect of plant growth regulators on grains yield was highly significant ($P \leq 0.01$) in 2021. Application of Cytokinins recorded the highest grains yield of 5,734 kg/ha which is statistically similar with all the plant growth regulators except with Vitalon (4,852 kg), and control treatment recorded the least (4,058 kg ha^{-1}). There was no significant ($P > 0.05$) interaction between the varieties and plant growth regulators on grains yield during the period of the study.

Discussion

Effect of Variety and Plant Growth Regulators on the Growth Parameters of Maize

The highest number of shoot population (establishment count) recorded on SAMMAZ-37 and M12M varieties over Admiral Improve Seed could be due their variability and adaptation to the environment. Babaji *et al.* (2012) also noted that hybrids maize responded differently to population density as well as soil and environmental conditions. And the none significant effect of plant growth regulators on establishment count is in contrast with findings of Santos and Vieira (2005) who recorded an increase in seedling emergence (%) with the application of plant growth regulators on *Gossypium hirsutum*.

The none consistence of either of the varieties to be dominant over another on number of leaves could be associated with their genetic makeup and favorable climatic conditions during the growth of the crops which provide optimum conditions for maize crops that enable them performed to their maximum. This result is in line with the findings of Kareem *et al.* (2020) who reported that the genetic makeup of each variety had more influence on the parameters than the treatments. The significant influence of all the plant growth regulators over the control on number of leave per plant could be due to the roles of these plant growth regulators in cell division and elongation. Stimulant

like Boostract, Super-gro and Vitalon contain humic substance and nitrogen compound (Kocira *et al.*, 2018). And the fertilizer also contains natural energy acids and their derivatives in a biologically active form (Mandava *et al.*, 1979). Cytokinins influences cell division and shoot formation, it also helps delay aging of tissues (Taiz and Zeiger, 2010) while Brassinolide help to stimulate cell division and elongation, resistance to stress and xylem differentiation (Wikipedia, 2018).

Effect of Varieties and Plant Growth Regulators on Phenological Parameters of Maize

The significant effect of SAMMAZ-37 variety on number of days to 50 % tasseling over M12M and Admiral Improve Seed could be due its genetic makeup which indicated that variability existed among species. This was in line with the findings of Agbogidi and Ofuoko (2005) who reported that, plants respond differently to environmental factors based on their genetic make-up and their adaptation capability, which indicates that variability, existed among species. Marfo-Ahenkora *et al.* (2023); Kisaka (2014) and Kpoto (2012) also reported similar findings and admitted that the influence of phenological parameters indicated that hybrids, open pollinated varieties and local inbred lines have varying days for phenological trait. Contrary to the findings of Kareem *et al.* (2017) who did not observe any significant effect of varieties on number of days to tasseling and silking. The minimum number of days obtained in the application of plant growth regulators over the control could be due to the positive role of plant growth regulators to induced plant to attain minimum number of days to flowering. Taiz and Zeiger (2010) also reported that application of plant growth regulators helps to promote early flowering. Application of Vitalon helps to increase return bloom (Mandava, 1979). The none significant effect of variety on number of days to 50 % silking could also be due to genetic constituent of the maize varieties used. Kareem *et al.* (2017) also did not observed any significant effect of variety on number of days to 50 % silking. And the significant effect of plant growth regulators over the control on minimum number of days to 50 % silking were earlier reported by Taiz and Zeiger (2010).

Effect of Plant Growth Regulators and Variety on Grain Yield of Maize

The significant influence of M12M variety over the rest of the varieties on grain yield could be due to its high yielding potential. The result is in line with the findings of Hasan *et al.* (2018) who reported that high yielding variety with higher genetic makeup also has the importance of getting highest yield. Kareem *et al.* (2017) also observed a significant influence of variety on grains yield per hectare of maize. Babaji *et al.* (2012) believed that new hybrids varieties have greater grain yield potential than the local varieties because these varieties are normally smaller, produce higher leaves, have higher leaf area and have low maturity leaf shading problem than the other cultivars. The significant effect of plant growth regulators with cytokinins producing the highest grain yield, though statistically the same with other growth regulators over Vitalon and control confirmed the role of cytokinins and other growth regulators in enhancing grain yield of a crop. Stone *et al.* (1999) also observed an increased in grain yield of maize with the application of bio stimulant when compared to the control. Significant higher grain yield was also observed in the application of plant growth regulators over the control by Qandeel *et al.* (2020). The none significant interaction between the varieties and plant growth regulators on all the parameters during this study demonstrated that the management of plant growth regulators on varietal differences may not influence the growth and yield of maize. This result is in line with the findings of Barcelos *et al.* (2019) who did not observe any significant interaction between maize genotypes and growth regulators on these variables:

Conclusion and Recommendations

From the foregoing, it could be concluded that variety M₁₂M produced better growth and grains yield while among the plant growth regulators Cytokinins produced the best growth and grains yield.

Based on the results obtained from this study, the following recommendations were made.

- i. Adaption of M₁₂M variety for its high growth and grain yield.
- ii. Application of Cytokinins on maize production for its maximum growth and grain yield in the study area.

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Table 1: Effect of Plant Growth Regulators and Variety on Number of Leaves Plant¹ of Maize (*Zea mays* L.) in Yola During 2019, 2020 and 2021 Grains Seasons

Treatment s	2019						2020						2021					
	2WA S	4WAS S	6WA S	8WA S	10WA S	12WAS S	2WA S	4WAS S	6WAS S	8WA S	10WA S	12WAS S	2WAS S	4WA S	6WAS S	8WA S	10WA S	12WAS S
Varieties																		
MizM	2.80	5.25	7.60	9.71	11.41	12.51	2.24	5.20	8.13	10.87	10.66	10.41	4.98	8.80	10.84	13.40	13.66	14.09
Sammaz- 37	2.78	5.32	10.40	9.73	11.58	12.68	4.93	5.40	7.93	10.04	10.67	10.78	5.40	9.36	11.49	19.00	13.98	14.69
Admiral	4.93	4.85	7.00	9.41	11.17	12.41	5.07	5.26	8.14	10.13	10.80	11.13	4.91	8.25	10.72	13.20	13.26	14.14
P of F	0.020	0.009	0.410	0.311	0.327	0.664	0.568	0.845	0.781	0.797	0.163	0.026	0.25	0.06	0.310	0.396	0.287	0.377
LSD	1.676	0.3150	5.610	0.473	0.547	0.607	0.742	0.964	0.9055	1.084	0.1826	0.482	0.75	0.87	1.2760	11.82	1.080	1.1592
				7			6										8	
PGRs																		
Cytokinins	3.78	5.11	14.80	9.56	11.50	12.73	5.04	5.47	8.16	10.51	10.62	10.87	5.28	9.18	11.69	13.70	14.22	14.76
Super-gro	4.04	5.20	7.50	9.84	11.70	12.82	5.20	5.36	8.33	10.93	11.00	11.82	5.16	9.16	11.11	13.60	13.82	14.58
Brassinoli de	3.48	5.29	7.40	9.77	11.50	12.54	5.18	5.24	8.22	10.82	10.67	10.89	5.04	8.64	11.10	13.60	13.76	14.62
Boosttract	3.61	5.33	7.30	9.67	11.42	12.67	5.04	5.29	7.80	10.64	10.76	10.87	5.24	8.70	11.22	13.70	14.00	14.58
Nanomix	3.74	4.96	7.20	9.31	11.24	12.16	5.16	5.40	7.84	10.36	10.78	10.93	5.11	8.87	10.87	13.20	13.53	14.22
Vitalon	3.54	5.02	7.20	9.51	11.62	12.39	4.89	5.53	7.78	10.62	10.89	11.09	5.27	9.20	11.62	13.80	14.02	15.00
Control	2.33	5.07	6.90	9.67	10.73	12.40	5.04	4.71	8.36	10.13	10.62	10.64	4.56	7.88	9.51	24.70	12.07	12.38
P of F	0.045	0.779	0.488	0.884	0.371	0.592	0.769	0.028	0.475	0.683	0.831	0.312	0.001	0.001	0.001	0.590	0.001	0.001
LSD	0.959	0.594	9.010	0.895	0.907	0.800	0.419	0.474	0.752	0.852	0.591	0.592	0.312	0.535	0.543	13.630	0.695	0.595
Va. x P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

PGRs = Plant growth regulators, NS = Not significant

Table 2: Effect of Plant Growth Regulators and Variety on Establishment Count, Phenological and Grain Yield of Maize (*Zea mays* L.) in Yola During 2019, 2020 and 2021 Growing Seasons

Treatments	Establishment count (%)			Days to 50 % tasseling			Days to 50 % silking			Grain yield (kg ha ⁻¹)		
	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
Varieties												
M12M	2.80	89.20	97.27	57.95	57.76	63.38	61.86	61.76	63.38	5536	5239	5348
Sammaz-37	2.78	80.80	97.88	57.52	56.84	60.43	61.52	60.71	60.43	5328	4034	5074
Admiral	4.93	87.80	97.67	57.86	57.24	63.66	61.57	61.10	63.60	5163	3903	5185
P of F	0.020	0.216	0.905	0.478	0.504	0.007	0.598	0.413	0.145	0.077	0.050	0.683
LSD	1.676	11.57	3.768	0.749	1.412	0.822	0.721	1.974	3.897	408.8	407.4	436.9
PGRs												
Cytokinins	3.78	91.90	98.38	57.33	56.22	61.89	61.44	60.67	61.89	5770	3832	5734
Super-gro	4.04	79.30	97.24	57.11	57.78	62.22	61.11	61.56	62.22	5290	4092	5576
Brassinolide	3.48	86.40	97.44	57.44	57.22	62.44	61.44	61.22	62.44	5423	3837	5274
Boosttract	3.61	89.20	97.29	58.00	57.44	63.00	61.78	61.33	63.00	5346	4065	5439
Nanomix	3.74	85.60	97.19	57.67	57.78	62.33	61.44	61.78	62.33	5387	3982	5481
Vitalon	3.54	78.80	98.24	57.56	57.00	62.71	61.22	60.67	62.71	5123	3865	4852
Control	2.33	90.40	97.44	59.33	57.56	62.82	63.11	61.11	62.82	4825	3480	4058
P of F	0.045	0.095	0.870	0.015	0.310	0.182	0.051	0.413	0.633	0.107	0.393	0.001
LSD	0.959	10.53	2.220	0.101	1.412	1.188	1.210	1.176	1.292	591.2	619.3	739.1
Interaction												
Var. x PGRs	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

PGRs= Plant Growth Regulators, NS= Not Significant



10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

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DISTRIBUTION OF AGRO-BASED PRODUCTS IN JEMA'A LOCAL GOVERNMENT AREA, KADUNA STATE

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Abstract

Agriculture plays a vital role in Nigeria's economy, contributing 25% to the Gross Domestic Product (GDP) and employing 70% of the labour force. In Jema'a Local Government Area (LGA) of Kaduna State, agriculture serves as the backbone of the local economy, with crops like maize, sorghum, millet, tomatoes, and fruits providing sustenance and income for rural farmers. Despite its significance, the distribution of agro-based products in Jema'a LGA faces critical challenges. These include inadequate infrastructure, such as poor road networks and insufficient transportation facilities, which impede the efficient movement of goods from farms to markets. Additionally, limited market access, inadequate storage facilities, and a lack of market information exacerbate post-harvest losses and economic inefficiencies. This study employs a mixed-methods approach, incorporating surveys, interviews, and thematic analysis, to identify barriers to efficient agricultural distribution and propose actionable solutions. Findings reveal that poor road conditions, dependence on traditional market systems, and information asymmetry significantly hinder farmers' profitability. Recommendations include investing in infrastructure development, establishing storage solutions, creating accessible markets, and implementing robust market information systems. By addressing these issues, the distribution networks in Jema'a LGA can be improved, enhancing farmers' livelihoods and contributing to the area's economic development. These findings underscore the urgent need for government and stakeholder intervention to unlock the full potential of agriculture in Jema'a LGA and similar rural settings in Nigeria.

Keywords: Agro-based products, Distribution Channels, Infrastructure, Market Access

Introduction

Agriculture remains a vital sector in Nigeria, contributing significantly to the nation's Gross Domestic Product (GDP) and providing employment for a large portion of the population. According to the National Bureau of Statistics (2019), agriculture accounted for approximately 25% of Nigeria's GDP and employed about 70% of the labor force. The sector is not only crucial for food security but also serves as a backbone for the rural economy, supporting numerous smallholder farmers and their families. In Jema'a Local Government Area (LGA) of Kaduna State, agriculture is the primary economic activity, with a wide variety of agro-based products being cultivated. These include staple crops such as grains (maize, sorghum, and millet), vegetables (tomatoes, peppers, and onions), and fruits (mangoes, oranges, and bananas). The agricultural output from this region is essential for local livelihoods, providing both food and income for the residents.

Despite the importance of agriculture to the local economy, the efficient distribution of agro-based products in Jema'a LGA faces several significant challenges. One major issue is inadequate infrastructure. Poor road conditions and lack of transportation facilities hinder the movement of goods from farms to markets, increasing costs and reducing the efficiency of distribution (Adamu, 2020). Market access is another critical challenge. Many farmers in Jema'a LGA have limited access to larger, more profitable markets, restricting their ability to sell their products at competitive prices (Bello, 2018). Additionally, logistical challenges such as inadequate storage facilities and lack of market information exacerbate the difficulties in the distribution process (Yusuf, 2019).

This paper aims to analyze the current distribution system for agro-based products in Jema'a LGA, identify the barriers to efficient distribution, and propose actionable strategies to overcome these challenges. By improving the distribution networks, it is expected that the livelihoods of local farmers will be enhanced, and the overall economic development of the area will be supported.

Literature Review

Agricultural Distribution in Nigeria

The distribution of agricultural products in Nigeria faces several significant challenges that impede the efficiency and effectiveness of getting produce from farms to consumers. These challenges are well-documented in the literature and are critical factors that contribute to post-harvest losses and reduced incomes for farmers. One of the primary challenges is the poor condition of road networks. According to Okafor (2019), many rural areas where agriculture is predominant suffer from inadequate and poorly maintained road infrastructure. This not only increases transportation costs but also delays the delivery of fresh produce to markets, leading to spoilage and waste. Poor roads can also deter traders from venturing into remote farming communities, thereby limiting market access for farmers.

In addition to transportation issues, the lack of adequate storage facilities is a major problem. Adeola (2018) highlights that many farmers do not have access to proper storage solutions, such as refrigerated storage or warehouses, which are crucial for preserving the quality of perishable goods. This deficiency results in significant post-harvest losses, particularly for fruits and vegetables, which have a short shelf life. The inability to store produce properly forces farmers to sell their goods quickly and often at lower prices, reducing their potential income. Another critical challenge is the insufficient market information available to farmers. As noted by Usman (2017), many farmers lack access to reliable and timely information about market prices, demand trends, and

potential buyers. This information asymmetry prevents farmers from making informed decisions about when and where to sell their products. Consequently, farmers may miss out on better prices or fail to meet market demands, further exacerbating their economic challenges.

These issues are interconnected and collectively contribute to inefficiencies in the agricultural distribution system. The combination of poor road networks, inadequate storage facilities, and insufficient market information not only leads to post-harvest losses but also results in reduced incomes for farmers. Addressing these challenges is essential for improving the distribution of agricultural products in Nigeria and enhancing the livelihoods of rural farmers.

Agro-based Products in Jema'a LGA

Jema'a Local Government Area (LGA) in Kaduna State is renowned for its diverse agricultural produce. The region boasts a variety of crops, including staple grains like maize, sorghum, and millet, as well as vegetables such as tomatoes, peppers, and onions, and an assortment of fruits, including mangoes, oranges, and bananas. These products are vital not only for local consumption but also for generating income for the farmers in the area (Musa, 2020).

Despite the abundance and diversity of agricultural produce, the distribution mechanisms in Jema'a LGA are predominantly informal. According to Aliyu (2019), the distribution of agro-based products largely relies on traditional markets. Farmers usually transport their goods to local markets where they sell directly to consumers or middlemen. This informal network, while crucial for the local economy, is often inefficient and fraught with challenges.

One of the primary challenges of this informal distribution system is its reliance on traditional market days. These markets typically operate on a periodic basis, sometimes weekly, which can result in delays in the distribution process. Additionally, the lack of formalized storage facilities and infrastructure at these markets exacerbates post-harvest losses, particularly for perishable goods (Bello, 2018). Furthermore, the transportation of goods to these markets is often hindered by inadequate infrastructure. Poor road conditions and a lack of reliable transport options increase the difficulty and cost of moving agricultural products from farms to markets. According to Okoro (2017), the road networks within Jema'a LGA are in dire need of improvement to facilitate more efficient transportation and distribution of agricultural produce.

The informal nature of the distribution networks also means that market information is not systematically disseminated. Farmers frequently lack access to accurate and timely information about market prices and demand trends, leading to sub-optimal decision-making. As Yusuf (2019) notes, this information asymmetry can prevent farmers from maximizing their incomes and effectively participating in larger, more lucrative markets.

Despite these challenges, the traditional market system remains a cornerstone of agricultural distribution in Jema'a LGA. It supports the livelihoods of many smallholder farmers and plays a crucial role in the local economy. However, there is a clear need for improvements in infrastructure, storage facilities, and market information systems to enhance the efficiency and effectiveness of these distribution networks.

Study Area

Location

Jema'a Local Government Area (Fig. 3.1) is located between latitude $9^{\circ}10'$ and $9^{\circ}30'N$ and longitude $8^{\circ}00'$ and $8^{\circ}30'E$. The Local Government is bounded in the East by Kagoro in Kaura Local Government Area, in the North by Zonkwa and Ungwar Rimi District of Zangon-Kataf Local Government Area, in the West by Jaba Local Government Area and in the South by Nassarawa State and in the South-East by Sanga Local Government Area respectively.

Relief and Geology

The area is generally a plain. It is lowest in the South and South-West with a height of 180m, rising steadily North and North-East ward to about 450m along the northern edge of the area. Sometimes reaching 600m in the extreme north-east as one is approaching the Jos Plateau. The relief inwardly influences the drainage pattern, most of the area lies within the Mada, Okawa, and Gurara River system. The Okawa and Mada systems flow into the River Niger (Nehemiah, 2009)

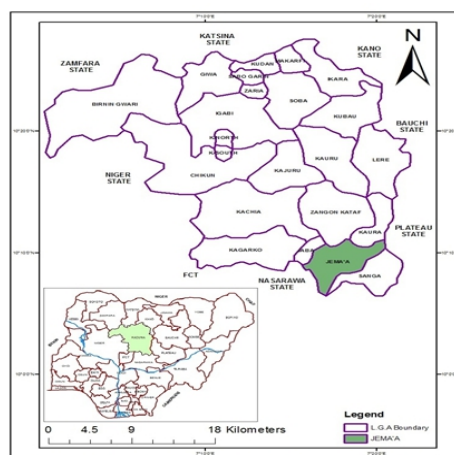


Figure 3.1: Kaduna State Showing Jema'a LGA with an Inset Map of Nigeria
Source: Adapted and Modified by Simeon, D. 2022

3.2.3 Weather and Climate.

The area is designated Koppen's Aw climate with two distinct seasons, a wet season in summer and a dry season in winter. Rainfall occurs between the months of April to October with a peak in August. The mean annual rainfall is about 1800 mm, and the mean monthly temperature is $25^{\circ}C$, while the relative humidity is about 62%. The orographic effects of the Jos-Plateau and the Kagoro Hills have positive influence on the climate influencing rainfall, temperature and relative humidity.

Jema'a L.G.A falls in the Tropical Savanna climate or Tropical wet and dry climate. This climate exhibits a well-marked rainy season and dry season with a single peak in August due to its distance from the equator (Ishaya and Abaje, 2008). The annual rainfall on the average is about 1,532mm. The temperature ranges between $20^{\circ}C$ and $30^{\circ}C$.

It has only two seasons. These are the dry season and the rainy season. The dry season is accompanied by a dust laden air mass from the Sahara Desert, locally known as “harmattan”, or by its main name, the Tropical Continental (CT) air mass, which starts in November and last to March while the rainy season is heavily influenced by an air mass originating from the South Atlantic Ocean, locally known as the South West wind, or by its name, the Tropical Maritime (MT) air mass which starts in April to October (Ishaya and Abaje, 2008).

During the dominance of the Tropical Maritime Air mass (MT) in the rainy season in this district, mornings are bright and sunny, the sun's heating of the land in the mornings and afternoons sets up convectional currents, these currents rise vertically and cumulonimbus clouds are formed, by afternoons to evenings and torrential downpour follows. The Tropical Continental Air mass (CT) locally known as the harmattan, is a wind originating from North Africa which crosses the Sahara Desert into West Africa. This air mass dominates this district climate during the dry season from November to March. The Tropical Continental air mass is dusty and creates a haze within the atmosphere when it predominates. The haze is as a result of the dust within the air mass limiting visibility and blocking much of the sun's rays from reaching the earth (Cometonigeria, 2015). The air mass has no ability of forming rain due to low humidity within the air mass, since it crosses the Sahara Desert; it picks up dust instead of water thereby creating little chances of rainfall, but when coming it brings some relief to farmers since the low humidity present in the air quickens the drying of their crops (Cometonigeria, 2015).

Soil

The main type of soil is the Ferruginous tropical soil which is related to the climate, vegetation, lithology and the topography of the area. (Ishaya and Abaje, 2008). The soils found in the district are typically red-brown to red-yellow tropical ferruginous soils. The soils in the area developed from the crystalline rocks of the basement complex, mainly sandstone sedimentary rocks which serves as the parent material (Morgan, 1983). Its main features include sandy surface horizon underlined by a weakly developed clayed mottled and occasionally concretion subsoil. Much of the surface has decomposed to laterite (Morgan, 1983). The soils in the upland areas are richer in red clay and sand, but poor in organic matter. However, the soils in the lowland areas are richer in kaolin (clay) and organic matter, very heavy and poorly drain, characteristics of vertisols (dark grey clay soils). These encourage the cultivation of market gardening crops such as tomatoes, onions, spinach, potatoes and sugarcane (Vivan, 2014).

Vegetation

The vegetation of this L.G.A falls under the Southern Guinea Savanna type. However, the vegetation of the area has been greatly affected by human activities which had been reduced to more of woodland and tall grass savanna and more of agricultural land in some parts (KSWB, 1991). The dominant species of trees include *Isobertina* (doka), *Isobalatomertosa*, *Monoteskerstingii* and *Uapacalogensis* are some of the woody species. The grassland has a well-developed grass layer of tufted and ropopenea. The Savanna woodland has been severely exploited for grazing, cultivation, fuel wood, building materials and construction purposes. Species of grasses include the carpet grass, goat weed, elephant grass, gamba grass etc.

Population

The study area has witnessed a tremendous growth in population in the last 30 years (Ishaya and Abaje, 2008). It has a population of 278,202 (NPC, 2009). With annual growth rate of 3% in the State. with the projected population of 373,880 as at 2018. Which comprises of 184,759 females and 189,121 males. The rural population concentration is moderate, reaching a high of 350 per sq. km (PATHS 2008). Despite the provisional nature of the census results, observation of movement of young able bodied male labourers in large numbers from rural villages to towns during the dry season and back to rural agricultural field during the wet season, suggest a sizeable seasonal labour force migration in the senatorial district. However, the seasonal labour migration has no effect on

agricultural labour demands in the traditional setting. Indeed, some of these seasonal migrants come to town to learn specific trade or acquire special training and eventually go back to establish in rural areas as skilled workers such as technician, tractors drivers, carpenters and motor mechanic, tailors etc. The people in this region are predominately Christians with a good number of traditional worshipers and a small percentage of Muslims and Fulani who are basically there for their business. Presently it has twelve wards as shown on the area.

Livelihood Activities

Agriculture is the major occupation of the area and contributes to over 80% of its economy. The people engage in the farming of both food crops and cash crops as well as animal farming. Major food and cash crops produced include groundnut, guinea corn, millet, ginger, beans, yam, sweet potatoes, cassava, rice sugarcane and maize. Other economic activities include pottery, blacksmithing lumbering and non-formal quarrying. There is also a tourist center like the Matsirga water falls (Vivan, 2014). Animals farming like Cattle, Sheep, Pigs, Pigeons, Rabbits, Goats, Fish, and Chickens. Trading of agricultural produce is another important economic activity of the area as weekly markets function to provide avenue for the exchange of goods and services example the pig market. Majority of the rural dwellers who depends on farming as a means of their livelihood The Local Government is also blessed with mineral deposit such as Sapphire Corundum, Amethyst, Aquamarine, Zircon, Mica, Chalcophyrite Topaz, Crystals, Topaz quartz, Columbite, Tantalite, Lead and suspected Diamond, Gold, Zinc

Health Care Services

In this Local government, there is a general hospital in the local government headquarter, dispensary and clinics both Government and Private own. There are above 54 functional healthcare facilities in Jema'a Local Government Area; as at the time the reconnaissance survey was conducted. Government healthcare facilities constituted 30 (55.6%) and 24 (44.4%) Private healthcare facilities. Kafanchan have the highest concentration of healthcare facilities; amounted to 18.5%. This is due to the fact that, it is a major town and where the Local Government head office is located. While 81.5% are spread all over the mini towns of Asso, Gida-way, Godogodo, Kaninkon and other Wards.

Cultural Activity

Jema'a Local Government Area is a multi-cultural setting. It is home to many ethnic groups, the most notable ones are Kagoma, Kaninko, Fantsuwam, Yeskwa and Hausa community. The major cultural activity in the area is the Gong day, Kafanchan day, Numana day, Dung day which are annual events that takes place every year. There are other pockets of cultural activities which are usually alive during festive period of Easter, Christmas, and New Year. The people love and cherish their culture.

Methodology

Data Collection

The study employs a mixed-methods approach, combining quantitative and qualitative data. Primary data was collected through surveys of 200 farmers and 50 distributors in Jema'a LGA. Additionally, interviews with local government officials and agricultural extension workers were conducted to gain insights into the institutional aspects of distribution.

Data Analysis

Data was analyzed using descriptive statistics and thematic analysis. Quantitative data was processed using SPSS software, while qualitative data from interviews was coded and analyzed thematically to identify recurring patterns and themes.

Quantitative Data Analysis

The quantitative data was analyzed using descriptive statistics, processed with SPSS software. The survey included responses from 200 farmers and 50 distributors within Jema'a LGA. The key findings are as follows:

Distribution Channels

- i. **Local Markets:** 75% of the farmers reported that they primarily sell their produce at local markets.
- ii. **Wholesalers/Middlemen:** 15% of the farmers sell their products to wholesalers or middlemen.
- iii. **Direct Sales:** 10% of the farmers engage in direct sales to consumers or businesses.

Transportation Issues

- i. **Poor Road Conditions:** 80% of respondents cited poor road conditions as a significant barrier to efficient distribution.
- ii. **High Transportation Costs:** 65% indicated that high transportation costs negatively impact their profit margins.

Market Access

- i. **Limited Market Access:** 70% of farmers reported having limited access to larger markets outside their immediate locality.
- ii. **Dependence on Market Days:** 60% of farmers rely on periodic market days to sell their produce, causing delays and potential spoilage.

Storage Facilities

- i. **Inadequate Storage:** 85% of farmers stated that they lack adequate storage facilities, leading to post-harvest losses.
- ii. **Post-Harvest Losses:** On average, farmers reported a 30% loss of produce due to insufficient storage and handling.

Information Asymmetry

- i. **Lack of Market Information:** 75% of respondents do not have access to timely and reliable market information, affecting their ability to make informed selling decisions.

Qualitative Data Analysis

The qualitative data from interviews with local government officials, agricultural extension workers, and market leaders was coded and analyzed thematically. The recurring patterns and themes identified are summarized below:

Infrastructure Challenges

- i. **Road Infrastructure:** Interviewees consistently highlighted the poor state of road infrastructure as a critical challenge. Many rural roads are unpaved and become impassable during the rainy season, severely affecting the transportation of goods.

Market Dynamics

- i. **Traditional Markets:** The reliance on traditional markets is a double-edged sword. While they provide a vital outlet for local produce, their periodic nature and lack of facilities pose significant limitations.
- ii. **Middlemen Influence:** Middlemen play a crucial role in the distribution network but often exploit farmers by offering lower prices, taking advantage of farmers' urgent need to sell their perishable goods.

Economic Constraints

- i. **Financial Barriers:** Many farmers lack access to credit facilities, which limits their ability to invest in better storage solutions and transportation.
- ii. **Low Bargaining Power:** The fragmented nature of the market means that individual farmers have low bargaining power, resulting in lower profit margins.

Potential Solutions:

- I. **Infrastructure Improvement:** There is a unanimous call for the government to invest in improving road infrastructure to facilitate better market access.
- ii. **Cooperative Models:** The establishment of farmer cooperatives could help in pooling resources for better storage facilities and collective bargaining.
- iii. **Market Information Systems:** Implementing robust market information systems to provide farmers with real-time data on prices and demand trends can empower them to make better-informed decisions.

Findings

Distribution Channels

The primary distribution channels for agro-based products in Jema'a LGA include local markets, wholesalers, and direct sales to consumers. Local markets play a critical role, with most farmers relying on these for their sales. Wholesalers and middlemen also facilitate the movement of products from rural to urban areas.

Challenges in Distribution

- i. **Infrastructure:** Poor road conditions and lack of transportation facilities significantly hinder the efficient distribution of products.
- ii. **Market Access:** Limited access to larger markets restricts the farmers' ability to sell their products at competitive prices.
- iii. **Storage Facilities:** Inadequate storage options led to post-harvest losses, particularly for perishable goods.
- iv. **Information Asymmetry:** Farmers often lack access to market information, affecting their ability to make informed decisions regarding the timing and pricing of their products.

Impact of Infrastructure

Infrastructure plays a pivotal role in the distribution of agro-based products. Poor road networks increase transportation costs and reduce the profitability for farmers. This section discusses the correlation between infrastructure quality and distribution efficiency.

Discussion

The findings indicate that improving infrastructure, enhancing market access, and providing better storage facilities are critical to improving the distribution of agro-based products in Jema'a LGA. Additionally, fostering better communication and information dissemination among farmers can enhance their market participation and profitability.

Recommendations

- i. Infrastructure Development:** Investment in road construction and maintenance to facilitate easier and cost-effective transportation of agricultural products.
- ii. Market Access:** Establishment of more accessible markets and development of transportation networks to link rural farmers to urban centers.
- iii. Storage Solutions:** Provision of adequate storage facilities to reduce post-harvest losses and ensure the longevity of perishable goods.
- iv. Information Systems:** Implementation of agricultural extension services and market information systems to provide farmers with up-to-date information on market prices and demand.

Conclusion

The distribution of agro-based products in Jema'a LGA faces significant challenges, primarily due to inadequate infrastructure and limited market access. Addressing these issues through targeted interventions can enhance the efficiency of distribution networks, improve farmers' incomes, and contribute to the overall economic development of the area.

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10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

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THE IMPACT OF THE NIGERIAN CIVIL WAR ON THE ESAN PEOPLE OF MIDWESTERN NIGERIA, 1967-1970

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Abstract

In the Nigerian Civil War study, major ethnic groups such as Hausa, Yoruba, and Igbo gained prominence. Perhaps the source material, more readily available in the major ethnic groups than the minority ethnic groups, may be the determining factor. However, it is indisputable that minority ethnic groups have received some attention in the civil war publications. Compared to the large number of minority ethnic groups in Nigeria, the coverage seems inadequate as this does not demonstrate the impact of the war on minority ethnic groups. Hence, it is the attempt to fulfill this aim that this paper examines the impact of the Nigerian civil war on the Esan people of Midwestern Nigeria. Using the qualitative research method, the paper believes that the Nigerian Civil War, which lasted from May 1967 to January 1970, had positive and negative impacts on the socioeconomic and political lives of the Esan people. The paper concludes by recommending that Nigerian political leaders should eschew ethnic prejudice and prioritize the interest of the country rather than sectional interest.

Keywords: *Impact, Civil War, Minority, Ethnic Group, Interest*

Introduction

The Nigerian Civil War lasted from 1967 to 1970 and was fought between the Nigerian Government under Colonel Yakubu Gowon and the Eastern Region (the Biafra Government) under Lieutenant Colonel Odumegwu Ojukwu. According to Osakwe and Itiri, "the war was a fallout from the inability of the Nigerian government to reach a truce over some grievances expressed by the people of the Eastern Region."¹ Many scholars have come up with different accounts of the causes and

Chukwuma C. C. Osakwe & Nnaemeka Uwakwe Itiri, "Immediate Post-Civil War Issues in the Afikpo Area of Nigeria, *Journal of Historical Society of Nigeria*, Vol. 28, 2019, 62.

consequences of the war². When the war broke out, the Esan people under the then Mid-West Region regarded it as a battle between the Hausa and the Igbo. Thus, perhaps Esan recorded no or low military presence until the Biafra incursion into the Mid-West on August 9, 1967. Before the Biafra invasion of the Midwest, Esan land was filled with displaced returnees from the Northern and Eastern regions³. The result of the Biafra incursion into the Midwest was the spread of the war to Esan, Agbor, Auchi, Benin, Warri, Sapele, Asaba, and other towns in the Midwest.

The Esan people had initially sympathized with the Biafran, and this was a result of the ill-treatment they went through during the 1966 pogrom and other crises preceding the war in the North. Ighodalo notes that “at the height of the killings in the North, every Southerner was a target. A lot of people from the Midwest were forced to come home⁴.” Geographically, Esanland was located in the northeast of Benin, the capital of the Mid-Western Region. Esanland was under the Mid-West region, and in the course of the war, the Mid-West region, which Esan was part of, was under the federal government's control. The Biafra invasion of the Mid-West on 9TH August 1967 drew the region into the war.⁵ This prompted the federal government to put machinery in motion to liberate the Mid-West from Biafra incursion on September 21, 1967.⁶ The Mid-West, including Esan, became militarized as a result of the Biafra invasion, and because of this, life was no longer the same in Esanland during the war. Thus, this paper examines the impacts of the war on the Esan people of the Midwestern Region of Nigeria.

Brief History of Esan People

Esan is the second major ethnic group in the present Edo state of Nigeria. The area is located on a Plateau about 134 meters above sea level. The Esan people have a mass of about 1,858 square kilometers and are located northeast of Benin, the Edo State capital.⁷ In Edo State, Esan people are in five local government areas - Esan South East, Esan North East, Esan West, Igueben, and Esan Central. Ighodalo notes that Esan is bounded in the West by the Orhiomwon local government area while on the North by the Etsako East and West local government area. On the South, the area is bordered by Ika, Aniocha, and Oshimili North local government areas of Delta State, and on the East by River Niger and Ibagi local government area of Kogi State.⁸ The people of Esan are mainly farmers, although they also engage in other economic activities, such as hunting, basket weaving, blacksmithing, and cloth weaving.⁹ The British colonized the area and the area was under the Benin Province in colonial times. Esan was located in the Western Region, when Nigeria had three regions, and in the Mid-West Region, when the country became four regions. The area was under the Midwestern region when the Nigerian-Biafran war broke out in 1967.¹⁰

For the history of the Civil War, see Olusegun Obasanjo, *My Command: An Account of the Nigerian Civil War, 1967-1970* (Lagos: Prestige, 1980); Philip Efiog, *Nigeria and Biafra: My Story* (Aba: Business Forum Publications, 2000); Alexander A. Madiebo, *The Nigerian Revolution and the Biafra War* (Enugu: First Dimension Publishers, 1980); John De St. Jorre, *The Nigerian Civil War* (London: Hodder and Stoughton, 1972); Emeka Odumegwu-Ojukwu, *Because I am Involved* (Ibadan: Spectrum Book, 1989).

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Conceptual Clarification

Civil War

For a proper understanding of civil war, we must understand the concept of war. Many scholars have seen war from different perspectives. Hoffman Nickerson states that "war is the use of organized force between two human groups pursuing contradictory policies, each group seeking to impose its policy upon the other."¹¹ In other words, war aims to implement a group policy by force. War can also be defined as an act of violence intended to make an opponent act to fulfill one's will. Karl von Clausewitz's most famous concept is that "war is a continuation of politics by other means."¹² It is not only a political act but also a political instrument. The political goal is the object of the war, while the means of attaining the goal is the war. This means that violent force is a means to an end. It means war is a tool used to achieve a particular objective.

War can be categorized into two parts: intra-state war and inter-state war. Interstate war is a war between or among nation-states. For example, Iran and Iraq War (1980-1988),¹³ Iraq and Kuwait (1990),¹⁴ Vietnam War (1954-1975).¹⁵ Intra-state wars, on the other hand, are wars within the confines of a state or country. Intra-state war is what is referred to as civil war. Civil war can also be seen as when a country is at war with itself. According to Joshua and Jon, civil war is:

*The war between factions within a state trying to create or prevent a new government for the entire state or some territorial part. (The aim may be to change the whole system of government, replace the people in it merely, or split a region off as a new state).*¹⁶

The 1860 U.S. Civil War, Eritrea and Ethiopia (1980)¹⁷ and the Nigerian Civil War are examples of civil war. Civil wars are the most brutal wars, and this is because, in most civil wars, there is always an ethnic dimension to it. Furthermore, people fighting their fellow citizens act cruelly than those fighting people from another country.¹⁸ The Nigerian Civil War of 1967-1970 was a war between the Eastern Region (Biafra) and the Federal government of Nigeria. The war had repercussions on the Esan people of Midwestern Nigeria.

Socioeconomic effect of the War on Esan people

The Nigerian Civil War, which lasted from May 1967 to January 1970, had positive and negative effects on the socioeconomic and political lives of the Esan people. In the first place, before the war, the 1966 coup and the crisis that followed it led to the displacement of the Esan people and the loss of their means of livelihood. The displacement brought them home, thereby making the villages crowded. By the end of 1966, the Midwest rehabilitation committee had registered 50,000 displaced Midwesterners, including Esan people. Similarly, the Ojukwu's proclamation ordering all non-Easterners out of the East resulted in the displacement of 15,000 Midwesterners, among whom were also Esan people.¹⁹ When the Biafran forces invaded Benin on August 9, 1967, a lot of

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Esan people were displaced in Benin, and many of them found their way home. One effect of the war is that it subjected the people to mental and emotional torture. The Esan people suffered from psychological trauma, especially those parents who watched their children displaced and returned home, losing their jobs, and those whose relatives were killed in the war. Similarly, the rumor that Biafran was coming to invade the Midwest set some people off balance.²⁰

Ojiakor notes that "one major consequence of the civil war relates to the colossal loss of human lives unprecedented in the history of Nigeria." ²¹ Over five million lives were lost on both sides, with the Eastern Region, particularly the Igbo, accounting for ninety percent of whatever figure that was presented. However, it is estimated that about two million seven hundred (2.7 million) Igbo died as a result of the war. Secondly, apart from an unprecedented loss of human lives recorded during the war, a greater percentage of the citizenry, particularly the Igbo, were wounded, and some others were permanently deformed throughout their lives.²² Out of the five million lives lost, there were Esan people. Sunday, Okoromi revealed that the Biafran troops killed seven people in Egbiki alone.²³ In Ekpon, 23 persons arrested from other parts of Esan were killed by Biafran troops on September 23, 1967. They were suspected of acting as reconnoiters to the federal troops. In Ebelle, Ewohimi, and Igweben, the Biafran forces kill a lot of mad people since most people acting as reconnoiters disguise themselves as mad people. Apart from emotional torture, the death of the people constituted a setback to their loved ones.

The insecurity and fear pervading the war affected Esan's commerce and economy. As a result of the fear of being conscripted, the youth could not continue farming, hunting, and trading activities. The burning down of the Uromi market²⁴ seriously affected trade in Esan as Uromi was the commercial hub center of Esan. The opening of the Igweben Training Depot diverted the attention of the youth of Esan from a worthwhile economic venture to the prosecution of the war—youth who were needed in the productive sectors enlisted in the Army. The war drastically reduced the volume of trade in Esan. For example, the Igala people stopped coming to the Illushi market after the Biafran troops looted their market items and used their boat to commandeer the items to the East in September 1967.²⁵ In Ekpoma, the fierce battle between the federal forces and the Biafran troops also reduced the trade volume in the area as the people became afraid to go to the market and farm. The Biafran and the Federal forces stole domestic animals in the rural communities. Iweze notes that:

*The produce of farmers and their livestock in the rural communities were either destroyed or stolen by the federal troops and other war destitute. This led to famine and acute food shortage because farming became risky due to military movements in the area during the war.*²⁶

Ogbemudia revealed that the Midwest State experienced meat shortage during the Biafran

Akubor, C 48 Year, University Lecturer Interviewed at Ife, January 29, 2019.

Ngozi Ojiakor, *Social and Political History of Nigeria, 1970-2006*, Second Edition, (Enugu: Evans Press, 2014), 2.

Ojiakor, *Social and Political ...*, 2.

Sunday Okoromi, c75 Years, Farmer, interviewed at Egbiki, Igweben, January 17, 2019.

Aregbeyegwale P. & Ojiefoh, *Uromi Chronicle, 1025-2912* (Uromi: Aregbeyegwa Publishers, 2015), 85.

Agbadamu Godwin, c68 Years, a retired Nigeria Army, interviewed at Illushi.

²⁶Daniel Olisa Iweze, "Ogbemudia's Regime and Post-Civil War Reconstruction of Economic and Social Infrastructure in Western Igboland, 1970-1975", *The Nigerian Journal of Economic History*, No. 11&12, 2014, 36.

occupation of the state.²⁷ Essential food products such as salt and eggs were also reported to be scarce in the state. The use of salt for explosives made it scarce in the Midwest, including Esan, when Biafran occupied the area. The lack of these food items reduced their nutritional value, resulting in health challenges, which are precursors to poverty.

Another consequence of the war in Esan was the capture of the young girls for sexual purposes. Young girls were potential targets of all forms of abuse, such as rape, sexual assault, and forms of inhuman treatment. The problem of sexual assault during the war made Esan young girls disguise themselves as married women, but this only reduced the problem, as even married women were sexually assaulted. Samson Aibueku revealed that in Ujemen, Ekpoma, a newly married woman was sexually assaulted by Biafran forces in August 1967.²⁸ Ojiefoh revealed that the federal forces "beat up people without cause, seize people's wives, and lock up innocent citizens..."²⁹ In Uromi, there were cases of sexual assault of young girls. Some were even impregnated without recourse to marry them. The case of sexual atrocities was prevalent in places like Uromi and Igweben because of the location of a garrison and Training Depot. Chief Idogun Cletus notes that a lot of girls were impregnated in Igweben, leading to babies being abandoned by the Federal soldiers.³⁰ The social implication of sexual activities on young girls is captured by Etekpe, who argued that early pregnancy deprived young girls of the right to education and dignity. Etekpe further reiterates that the fatherless children eventually raised from the above pregnancy become hoodlums. He thinks that there is a strong correlation between hoodlum and youth restiveness.³¹ The war led to the breakup of marriages. This is either as a result of the death of the husband or the capture of a married woman. For example, Elder Joseph Okoyomon revealed that a federal soldier collected the wife of Mr. Isibor Peter of Idumosodi in Ubiaja. Okoyomon also revealed further that the federal troops impregnated a lot of Ubiaja girls.³² Marriage institutions are sacred in Esan land, but the war led to their desecration.

Notwithstanding, some Esan women voluntarily married soldiers, which enhanced relationships between Esan and other ethnic groups in the country. Some of these Army became senior Military officers, which helped to evaluate the status of their wives' relatives. For example, Lt. Col. Daramola married Theresa Masada from Ebhoiyi, and Lt. Col. Adeniran married Patricia Okoriah from Uromi.³³ The war impacted some aspects of Esan culture. Chief Philip Ekeoba notes that urinating and defecating inside the living house was at variance with Esan culture. But, with Biafra and the federal forces in the area and the fear of either being captured or being killed, the people decided to put small containers inside to defecate and urinate.³⁴

The disruption of educational activities was a significant consequence of the war. The Biafran and federal forces occupied schools, and this led to the closure of the schools. The Biafran troops

Samuel O. Ogbemudia, *Years of Challenge* (Ibadan: Heinemann Educational Books, 1991), 60.

Samson Aibueku, c82 Years, Politician, Interviewed at Ekpoma, January 18, 2019.

Ojiefoh, *Uromi Chronicle*..., 85.

Idogun Cletus, c71, Retired Principal, Interviewed at Igweben, January 19, 2019.

A. Etekpe, *The Politics and Conflicts Over Oil and Gas in the Niger Delta: The Bayelsa State Experience* (Port-Harcourt: Tower Gate Resources, 2007), 66.

Okoyomon Joseph, c72, Farmer, Interviewed at Ubiaja, January 19, 2019.

Aregbeyegwale P. Ojiefoh c75 Years, Director, Centre for Esan Studies, Uromi, Interviewed at Uromi, January 15, 2019.

³¹ Philip Ekeoba, c84 Years, Retired Staff of Midwest Palm Oil Development Company, Interview at Ewohimi, February 5, 2019.

invaded the teacher training college Igweben and later by the federal forces; this led to the closing of the school. The Army occupied the school from August 1967 to 1973, when the federal troops returned to the barrack. In other parts of Esan like Uromi, Ekpoma, Ubiaja, Ebelle, Ewohimi, Ekpon, Illushi, and Uzea, schools were turned to army camps for Biafran and the Nigerian soldiers. For example, St. Augustine primary school, the only primary school at Illushi, was occupied by the Biafran troops and later the federal forces. Similarly, they occupied St. Benedict primary school, Ubiaja. Ogbemudia captured the situation when he said that the secessionist invasion of the Midwest made many schools go on forced holidays.³⁵ Even when the Midwest government opened schools in the state after liberation from Biafran forces, the federal troops occupied them. For example, Agba Grammar School Uromi and St. Augustine Primary School Illushi, to mention a few, were still closed. Before some of these schools were opened, the pupils and students had outgrown school age, as the hostility of the period did not allow proper learning to take place.

Immediately after the war, the government took over all private and missionary schools in 1971 without compensation. Even though the measure was a national educational policy, many people saw it as a means of punishing the missionaries for their role in the war.³⁶ It must be emphasized that the federal government accused the missionaries of supporting the Biafran during the war. With the government taking schools, scholarships were introduced to assist students from poor backgrounds, and many Esan benefited from the government's kind gesture. After the war, the Midwestern state government made educational development cardinal in its scheme. The state government introduced a special scholarship for the training of female graduate teachers in July 1970 to address the problem of a shortage of female teachers in the state, and many Esan benefited from the program.³⁷

The civil war portrays the Esan people in a good light. At the same time, the Igbo who fled Esan as a result of the war came back to repossess their property after the war. This was contrary to the situation in Rivers State, where many Igbo were not allowed to claim their properties. For example, Chief J. A. Uba met his two-story building intact at Uromi, and the rent collected was handed over to him. Other Igbo that claim their properties after the war in Uromi are Mr. Pius Eyin Arinze, Sylvanus Nwerem, Boniface Ihenfobi,³⁸ etc. In Illushi, Mr. Fidelis Igbonezu returned to claim his house after the war.³⁹ In Igweben, Idogun Cletus revealed that the Igbo people returned to possessing their houses after the war.⁴⁰ Similarly, Elder Joseph Okoyomon noted that Igbo who fled Ubiaja during the civil war returned to possess their properties after the war.⁴¹

The civil war removed Esan's economy from the Igbo's hands and allowed the Esan to take over their economy. John Okohere notes that the Uromi people were unhappy with the Igbo before the war because they occupied all aspects of Uromi's economy. Okokhere said further that the Civil War was a blessing for the Uromi people since it allowed them to control their economy.⁴² Ojiefoh notes

Philip Ekoeba, Interview.

Ogbemudia, *Years...*, 199.

Jones Ahazuem, "The Long-Term Effects of the War", in Helmut Bley (ed.) *A Social History of the Nigerian Civil War*, (Enugu: Jemezie Associates, 1997), 203.

G. N. I. Enobakhare, "Special Scholarship for the Training of Female Graduate Teacher", *Daily Times*, July 3, 1970.

Ojiefoh, Interview.

Idogun Cletus, Interview.

Joseph Okoyomon, Interview.

⁴² John Okokhere, c83 Years, Retired School Principal, Interviewed at Uromi, February 17, 2019.

that "the legacy the Uromi indigenous sons got from the Igbos was well consolidated during the civil war."⁴³ Ojiefoh affirms further that "the Uromi artisans now replaced the Igbos who were their masters. Uromi sons who were traders, mechanics, drivers, etc., returned home and established various trades in Uromi."⁴⁴ Most of our interviewees believe the war was suitable for the Esan people because it allowed them to return home and engage in their occupation. The change of Nigerian currency during the war and the indigenization Decree immediately after the war did not only impoverish the Igbo but also routed them "from the commanding height of Nigerian economy."⁴⁵ The Igbo who fled Esan returned very poorly, without the capital to start their businesses. Since the currency change and indigenization did not adversely affect the Esan people, they took over the Igbo's position.

The war created animosity between individuals and groups. There are instances where people were reported to either the Biafran or the federal forces as constituting saboteurs to them. These individuals or groups are arrested. Some people in Esan used the civil war to settle their old scores. Mr. Joseph Odigie wrote a petition to Murtala Mohammed that the Onogie of Ewohimi was supporting the Biafra forces during the war. The Onogie of Ewohimi, Enosegbe II, was arrested by Mohammed and taken to Asaba. On getting to Asaba, the Onogie could present 36 previous petitions written against him by Odigie even before the war. The federal forces under the command of Murtala Mohammed concluded that the problem between the Onogie and Odigie predated the war and set the Onogie free.⁴⁶ Similarly, Pa Imoesili Agbator was arrested during the war by the federal forces at Ukpoke, Uhiele Ekpoma, because he was reported by some individuals that he was supporting the Biafran troops.⁴⁷ The incident of reporting each other has created animosity between the Esan people. Besides, the Biafran invasion of the Midwest created inter-ethnic bitterness between non-Igbo groups like Esan and Western Igbo groups.⁴⁸ The non-Igbo group saw the Biafran invasion of the Midwest as an opportunity for the Igbo group to dominate the political affairs of the state, which the Esan resented. Chief Michael A. Ojomo, from Uromi formed and financed the most effective movement that resisted Biafran in Benin.⁴⁹

The unfortunate incident of the Biafran invasion of the Midwest created long-time ethnic bitterness between Esan and her immediate neighbor. This is why Iweze affirms that "the post-civil years witnessed increasing bitter ethnic frictions and prejudice in the Midwest, especially the Igbo and non-Igbo ethnic groups".⁵⁰ However, the Biafran invasion forged greater unity among the Esan people. Party politics divide notwithstanding; the Esan people were unanimous in rejecting the Biafran incursion into the Midwest.

Political Effect of the War

The war had political implications for the Esan people. In the Midwest, the majority of people from the Western Igbo lost their positions in the state because of the role they played when Biafran

Ojiefoh, *Uromi Chronicle*..., 78.

Ojiefoh, *Uromi Chronicle*..., 78.

Chinua Achebe, *The Trouble with Nigeria* (England: Heinemann Educational Books, 1984), 46.

Philip Ekeoba, Interview.

Mark Ehimen Aigbomian, c65 Years, Executive Officer, Clinical Science, Ambrose Alli University, Ekpoma, Interview at Ekpoma, February 14, 2019.

James O'Connell, "The Conflict and After: Christian Concern in the Nigerian Civil War", (Ibadan: Daystar Press, 1969), 50.

Nowamagha A. Omoigui, "The Midwest Invasion of 1967: Lesson for Today's Geopolitics", accessed January 8, 2019. www.dawodu.net/Midwest.htm.

⁵⁰Iweze, "Post-Civil War", 186.

invaded it. Col. Ogbemudia set up the Rebel Atrocities Tribunal of Enquiry in October 1967 to look into, among other things, the role played by public servants in the Biafran invasion of the Midwest.⁵¹ Although the tribunal's reports were never published, Iweze reveals that top Western Igbo civil servants considered the guiltiest were dismissed from service. The less guilty were reabsorbed but demoted.⁵² The non-Igbo groups like Esan mostly filled the vacancies created by the dismissal of the Western Igbo groups.

Another political impact of the war was that the Midwest Region remained one piece despite splitting the four regions into twelve states. Consequently, the Esan Division remained as it was when it was four regions. Notwithstanding, "Owegbe as a political force had virtually divided the state into factions, the Igbo-speaking and non-Igbo-speaking area."⁵³ The civil war affected recruitment in the Army. Omoigui argued that many viewed the Army as an unattractive profession meant for school dropouts. Omoigui affirms further that it was during the war that a large number of non-Igbo groups like Esan joined the Nigerian Army.⁵⁴ For example, 80 persons from the Esan Division passed out from the Lagos Training Depot in September 1967.⁵⁵ The war experience was, for example, in the Midwest, where Western Igbo dominated the Military during the war, leading to the clamor for a policy of equitable representation in the Military in both the state and local government.⁵⁶ Since the Esan people do not want to repeat the civil war, its effects will remain unforgettable. The Esan people and Nigerians have learned their lessons.

Conclusion

This paper examines the effects of the Nigerian Civil War, which ranged from 1967-1970, on the Esan people of Midwestern Nigeria. When the war broke out, Esan experienced no or low military presence until the Biafran invasion of the Midwest on August 9, 1967. The paper thinks the Biafra Incursion into the Midwest spread the war to Esan and other towns in the Midwest. The paper finds out that with the spread of the war to Esan, life was no longer the same, and this invariable made the war have positive and negative effects on Esan people. The war had a social, economic, and political impact on the Esan.

Ethnic bigotry is a major cause of the Nigerian civil war. In Nigeria today, the struggle for self-determination and irredentism can be attributed to the country's lack of ethnic harmony. Good governance is a prerequisite to eradicating ethnic struggle in the country. Good governance and good leadership go hand in hand. Good governance and leadership can encourage citizenship loyalty, accountability, and open consultation and strengthen civil society.

Ogbemudia, *Years...*, 113.

Iweze, "Post-Civil War", 182.

Oshomha Imoagene, *The Edo and their Neighbour of Midwestern Nigeria* (Ibadan: New-Era Publisher, 1990), 87.

Omoigui, "The Midwest."

Emmanuel Abbulimen, c80 Years, Retired Nigerian Army, Interviewed at Irrua, January 18, 2019.

⁵⁶Omoigui, "The Midwest."



10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

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EFFECT OF VALUE ADDED TAX ON INFLATION IN NIGERIA

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Abstract

Value-Added Tax (VAT) has been recognised as a vital source of government revenue in the world over. It has been a concern for researchers and policy makers whether VAT is a trigger for the rising inflation rate in Nigeria. This paper thus examined the effect of the implementation of Local VAT (LVAT) on inflation rate in Nigeria, the effect of Foreign VAT (FVAT) on inflation rate in Nigeria and the effect of Import VAT (IVAT) on inflation rate in Nigeria from 2011 - 2024. Secondary data from the Federal Inland Revenue Service (FIRS), the National Bureau of Statistics (NBS) and the Central Bank of Nigeria (CBN) were used for the study. Data on LVAT, FVAT, IVAT and inflation rate were used for the study. Descriptive and Autoregressive Distributed Lag (ARDL) regression techniques were employed in analysing the data. The ARDL being an inferential statistic was adopted because some the variables of the work were not stationary at level that is, $I(0)$. The findings show that, LVAT has a positive but insignificant effect on inflation rate in Nigeria, while FVAT and IVAT had a negative and insignificant effect on inflation rate in Nigeria. In addition, the Error Correction Term $\{ECT(-1)\}$, been correctly signed indicated that once there is disequilibrium in the system, it will take an average quarterly speed of 102.97% to restore the long-run relationship between inflation rate and VAT. The work therefore recommended among other, that the Nigerian government at all levels and policy makers should halt any plan of increasing the LVAT as it portends danger of worsening the already high inflation rate in Nigeria.

Keywords: Value Added Tax, Inflation

Introduction

Taxation has increasingly become a major tool for achieving the broad macroeconomic goals which include control of inflation. The immediate priority of many nations around the world is to strive for rapid overall development through fiscal consolidation and broadening the revenue base. Despite the fact that taxation is one of the most important revenue generating mechanisms in many economies, it usually triggers inflation with attendant adverse effects on economic performance hence it often features as a major monetary policy objective. Value Added Tax is a form of consumption tax that may or may not increase the prices of other commodities in many countries of the world (Tait, 1988).

Developing countries like Nigeria, have selectively adopted new tax systems to increase government revenue, influence purchasing power, improve the social conditions of the population and achieve rapid economic growth (Ilorun, 2012). Value Added Tax is an indirect tax introduced in Nigeria in 1993 as a replacement for the Sales Tax with the aim of broadening the tax base and generating additional revenue for the government. There are many factors and considerations that specifically justify replacing sales tax with VAT. The tax base of VAT is broader than that of sales tax, as it covers not only consumer goods, but other professional services. The tax is collected only by the Federal Inland Revenue Service (FIRS) at a rate of 5% which was increased to 7.5% on the 1st of February 2020 (PwC, 2024).

The relationship between VAT and inflation has been a subject of interest and debate among economists and policy makers. On one hand, VAT can potentially contribute to inflationary pressures by increasing production costs and prices of goods and services. On the other hand, VAT can also have a dampening effect on inflation by enhancing tax compliance, reducing fiscal deficits, and promoting fiscal discipline. The main reasons for introducing VAT in Nigeria include: increasing public spending and increasing national income and reducing over reliance on crude oil imports and domestic challenges resulting uncertainty in international markets. The objective is to ensure that VAT is paid on those goods and revenue accrued therefrom channel to economic growth, but the process and the consequences have become debatable and hence an inquiry like this is justified.

The Nigerian government has continually increased VAT as an alternate source of revenue despite expressing concern to attain macroeconomic stability which includes price stability. There is that fear that Nigerians will soon pay VAT on almost everything (Olaoye, 2014). The effect of all this is that it changes citizens' views of the system, making them question the government's intentions. These problems can directly affect the standard of living of ordinary residents, such as excessive burden on end consumers via undesirables like rising fuel price and triggering spirals of inflation. This general perception has been a major cause of concern because the success of any public policy is judged by its impact on society (Clown, 2012).

Value Added Tax is collected in Nigeria on locally produced and consumed goods (LVAT), on export goods (FVAT) and on goods imported into the country (import VAT). It is expected that VAT should have massively contributed to government revenue, significantly reduced public borrowing and produced colossal positive impacts on livelihood but ironically the country has been on foreign borrowing spree ever since its introduction. The living standards of the people has been dwindling ever since and Nigeria has become the world centre of poverty with over 50% of the people living in

extreme poverty (RSIS International). This brings to question the possible cause of the fiasco and the necessity of investigating the impact of VAT on inflation seeing inflation relates directly to the prices of consumption and investment goods and services.

Objectives

The specific objectives are to:

- i. Assess the effect of local VAT on inflation rate in Nigeria
- ii. Examine the effect of foreign VAT on inflation rate in Nigeria
- iii. Investigate the effect of import VAT on inflation rate in Nigeria

Literature Review

Concepts VAT and Inflation

The two prominent concepts that this work hangs upon are VAT and inflation. It is incontrovertible in economic history that these concepts unlike many others have universally accepted definitions and hence limited arguments as to what they mean or represent. VAT is tax variant on supply of goods and services which is levied at and deducted at each stage of the production and distribution chain. Each business along the production chain in an economy is required to pay this tax on the value of the produced goods/services (Caleb et al., 2018). Oyedokun (2020) asserts that VAT is a consumption tax levied on goods and services in contrast to sales tax. VAT is neutral with respect to the number of passages from the producer to the final consumer, whereas sales tax is levied on total value at each stage. ultimately, the final consumer bears the cost. In Nigeria, the definition of clarity of the concept of VAT is not debatable. VAT has been precisely 5% at any stage in the production or distribution chain until February 2025 when it was increased to 7,5%. Bhattacharya (2014) describes inflation as a quantitative measure of the rate at which purchasing power for goods and services decreases over time. This means that, inflation erodes the purchasing power of consumers. Maina et al. (2014) added that inflation is a process by which money loses value manifesting quantitatively in rise in general prices of goods and services. Caballe et al. (2004) have a different opinion; that inflation is the daily increases in the prices of the goods and services. Obviously, the description of inflation in this case, focuses on galloping inflation.

Theoretical Framework

This paper is based on the New Keynesian school of economic thought particularly the New Keynesian inflationary theory. The New Keynesian Economics emphasizes that public policies must be designed to impact both the macroeconomic and microeconomic scenario simultaneously. It must take cognizance of aggregate demand and microeconomic decisions of households and firms if it must effectively generate inclusive growth. The perspective of the school as relates to taxation focuses on three (3) key issues: fiscal policy interactions within an economic system, systemic price stickiness and aggregate demand variation. The school provides a central place to inflation and its impact in the economy both at the macroeconomic and the microeconomic levels. It places the current inflationary rate (IF_c) as a function of lagged inflation (IF_{c-1}), and output growth rate ($Y - Y_e$) (Investopedia, 2020)) :

$$IF_c = IF_{c-1} + \beta (Y - Y_e) \dots\dots\dots (1)$$

Where Y = current output level and Y_e is the desired equilibrium output level.

Modifying the equation to capture our interested variables would then appear as;

$$IF_c = IF_{c-1} + \beta (VAT) + U_t \dots \dots \dots (2)$$

In the estimation model proper, VAT shall be represented in its various operational types.

Amplifying these 3 cardinal viewpoints: firstly, fiscal policy interactions within an economic system in this research could imply that VAT policies must necessarily interact with other fiscal and monetary policies at both macroeconomic and microeconomic levels and hence impacts macro economically the aggregate demand and micro economically the households and firms' profits. Specifically, the fiscal policies of tax interact with government spending and subsequently impacts on inflation dynamism (Kehoe, 2020). In cases of poverty dominated nations like Nigeria, increased VAT results into direct reduction of disposable income and hence increased inability to secure basic needs. Until and unless this danger is carefully factored into policy formulation, the unfortunate consequence would be inevitable.

Secondly, the school's assertion of price stickiness is derived from the fact that price changes due to inflationary trend takes time as firms will not automatically vary the prices of goods and services following an instant uncertain price variation in the market (Corporate finance Institute, 2024). However, in import - dependent countries like Nigeria where prices of goods and commodities are determined externally and are heavily influenced by the volatile exchange rate, its vital to note that the price system as advanced by the New Keynesian school becomes fallacious as price stickiness does not exist. Operating a tax regime in such a price system must note that price stickiness is not automatic and must rather be a target to attain such that tax implementation do not instigate a galloping inflation.

The New Keynesian's assertion that changes in tax rate and tax variants impacts on aggregate demand which in turn influences the existing inflationary rate is relevant. In fact, the tax multiplier is normally stronger in a country with high poverty rate. In a country grappling with a persistent double-digit inflation like Nigeria, this postulation is very relevant for tax policy formulation, implantation and impact evaluation.

Empirical Literature

There are many studies on the relationship and impact of tax on inflation in Nigeria. The outcomes of such studies fall into two distinct groups; of those that have found positive relationship and those that have discovered negative relationship between the variables. A positive impact of tax on inflation is possible if the government can effectively manage the formulation and implementation of the tax and the utilization of the tax proceed to impact aggregate demand. If this is achieved, the aggregate demand can aid stabilization of the general price system and mitigate inflationary pressures. The researchers that have identifies a positive relationship between tax and inflation in Nigeria are many such as Adegbite (2019), Obaretin and Akbor (2022).

Other researchers such as Adegbite (2019); Anichebe (2015); Afolatan et al. (2021) using different techniques arrived at the conclusion that taxation of different natures (whether income tax or consumption tax like (VAT) has negative relationship with inflation in Nigeria. They all identify the existence of a short run disequilibrium in the relationship and identify the corrective capacity of the *invisible hand* in correcting the disequilibrium via the Error Correction Model (ECM) in the

long run. The speed of adjustments is variously identified but generally they are all above 50%. These studies seem to ignore the role of the government in policy formulation particularly in the area of correcting the disequilibrium in the short run and look forward more to mythological, non-existing and fallacious role of the *invisible hand*. In reality, accumulated short runs sum up to the long run. This makes nonsense of the ECM tool and the fallacious expectation which if not taken seriously would make the long run expectations fallacious.

On a slightly varied level, Matthew et al. (2021) assessed the effect of an increase in VAT rate on inflation rate in Nigeria as well as the relationship between VAT and Nigeria's total debt outstanding. Emmanuel and Gbalam (2018) interest were mainly on the link between VAT and price stability. Koyck findings showed that, increase in VAT rate does not guarantee more revenue or a significant reduction in government borrowing in Nigeria. Afolabi and Bankola (2022) found that, there exist a positive long run interconnection between VAT and economic growth in Nigeria. These outcomes relating to VAT and important macroeconomic variables depict the centrality of either inflation or tax (VAT) on economic growth and development of Nigeria.

Methodology

Research Design and Data

The ex-post facto research design was employed in this work because the phenomenon to be investigated has already occurred and has been documented. An attempt to examine a cause - effect relationship between independent variable VAT which has already occurred and the dependent variable Inflation rate (INF) is the focus. This research used secondary data - INF sourced from CBN Statistical Bulletin (2022) and the NBS report (2023). Data on VAT was sourced from FIRS's Tax Statistics/Report (2023). The data obtained were on variables such as LVAT, FVAT and IVAT. All data were obtained in quarterly time series structures from 2011 Q1 to 2024 Q1, giving a total of 53 data points.

Method of Data Analysis

Descriptive statistical tools of minimum and maximum values, and standard deviation were employed to show the behavior of the data. Unit root test was conducted to know the time series properties of the data in order to avoid spurious result and also identify the appropriate estimation technique to use. The study eventually employed the ARDL technique because some variables were not stationary at levels 1(0) when stationary test was conducted using Augmented Dickey Fuller (ADF) test see Appendix. Furthermore, post estimation tests of Breusch - Pagan-Godfrey Heteroscedasticity and Multicollinearity were carried out to validate the results.

Model Specification

The model is made of a dependent variable - INF and three variants of VAT as dependent variables i.e. LVAT, FVAT and IVAT. The functional form of the model is:

INF f (LWT, FVAT, IVAT) (1)

The econometrics form of the model is stated as;

$$INF_t = \beta_0 + \beta_1 LVAT_t + \beta_2 FVAT_t + \beta_3 IVAT_t + U_t$$

Where β_0 = constant/intercept of the regression line, β_1 , β_2 and β_3 = Parameter estimates or slope of the variables and U_t = Error term.

Results, Interpretation and Discussion of Findings

Descriptive Statistics Result

Table 1: Descriptive Statistics

	INF	LVAT	FVAT	IVAT
Mean	185.6845	5.098954	4.136229	4.192076
Median	14.91000	4.850701	4.074822	3.970481
Maximum	9021.000	6.497046	6.077023	5.805165
Minimum	8.700000	4.524611	3.235930	3.570377
Std. Dev.	1236.975	0.545981	0.727023	0.545926
Skewness	7.072215	1.207502	0.643349	1.040473
Kurtosis	51.01727	3.212368	2.482061	3.232176
Jarque-Bera Probability	5533.472 0.000000	12.97915 0.001519	4.248508 0.119522	9.681871 0.007900
Sum	9841.280	270.2446	219.2201	222.1800
Sum Sq. Dev.	79565538	15.50097	27.48522	15.49782
Observations	53	53	53	53

Source: Authors Computation using E-views 12

The descriptive statistics in table 1 shows that INF 2011Q1 – 2024Q1 had maximum and minimum values of 9021 and 8.7% respectively INF averaged 185.68% during the period with a standard deviation of 1236.9%, which implies that the data deviated from both sides of the mean by 1051.29%. This implies inflate rate in Nigeria was widely dispersed during the period under study, thus, a significant fluctuation in inflation rate which can be attributed to poor management of macroeconomic variables in Nigeria, particularly from the 2023Q2 – 2024Q1. The shape of the distribution, measured by the skewness, revealed a coefficient of 7.072215 which implies a positive skewed distribution and deviates from normal distribution. With a Kurtosis of 51.01727, it implies that inflation is leptokurtic which means that, the distribution is peaked relative to the normal distribution. The descriptive normality results equally reveal that the Gaussian distribution assumption of the normal data on inflation did not follow the normal curve since the null hypothesis of normally distributed data cannot be accepted given the Jarque-Bera probability value of 0.00000, which is less than 0.05.

Local VAT during the period had minimum and maximum values of 4.524611 and 6.497046 respectively. The average value of LVAT was 5.098954 and a standard deviation of 0.545981 implying that deviation from both sides of the mean by 4.55. This suggests that the data for LVAT was widely dispersed from the mean during the sample period as the standard deviation was found to be lower than the mean value. The co-efficient of skewness of 1.207502 suggests that the data is positively skewed and does not comply with the symmetrical distribution assumption. The kurtosis value of 3.212368 which is greater than three implied that LVAT is leptokurtic, thus the distribution is peaked relative to the normal distribution. The Jarque-Bera P-value of 0.001519 (which is less than 0.05) means that, LVAT is not normally distributed at the 5% level of significance.

Foreign VAT had minimum and maximum values of 3.235930 and 6.077023 respectively, while the mean value and standard deviation are 4.136229 and 0.727023 respectively. This shows that FVAT is fairly dispersed from the mean with magnitude of 3.41. Foreign VAT was also found to be positively skewed with 0.643349 and non-symmetrical. With a kurtosis value of 2.482061, it implies that FVAT is platykurtic, which is flat relative to the normal distribution. The Jarque-Bera P-value of 0.119522 suggests that, FVAT is normally distributed at the 5% (0.05) level of significance. Finally, IVAT had minimum and maximum values of 3.570377 and 5.805165 respectively. The average value of IVAT during the period was 4.192076 with a standard deviation of 0.545926 implies that, the data deviated from the mean value by 3.64615. This suggests that IVAT in Nigeria was widely dispersed during the period under study as the standard deviation was found to be less than the mean value. The skewness co-efficient value of 1.040473 suggests that IVAT is positively skewed and does not comply with the symmetrical distribution assumption. The kurtosis value being 3.232176 indicated that, IVAT is leptokurtic, which is peaked relative to the normal distribution. The Jarque-Bera P-value of 0.007900 suggests that, IVAT is not normally distributed.

Diagnostic Test Result

White's Heteroscedasticity Test

The primary reason for conduction heteroscedasticity test is to detect violation of the Ordinary Least Square (OLS) constant variance assumption, with the hypothesis:

Ho (Null Hypothesis): There is homoscedasticity

H₁ (Alternative Hypothesis): There is heteroscedasticity

This work used the White's Heteroscedasticity test (Breusch-Pagan-Godfrey) to verify whether the constant variance assumption is violated in the models.

Table 2: Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.117602	Prob. F(4,47)	0.9756
Obs*R-squared	0.515295	Prob. Chi-Square(4)	0.9720
Scaled explained SS	10.11214	Prob. Chi-Square(4)	0.0386

Source: Authors Computation using E-views 12

Reference to table 2, the Prob. value of the White's F-statistic being 0.9756, which is greater than 0.05% level of significance, implies that there is no heteroscedasticity. Thus, Ho is accepted.

Multicollinearity Test Result

Multicollinearity exists when the independent variables are correlated with one another. The effect of multicollinearity is that the estimated regression coefficients of the independent variables that are correlated tend to have large sampling errors, and hence, undermine the reliability and stability of the estimated coefficients. Multicollinearity is detected using the Variance Inflation Factor (VIF) given by the formula:

$$VIF_k = 1/1-R_k^2$$

Where:

R_k^2 = the squared multiple correlation for predicting the kth predictor from all other predictors.

Under the ARDL/Bounds test approach, the decision rule is that, if the value of the uncentered VIF is greater than the centred VIF, it indicates that there is no multicollinearity among the independent variables.

Table 3: Multicollinearity Test

Variance Inflation Factors

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
INF (-1)	0.021265	1.032291	1.008818
LVAT	12.29027	22.42304	7.568841
FVAT	38.71206	15.74119	7.133534
IVAT	137.6793	40.85858	13.96423
C	107018.2	3.319106	NA

Source: Authors Computation using E-views 12

Table 3 shows the values of the uncentered VIF which are greater than the centered VIF across all the variables. This implies that, there are no multicollinear variables in the model, hence absence of multicollinearity among the independent variables.

Model Estimation and Interpretations of Model

Table 4: ARDL Error Correction Regression Results

ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CointEq(-1)*	-1.029699	0.139980	-7.356031	0.0000
R-squared	0.514800	Mean dependent var		0.375962
Adjusted R-squared	0.514800	S.D. dependent var		1784.527
S.E. of regression	1243.036	Akaike info criterion		17.10754
Sum squared resid	78802053	Schwarz criterion		17.14507
Log likelihood	-443.7962	Hannan-Quinn criter.		17.12193
Durbin-Watson stat	2.003965			

Source: Authors Computation using E-views 12

From table 3, the lagged coefficient of the Error Correction Term {ECT(-1)}, is correctly signed (negative) and statistically significant at 5% level of significance (as shown by -1.029699 and a probability value of 0.0000). It implies that once there is disequilibrium in the system, it will take an average (quarterly) speed of 102.97% to restore the long-run relationship between inflation rate and VAT. In other words, deviation from short run to long run equilibrium will be adjusted by approximately 102.97% within the next quarter to ensure full convergence to equilibrium level. Specifically, it means the system overcorrects slightly beyond equilibrium. Thus, any shock to the system is quickly nullified, which indicates that inflation rate in Nigeria adjust quickly to changes in VAT rate. The policy implication of this is that the Nigerian economy is highly responsive and slightly overactive to deviations from equilibrium.

The co-efficient of determination (R-square), which measures the goodness of fit, indicates that the model is relatively fit for prediction. The R-square shows that 51.48% of changes in inflation rate were collectively due to LVAT, FVAT and IVAT, while 48.52% of the unaccounted variations were captured by the error term. Durbin Watson statistic shows that, there is no evidence of autocorrelation, as indicated by the DW statistic of 2.00.

Table 5: The ARDL Long-Run Results

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	295.0712	327.1363	0.901982	0.3717
INF(-1)*	-1.029699	0.145824	-7.061226	0.0000
LVAT**	0.424373	3.505749	0.121051	0.9042
FVAT**	-2.013953	6.221901	-0.323688	0.7476
IVAT**	-0.172436	11.73368	-0.014696	0.9883
* P-value incompatible with t-Bounds distribution.				
Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LVAT	0.412133	3.404699	0.121048	0.9042
FVAT	-1.955865	6.036628	-0.324000	0.7474
IVAT	-0.167462	11.39532	-0.014696	0.9883
C	286.5606	314.8560	0.910132	0.3674
EC = INF - (0.4121*LVAT -1.9559*FVAT -0.1675*IVAT + 286.5606)				

Source: Authors Computation using E-views 12

The results in table 5 indicates that LVAT has a positive and insignificant effect on inflation rate. This implies that a 1% increase in VAT leads to approximately 0.41% increase in inflation rate in the long run. It indicates that LVAT has a positive but an insignificant effect on inflation rate in the long run. The estimated coefficient of FVAT being -1.955865 shows that a negative effect of FVAT on inflation rate. Thus, a percentage increase in FVAT results in approximately 1.96% decreases in inflation rate in the long run, holding other factors constant. The -0.167462 estimated coefficient of IVAT indicates a negative effect of IVAT on inflation rate. The result implies that a percentage increase in IVAT reduces inflation rate by approximately 0.17%, holding other factors constant.

Major Findings and Discussions

There are three major findings from the ARDL regression results in table 4. Firstly, the p-value of LVAT which is 0.9042 is greater than 0.05 level of significance. This implies that LVAT has a positive but insignificant effect on inflation rate in Nigeria. This is consistent with the findings of Akhor and Osasu (2022) and that of Matthew et al. (2021). Although, the LVAT has an insignificant effect on inflation rate, the positive nature of the insignificance effect should be taken serious. This is

because the Nigerian economy has an endemic inflationary already and any small stimulation of the inflation may exhibit a high inflationary multiplier effect which could trigger hyperinflation. Also, when businesses and consumers anticipate a VAT increase, no matter how insignificant, they easily adjust their behaviour. Businesses might preemptively raise prices in anticipation of higher costs, and consumers might increase their demand before the tax hike. Both of these can drive inflation to higher levels. In addition, sectors of the Nigerian economy with lower price elasticity of demand are more inclined and likely to pass on the full VAT increase to consumers, hence, amplifying the inflationary effect.

Secondly, the p-value of FVAT from the table 5 is 0.7474 is greater than the 0.05 level of significance in the long run. This implies that FVAT has no significant effect on inflation rate in Nigeria. Foreign VAT was discovered to have a negative effect on inflation rate in Nigeria, therefore agrees with the work of Milenkovic et al. (2020) that was conducted in selected Balkan countries. Thus, imposition of VAT on foreign goods is not among the real triggers of inflation in Nigeria. One plausible reason for this is that higher foreign VAT can lead to a substitution effect where Nigerian consumers replace more imported goods with the relatively cheaper local alternatives, thus, reducing pressure on domestic inflation. It will lead to shifting of demand from the once treasured *foreign rice* to its local counterpart as a result of the increase cost of foreign rice in Nigeria. Also, another reason for this negative effect of foreign VAT and inflation rate could be the reduced competitiveness of foreign goods due to higher VAT rates abroad which has incentivized local production, hence boosting supply and lowering domestic prices.

Finally, the ARDL estimated result in table 5 indicates that, the p value of import VAT is 0.9883 which also is greater than the 0.05 level of significance. The implication is that, import VAT has no significant effect on inflation rate in Nigeria in the long run. Import VAT from the regression result has a negative effect on inflation rate in Nigeria which means that, import VAT is not a trigger of inflation rate. This is due to the fact that, increased import VAT can dampen the demand for imported goods. When the demand for imports declines, the overall demand pressure on the economy might reduce, leading to lower inflation. On the other hand, higher import VAT can lead to a reduction in overall consumer spending, as consumers face higher prices for imported goods. This reduction in demand will invariably contribute to lower inflation. Another reason can be a situation where the higher import VAT affects non-essential goods, in which case the overall impact on inflation might be minimal as consumers cut back on non-essential import.

Conclusion and Recommendations

The study discovered a long run insignificant effect of all components of VAT (local, foreign and import) on inflation rate in Nigeria. It was also discovered that, inflation rate in Nigeria adjust quickly to changes in VAT rate in the period under review (2011 Q1 — 2024 Q1). Therefore, this study established that VAT in its various dimensions (local, foreign or import) has not contributed significantly to rising inflation in Nigeria.

In line with the findings, the following recommendations were proffered:

- i. The government at all levels (Federal, State and Local) can gradually or totally remove VAT on locally produced foodstuff. This is because the effect of all forms of VAT on inflation is insignificant.

- ii. Government at the national level can raise more revenue from foreign VAT as it portends no danger for inflation. This will go a long way in addressing the low Tax - GDP ratio that has characterized the Nigeria economy over the years.
- iii. The rate of import VAT should also be increased by the Federal Government of Nigeria, since doing that will not lead to any rise in inflation rate in the nation. In addition, there will be more revenue, and domestic production will as well be stimulated.

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APPENDIX

ADF Unit Root Test Results

Variables	At Levels	5%Critical Value	At 1 st Difference	5% Critical Value	Order of Integration	Remarks
INF	-7.2212	-2.9187	-8.3964	-2.9211	I (0)	Stationary
<i>ln</i> LVAT	4.5068	-3.5043	-8.6474	-3.5004	I (1)	Stationary
<i>ln</i> FVAT	2.3829	-2.9187	-4.8778	-2.9199	I (1)	Stationary
<i>ln</i> IVAT	1.8584	-3.4986	-5.7234	-3.5004	I (1)	Stationary



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THE ROLE OF COMPUTER AIDED DESIGN IN ARCHITECTURE

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Abstract

There was an comment on the computer design tool (CAD) Architects are widely used for decades. I have It was developed from a simple development tool to the point. Architecture software and powerful communication means The CAD architect plays an important role in the job. The architecture is the main tool of all architectural companies. This is not You can compete with a building company without accepting it. Advantages of computer software due to high demand Competition of the architectural industry. The purpose of this study is Effect of CAD for the architectural design process Conceptual level in the final product, especially in architectural practice. He explores the advantages of CAD integration in the industry. Discuss the possible defects that limit architects. method This study is based on the data collected properly. Expert's view. Identified benefits and restrictions in the architectural design process, the CAD potential and experts who use it appropriately Performance will be improved in the industry. With the highest quality at the architecture office.

Keyword: Architecture, Architecture Practice, Computer Support Design, CAD, Design Process.

Introduction

CAD implementation in construction industry is vast, amazing progress was achieved in terms of diversity. Design, quality and effects of final products Design process. The use of CAD is becoming more and more popular. Simplify the complexity of modern architecture design Sad products of architectural design are easy to use for light and communication purposes. Among those who participate in design and architecture process. With the help of CAD The building is visible and works after completion. Aesthetically and technically. You can also study by visualizing the structure from a different perspective Minimize undesirable results. Also, CAD is helpful Architects who provide various types of information Architecture plan, altitude, Section, internal drawings, landscaping structures, etc. Edit and review process Allows the architect to store the project. There is no need to start at the beginning every time you review. design. In general, it can be said that CAD has made a big revolution.

Construction Industry

Given this, this study will be Look at the role of CAD in the architectural industry. And emphasize how revolutionary CAD is in architecture Design process. II.CAD: That definition and result Architectural company CAD represents a computer and expert use process. Software for generating two -dimensional products of virtual three -dimensional models and products. Various types CAD software has been developed to use in numbers Application and industry [1]. CAD for using computer technology during design Processes and documents. You can use CAD to create 3D A model that shows accurate design calculations and structure. There is no doubt that the architect will be limited. If they do not use CAD; Complex and intellectual software You need to create a complex design and structure. In meaning CAD, such a design will be much easier and easier. saturated. The architect had to use traditional handles and paper before CAPR. How to draw; Each drawing and measurement must be done It was a difficult process to pass it manually. this It will take a few days or weeks to solve the CAD. It can be produced in the watch. But this does not mean a pen and the paper method is old -fashioned. Some architects are still preferred Prior to transmission, the initial design concept is drawn on paper. In CAD. With the help of CAD, the architect can create a variety of design options. You can develop a concept with detailed design Then 3D visualization and modeling. Yes They can see various aspects and prospects Buildings without having to build a physical structure Or model. This allows you to control and solve the problem Fast and efficiently. Then they can show this Designed to customers as a virtual tour.

Architectural Design

The process of architectural design is creative and problem Solution in the process. The design process is in order Actions that the architect must follow Design it until you reach the final product. building the design process is a complicated and ambiguous process. no way Designers usually start with abstract problems Developed at various stages to achieve detailed finale way out. In general, the architectural design process can be classified. In the four major stages

- i. Sketch design scenes (concept drawings of sketches)
- ii. Preliminary stage of design (more detailed sketch drawings)
- iii. The last stage of the design (detailed drawings).
- iv. The last stage of the design (work drawing).

Determines the effect of computer tools on each Step, potentially strengthening and improving or in Contrast is limited, so you should understand at each stage, the designer's activities and work are

better. The design stage of the sketch is abstract and unclear. More related to the architect's work. At this stage the architect defines concepts and basic ideas.

Initial thought Due to the function, in the shape of a building the location of the building can be seen at this stage. sketch the picture mainly shows the main idea of the architect. This emphasizes the design. This sketch can be used as follows. Communication tool between architects and clients. Between the architect and his colleagues. The preliminary stage of the design is more accurate and detailed. Type of drawing. Most of the time architects make it more detailed. A physical 3D model for presentation goals at this stage. At the specific design stage, the drawings are more accurate and detailed. They show and include the exact shape. More information about size, material, and connection.

At the end of the design, a large-scale drawing is created. To explain the details of materials and compounds measurement. Such work drawings cannot be drawn the architect itself is used for communication. Detailed information between construction transactions. IV effect in IV architecture design process CAD Architects can use different computer tools for various computer tools. Step of the design process. But the design stage the process is not the only criterion that is considered. Select computer tool, size and project type other decisions of this decision. The initial stage of the architectural design process is CAD accuracy and function are required. So many the architect still prefers pens and paper models or prefer scaling. Early steps [9]. At first, we use these exact programs. The stage of the design process can limit creativity. You can encourage designers and poor designs [10]. because the architect, which is an exact program for these functions, must be. Provides values and measurements in the previous stage in general, it does not occur in the initial concept sketch. However, it is widely used to promote the steps Design process. On the other hand, computers can create some the work is better than a person. They can be faster and more reliable calculate. Reduce time for this reason in the initial design stage, some architects use CAD. CAD had a great influence on training and training. And design practice [11]. Designers can use CAD Create a conceptual detailed design of 2D and 3D drawings, Operate the shape and more complex design Problems in a faster time.

According to Dong and Gibson, [12] Digital models provide opportunities to architects. When designing, I think, imagine, connect, and assume process. CAD is a very interactive and expanded software. Various simulations to help make the best visual visuals Design concept. CAD provides designers with a switching ability Between 2D (2D) and 3D (3D) You can see, increase, go out, and rotate images at any time. From different perspectives, they change the scale Too fast and easily manipulate the numbers. In general, there are several aspects for construction. A design process affecting computer use; here One of the main advantages of CAD implementation. System of Architecture Office: The CAD provides designers with the ability to visualize 3. Extract the completed dimension and information It is more time modeling quickly and easily, so there is more time. Focus on design processes. Also, this is possible Designer to model building performance Adjust and control the final product that will help you Immediately perform the necessary modifications. CAD is also helpful Combination, analysis and documentation designer Design that improves performance together Designer for fast design, low cost and short time Project completion. Also, after the CAD system Providing a greater accuracy will cause the error to decrease rapidly. Designed product leading to a better design. Another cool feature of CAD What is popular is the communication he brings. building The CAD system facilitates connection between architects.

And the contractor allows a file made of something else. It is also included in the system that needs to be read in the same model. Related information for other experts relevant. Above all, CAD contributes to liver communication Provides opportunities to architects, customers and customers Include in the design process. Customers are not needed I have an architectural knowledge to understand the rendered CAD 3D model that provides many perspectives and virtual Inside and external building travel. Consider the document as one of the most important documents. CAD, part of the design process, can easily create high quality. There are few pictures that help the best design documents. Error and clarity are high. Also all data The drawings used for the design can be easily preserved and used. There is no need to design for future links. Or repeat them repeatedly.

Conclusion

CAD had a significant impact on evolution. architecture. CAD has created almost all construction stages. The design process is easy and fast to complete. CAD is being promoted Design of complex buildings for designers; how is it Used to make a decision in the design process In addition to producing drawings. Usually use CAD Improving performance level, improvement of structural quality, Lower design cost and excellent time efficiency. but, Drawing practice is dominant for design Development of architecture is a good idea to use. Traditional sketch method before development Basic of the design process. So this study is Provides a successful mix of traditional design methods It can be created with the use of CAD technology. Excellent combined products like the finished design. Therefore, it must be in architecture practice Traditional methods and CAD tool.

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THE IMPACT OF ARCHITECTURE ON URBAN SPACES AND DEVELOPMENT

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Abstract

Urban space serves as an important center for community interaction development, and architecture plays an important role. The formation of function and the role in the inclusion of such space. This article explores history Modern relations between architectural design and urban social epidemiology. By studying Architecture principle, topic research and design. The plan can contribute to social cohesion, increase safety, and strengthen the identity of the community. Also discuss Problems such as aesthetic neglect and separation of social space that undermine the potential of the city gap. Finally, this study is how attractive and comprehensive, and A space where culturally teaching resonance spaces, educating and participating in the community.

Keywords: *Urban Space, Community Interaction, Architecture, Urban Planning, Social Cooperation.*

Introduction

Urban space is an important catalyst for interaction between members of larger communities. people They usually gather for work or entertainment, but architecture plays an important role. This trip is changed to social conference. Design and function of available community the area helps to contribute to greater public activities in urban spaces, otherwise Magistral. Urban Planning Theory emphasizes the most successful when this space is included. Flexible use options for various people. Architects and planners must act first as a promoter who can identify the specific reactions of the larger community. Too much Often designers focus on determining the form of the project without thinking about social use. subsequently, the official results you want may not even use the developed results [1, 2]. Physical Factors such as accessibility and safety also affect whether the residents use space exclusively. Or visit more people in a wider range of people. The integration of various resident's General view of the region. External space cannot be used even if a resident is found. It is not attracted aesthetically. As a result of these numerous factors, urban plans try to build construction. Environmental encouraging social interaction between neighbors. Fortunately, there are certain conditions This has been shown to contribute to the empathy of the community. The use of zoning land can be promoted informal. In society, planners can successfully integrate urban spaces. Historical influence on action. The form and function of the status and personal architecture Undoubtedly, the strong influence on the social structure of the world residents. Thus, Social problems are undoubtedly affecting architecture. In the modern world, certain designs are suitable. The sense of the community has changed. These four approaches are historical Region, city and public open space. About the history of architecture and about its history of public places. Community is a must -have part of training. Social aspects the architectural form cannot be separated. Modern and postmodern architectural schools can be considered as follows. Response to the social politics and construction conditions of the construction environment.

Historical prospects for architecture and urban planning

Architecture and urban planning were part of human efforts from the beginning of urbanization. city the cradle of civilization witnessed major philosophy, religion, war and economy. Exercise that is the basis of humanity. Many movements in the socioeconomic and other fields It is reflected in the building environment and the architectural style of the region or building. evolution Through history, it is reflected in various styles and ideologies that are popular in certain times. Certain places or buildings were considered a cause of death or for representing a certain period. Growth of socioeconomic thinking [5, 6]. Some of the most popular architecture and urban styles the plan is the Savannah Plan, the wall of the wall, the baroque design, the expansion leader model, colonial model, city, industrial revolution, modernist concept and high-rise building. This style has been developed in various social political thinking,

which is mainly defined as people. He approached the space in the urban area. Therefore, the style of the city was the reaction of citizens. Like a modernist the times and post war residential buildings can give us a vision for the development of this time. no way Higher buildings or small or long "blocks" structures are small or historically considering in fact, the city's architectural heritage actually shared the poor and marginalized people. More competent and socially recognized. Therefore, many of these buildings It is necessary to remove architectural aesthetics, social culture and urban factors. We demanded the necessity of attracting a safe distance from the pound. Therefore, the architecture is related Urban is part of urban fabric management applied and reflected by the law adopted to date.

The role of architecture in the formation of community identity. Despite the popular modern beliefs that emphasize the decrease in the role of architecture in urban formation, Buildings and urban spaces are still needed to create a sense of place. Check out the local identity reflected in the physical form that the community recognizes and appreciates. The identity community is a community resident Visitors feel and feel when they see or visit more than one area, especially related areas. Famous figures show the characteristics of cultural roots, roots and traditions. shaker She emphasized the inevitable desire for the sacred perfection of identity. Architecture, planning and design Experts often identify identity, relationships, memory and values and are not preserved. The decisive signs consist of the silhouette of the city you will learn and confirm the place and confirm the place. somewhere. Tourist attractions make physical images and ask people about their attractions. Describe them as if they describe people. A cult like her "I make a decision in a city where she calls" MasterCard Place, "" I know where the phrase is, who I am. I'm too connected to the product, where the product is, as follows. Recognition or passion? The unique mental and cultural demands of certain people in certain places. A city like Florence The picture of how charm votes to people with special visual characteristics help Europeans. It recognizes different cultures from reasonable Greeks to colorful North American.

Design Principles to promote social interaction in urban spaces Invitation. The invited place is characterized by a distance where the east wind does not cut with a knife. The sun, the cool place in the summer, the restaurant with a friendly crowd in the winter evening, the public plaza As some people come and go With the impulse of the moment, angle with a friend. People will pass the environment Collect it as a group with social goals or intentions to encourage them. This concept covers society The need to include not only interaction between people, but also a space for people to retreat and see Without participation. In urban situations, you can be children in the game space. If you open a cafe, region, and festival visitors through exercise. Urban designers must encourage the movement between other areas of the city, especially in residential areas, and cities, center. Exercise along the direction of exercise, surrounding parks, and the direction of earth tracks such as green the universe and water should make a place along the intersection they want. Welcome to what you have come, and see them together to pause and play, or to enjoy familiar and deep attractions. Their city. The recent collection space is that people want to use. They feel comfortable and safe and enjoy the environment. Local people and tourists (parts the situation) should be able to enjoy buildings, streets, species, square and places. personality the place must be particularly related to the local identity and demands of the community. Therefore, it is instructed to be seen and felt in different places in other places. It must also be connected Cultural identity in this field.

Topic research on successful urban architecture projects

There may be many other cases around the world, but the next project shows an example. Successful urban planning and construction performance. This case shows the interaction with the community. It can be placed with the help of urban projects and even proceeds. How can there be a specific program? How to collect from a site to pioneer the use combination and construction intervention Mental process. In other cases, the design of public places, regions and regions is generally It functions as a restrictor for potentially undesirable activities, so it attracts desirable people. In public environment. One of the places to study in urban design is the effect of architecture on the community.

Many examples We own the fact that we do not call the strategy, atmosphere and lifestyle to the place of strategy. It is universal or attractive and usually alienated. Topic research data It indicates that urban design is important and not protected depending on the situation. Potentially meaningless plug-in system. The data of the subject research is also different places. Various types of activities, which are considered undesirable generally in the modern urban environment, are Successfully adapts to design independently. Such a topic study shows this The main name of the space can generally attract unheard activities. Therefore, if you increase the preferences of the space as a whole, in this case, the opposite is not evaluated. The process, that is, the degree of not desirable to prevent other types of public activities Settings.

Conclusion

Architecture and Urban design have a deep impact on the way the community interacts and forms a connection. Within the whole space. Historical ideas often reflect social values, while architectural ideas Modern urban plans should consider inclusiveness and stability. Topic research is emphasized The importance of creating a space aesthetically attractive, culturally and functionally Adapt to various social use. Successful urban architectural projects The interaction and improvement of the identity of the community requires an integrated approach to adjusting the architecture. Innovation with local needs and cultural heritage. Architects, planners and politicians must cooperate Not only does it meet real needs, but also creates nutrients and stable urban environments. Community.



10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

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THE USE OF EDIBLE PLANTS AND FRUIT TREES TO IMPROVE THE VENTILATION AND LANDSCAPE OF A BUILT ENVIRONMENT

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Abstract

A fruit tree simply refers to a tree that bears fruit for human consumption. Over the years it has been observed that flowers have been used for the purpose of beautification and landscaping of the environment. However, the maintenance of these flowers has proven to be very tasking, especially cutting and trimming of the leaves and branches or watering the plants to ensure their leaves remain green during dry season. This process wouldn't have been so tedious if there was an economic benefit of the plants rather than only for beautification. This research work is aimed at enlightening the society on how to replace the flowers with edible plants such as: waterleaf, pepper, curry, and the Ocimum Gratissimum popularly called scent leaf e.t.c. Also, orange trees, guava trees, pawpaw, mango and coconut trees can also be introduced to create some shade and sitting areas in our environment. At the end of this research work we will learn how to achieve a well-designed landscape environment using economic plants and trees that will feed our society.

Keywords: *Environment, Edible, Economic, Landscape.*

Introduction

Edible plants in landscaping offer a unique combination of aesthetics, functionality and sustainability. They enhance the garden with a unique ornamental component while providing health, economic and environmental benefits. The main objective this is the production of food and raw materials and the provision of good landscape with high aesthetics value. Agriculture is the main use of land resources but cities have consumed a large amount of the agricultural land. Urban agriculture has become increasingly popular and is referred to in a variety of ways, e.g., urban gardening, urban homesteading, and edible landscaping (Nolasco, 2013). Dormant lands -green fields- can be used to produce crops, and decorative landscapes can be converted into productive landscapes (edible landscape, community garden, allotment garden, rooftop vegetable garden, urban agriculture) with food and medicinal plants (Grichting and Awwaad, 2015). The challenges industrial food system separates people from their food sources (Philips, 2013). People living in urban areas often have little to no green space and are dependent upon outside sources (oftentimes hundreds of miles away) for their food (Hezik, 2016).

In the last years, green infrastructure programs have proliferated in cities. Initially focused on planting trees, restoring habitat, and developing trails and greenways, green infrastructure programs now include storm water management projects. They also include food security projects, such as edible landscaping, community gardens, rooftop vegetable gardens, and public orchards. The collective goal of these programs is to create sustainable urban ecosystems through the development of a dense network of open space, air sheds, watersheds, woodlands, wildlife habitat, parks, and other natural areas that provide the vital services that sustain life and enrich the quality of life (McLain et al., 2012). This paper aims to provide a conceptual framework to address edible landscape under conditions of the urbanization, agricultural land conversion and population increase.

What is Edible Landscape?

Edible landscape may be referred to as a designed vegetation which consist of productive plants with parts that are safely edible by humans. Edible landscaping plants are both food plants and ornamental or decorative plants. Edible landscaping is the use of food plants as design features in a landscape. These plants are used both for aesthetic value as well as consumption but do not include food items produced for sale. Edible landscaping oftentimes called foodsaping is a progressive food systems approach that encourages all people in their homes, public spaces and workplaces to promote local food (Thompson and Sokolowski, 2016). Edible landscaping utilizes food-producing plants in the residential landscape. It combines fruit and nut trees, berry bushes, vegetables, herbs, edible flowers, and other ornamental plants into aesthetically pleasing designs. The location and design of these gardens may vary between large agricultural landscapes, urban areas (e.g. sidewalks, rooftops, and indoors), community gardens, and one's own backyard (Mackalvie, 2014). Edible landscaping offers an alternative to conventional residential landscapes that are designed solely for ornamental purposes. Edible landscaping is the use of food-producing plants in the constructed landscape, principally the residential landscape (Beck and Quigley, 2001). Edible landscaping, which integrates food producing plants into ornamental plantings and conventional designs, is also put forward as a productive landscaping alternative (Kourik, 2004). Edible landscaping, simply put, replaces plants that are strictly ornamental with plants that produce food. Edible landscaping will allow creating a multi-functional landscape that provides returns (fruits, vegetables, etc.) on investment of water, fertilizer, and time. An edible landscape

can be just as attractive as a traditional one; in fact, the colorful fruits and foliage of many edibles are quite beautiful. Edible landscapes can include fruits (apple, cherry, fig, pear, strawberry, blackberry, kiwi, etc.), vegetables (tomato, pepper, eggplant, bean, lettuce, etc.), medicinal and aromatic plants (geranium, peppermint, thyme, rosemary, sage, echinacea, etc.), herbs, and even contain flowers. These designs can adopt any garden style and may include anywhere from 1-100% edible specimens (Worden and Brown, 2007). Edible landscaping is the practical integration of food plants within an ornamental or decorative setting (Figure 1). Almost any herb works in edible landscaping (Creasy, 2010). While the same basic factors (i.e., space, money, norms, and social pressure) associated with landscaping styles, general gardening activities, and lawns potentially influence edible garden presence, food producing gardens differ from other yard features in a number of ways. First, edible landscapes provide tangible benefits in terms of fruits and vegetables for consumption. The ability to grow certain foods can be particularly important in maintaining cultural identities, particularly if those items are not readily available for purchase. Second, given that edible landscapes are typically considered a utilitarian feature, they are usually regulated to the backyard (Conway and Brannen, 2014). Edible landscape types can be residential, institutional, educational and public. Edible landscapes encompass a variety of garden types and scales. Edible landscape may be an integral part of house garden, rooftop gardens, public parks, streetscape, community gardens, backyard plots, schoolyards, campuses, urban forest and green way.

History of Edible Landscaping

Edible landscaping is as old as gardening itself and has undergone a recent revival. Ancient Persian gardens combined both edible and ornamental plants. Medieval monastic gardens included fruits, vegetables, flowers, and medicinal herbs (Beck and Quigley, 2001). Edible gardens of the Renaissance were as much about pleasure as they were about sustenance. Many of the fruits (figs, pear, apples, strawberries and melons) and vegetables (cabbage, leeks, onions, broad beans, peas, gourds and squash) were commonplace in a Renaissance Garden. Renaissance-style gardens produced fruit, vegetables and herbs which are sold locally to raise funds for the maintenance of the chateaux (Figure 3). The only difference is perhaps that in that period (about 1350 to 1600 in Europe), much of the produce grown was part of a peasant diet, while meats were reserved for the upper classes. Now, low-income communities are offered fast food chains instead of vegetable stands in areas considered to be “food deserts” (Willhelmi, 2013). Plans for 19th century English suburban yards, which modeled themselves after country estates, often included edible fruits and berries. The edible components of residential landscapes were largely lost in the cities to the now familiar shade trees, lawns, and foundation plantings. In the past two decades, however, there has been a revival of interest in edible landscaping (Beck and Quigley, 2001). When people think about growing food in urban areas, the first idea is generally to hide the vegetable garden somewhere in the backyard. Edible landscaping offers an alternative to conventional residential landscapes; edible plants can be just as attractive while producing fruits and vegetables. One can install an entirely edible landscape or incorporate some edible plants into existing gardens (Worden and Brown, 2007). The public perception of edible landscaping has changed greatly in recent decades. Landscapes are freed from the lock-step lawn and shrub restrictions of the last century. Now that edible landscaping has become part of the vernacular and is widely accepted, the edible plant palette has changed dramatically (Creasy, 2010). The Benefits of Edible Landscapes Using edibles in landscape design can enhance a garden by providing a unique ornamental component with additional health, aesthetic, and economic benefits (Creasy, 2010).

There are many reasons to incorporate edible plants into the residential landscape. These include:

- i. To enjoy the freshness and flavour of home-grown, fully ripened fruits and vegetables,
- ii. To grow unusual varieties not available in stores,
- iii. educational opportunities. It provides the opportunity to learn about gardening, food production, sustainability hence fostering a deeper understanding of our source of food
- iv. To get outside, interact with the natural world, and have fun (Beck and Quigley, 2001),
- v. To allow users to be more connected to their land and their food while being able to build a food community around them,

To share foods that are grown with friends and neighbors (Worden and Brown, 2007). Edible landscapes can be designed in many different forms and at many different scales, to provide an enormous range of benefits for urban residents (Lovell, 2010). Edible landscaping promotes sustainable practices that maximize water and energy efficiency, support wildlife and reduce the use of chemicals in the landscape. Instead of the conventional landscape, edible landscapes offer sustainable benefits which includes:

- i. **Energy savings:** Food from your yard requires no shipping, little refrigeration, and less energy to plow, plant, spray, and harvest the produce.
- ii. **Water savings:** Tests show that most home gardeners use less than half of the water agricultural production needs to produce a crop. Drip irrigation saves even more. And unlike in agriculture, fields aren't flooded and huge vats of water aren't needed to cool down the harvest.
- iii. **Money savings:** Enough food can grow in a small garden and save money on grocery bills. Certain edibles are highly productive and are more economical to grow at home than to purchase (Worden and Brown, 2007).
- iv. **Food safety:** Edible landscaping is just one example of how communities can begin to address local food insecurity. Increase the food security of household. Control the quantity and kind of pesticides and herbicides used on the foods you consume (Mackelvie, 2014).
- v. **Better nutrition:** Fully ripe, just-picked, home grown fruits and vegetables, if eaten soon after picking, have more vitamins than supermarket produce that was usually picked under-ripe and is days or weeks old when you eat it (Worden and Brown, 2007).
- vi. **Healthy community:** Many studies have shown links between the edible landscape activities and the health (physical and psychological), social, economic, and ecological benefits.

Edible Landscape Design

Food plants and ornamental plants can co-exist beautifully in a well-designed garden. Many people love the idea of including functional plants (edibles and herbs) in ornamental plantings, but in reality it's not always easy to achieve an acceptable aesthetic without careful design, plant selection, and attention to each plant's growth habit and needs (Sousa, 2016). Edible landscaping is the practical integration of food plants within an ornamental or decorative setting. Edible plants can be combined in many creative ways-with other edibles, or with ornamentals (Figure 5). The same design principles as for ornamental landscapes are used, while substituting edible plants such as lettuces, blueberries, vegetables and fruit trees for some of the otherwise unproductive plant material. Edible landscaping is a mixture of beauty and utility. However, edible landscaping doesn't have to be all edible. In fact, filling the yard with edibles would often produce too much food for most families, not to mention time and work. Instead, careful planning and the judicious use of

fruits, herbs, and vegetables results in a yard that is flavorful, practical, visually pleasing (Creasy, 2010). A visually appealing edible landscape is created from the artful combination of edibles and traditional ornamentals in the garden. Although basic design principles apply, the substitution of edible plants for ornamental plants can present some challenges and opportunities. Although design basics for edible ornamental landscapes are essentially the same as strictly ornamental landscapes, a few details ensure the success of the edible landscape (Hansen, 2016).

Common Edible Shrub used for landscape includes:

All shrubs below are deciduous and grow best in full sun and on well-drained soil unless otherwise stated.

- i. American Cranberry bush (*Viburnum trilobum*) - This 6- to 10-foot- tall shrub is hardy in zones 3 to 8. It produces white flowers in spring and bright red fruits in late summer. The fruits are good in jams and they are an excellent wildlife food. This sprawling shrub is best used as an informal hedge.
- ii. Blueberry (*Vaccinium*) - Select varieties that are highbush (5 to 6 feet tall) or half-high (1 to 4 feet tall) depending on your location. Southern and rabbiteye blueberries are highbush types adapted to the South. Blueberries need a well-drained, acidic soil with the pH below 5. Add sulfur to lower the pH. They can be planted near other acid-loving shrubs, such as holly. They are hardy in zones 3 to 9.
- iii. Brambles (*Rubus*) - Hardy in zones 3 to 9, blackberries and raspberries make excellent barrier shrubs. They can also be trained to grow along a fence in a narrow bed since their growth habit is so vertical. Select spreading brambles, such as red raspberries and blackberries, as an informal barrier hedge. Their suckers will quickly fill in the blank areas. For a more contained barrier hedge, plant black raspberries that send up suckers from only around the crown of the plant and are less invasive. For fruit production in summer and fall, grow everbearing red raspberries such as 'Heritage'.
- iv. Bush Plums (*Prunus*) - Sometimes called cherry-plums, Nanking cherries, or sand cherries, these small-fruited shrubs grow about 6 to 10 feet tall, have showy white flowers and 1/2-inch-diameter tart fruits and are hardy in zones 3 to 9 depending on the species. The fruits are best used in jams and jellies. Sand cherries make good coastal plants because of their adaptation to salt spray and sandy soil.
- v. Currants and Gooseberries (*Ribes*) - White, red, and black currants make excellent foundation plants, and can be grouped to block an unsightly object, or grown into informal hedges. Hardy in zones 3 to 8, most grow to 5 feet tall and have attractive and delicious fruits. Red and white currants are best used as juices and for fresh eating, while black currants are best used in jams and preserves. Black currants are the alternate host to a deadly disease of white pines (blister rust). So if you have white pines growing near your property, grow disease-resistant black currant varieties such as 'Consort'. Gooseberries grow to 3 to 4 feet tall and have thorny branches. They produce tasty 1-inch-long fruits for fresh eating, pies and jams.
- vi. - A cross between a filbert and a hazelnut, this 8- to 12-foot-tall shrub is hardy, has beautiful fall foliage, and produces edible nuts. It makes an excellent edible hedge.
- vii. Natal Plum (*Carissa grandiflora*) - This tropical evergreen shrub is only hardy in zones 9 to 11. It grows to 6 to 10 feet tall with fragrant, white flowers and edible red fruits. The plum-shaped fruits taste like cranberries and can be used to make jam. This is another good seaside plant. It makes an excellent foundation plant or hedge.

- viii. Pineapple Guava (*Feijoa sellowiana*) - This large, evergreen, tropical, shrub grows to 15 feet tall and wide in zones 8 to 10. It produces edible, pear-shaped fruits with a pineapple- and strawberry-like flavor. These are best used as informal hedges.
- ix. Rosemary (*Rosmarinus officinalis*) - This evergreen shrub is hardy in zones 9 to 11 and makes an excellent low hedge or border plant. The fragrant leaves are essential in many culinary dishes.
- x. Rugosa Rose (*Rosa rugosa*) - This species rose is hardy in zones 3 to 9, and can grow to 8 feet tall. It produces edible, fragrant, white, pink, or red flowers in spring and red or orange rose hips in late summer. The hips are high in vitamin C and best eaten raw, in teas or in jams. The thorny branches make it an excellent barrier plant, especially since new shoots arise from root suckers. This is another good seaside plant.
- xi. Vegetable landscapes are nothing more than mixing flowers and vegetables throughout the garden, otherwise known as edible landscaping. In this type of garden design, you can have fruit and nut trees growing in the same place as your ornamental plants.

Edible Landscape Maintenance

Edible plants, like ornamental plants, require maintenance. Many common ornamental plants can survive with minimal care. Most edible plants, however, require a certain amount of attention to produce well. They may require a little extra watering, pruning, fertilizing, or pest management (Beck and Quigley, 2001). Responsibility for the care and maintenance of the edible landscape must be clearly designated and understood by residents, housing staff, project leaders, maintenance staff, volunteers, and funders (Anonymous, 2005). A schedule for maintenance must be created to ensure proper management of the plot between all parties involved (Nieman and Ressler, 2012). Reduce maintenance requirements by planting the “right plant in the right place”. In other words, be sure to match a plant’s growing requirements with local conditions. When growing vegetables (consider the season as well) since they only grow at specific times of the year. All plants require some pruning, fertilizer, and water, as well as monitoring for pest problems. Harvesting is rewarding, but sometimes challenging. Keeping up with ripening fruits and vegetables may require weekly, or even daily, monitoring during the harvest period. If they are not harvested, fruits dropping from trees may be hazardous and/or aesthetically unsightly. Rotting fruits will also attract vermin. Highly perishable crops will require either quick processing, such as canning, freezing, or drying, or friends and neighbors to accept the abundance (Worden and Brown, 2007).

The Importance of Edible Landscaping for Urban Environments

Today, 54% of the world’s population lives in urban areas, a proportion that is expected to increase to 66 percent by 2050. Projections show that urbanization combined with the overall growth of the world’s population could add another 2.5 billion people to urban populations by 2050. The urban population of the world has grown rapidly and managing urban areas has become one of the most important development challenges of the 21st century (Anonymous, 2014). In most countries agriculture is the main user of land resources, and changes in agricultural land use is one of the major driving forces in global as well as local environmental change. Conversion of agricultural land to artificial surfaces (soil sealing) can have several environmental impacts on soil, water and biodiversity resources. A general decrease in agricultural areas has been observed in the last decades in industrialized countries as a consequence of growing demand for nature conservation areas, urban, industrial and infrastructural areas, amenity areas, and also as a consequence of land abandonment. Many land development activities result in land use change from agricultural land

to artificial surfaces: transport infrastructure (motorways, railways, etc.), urban sprawl (housing and industrial developments), tourism and recreation facilities. Increased land development often results in higher prices for land and has an important impact on the environment and agricultural landscapes. The impact is obviously much diversified in the case of a change to urban land compared to the case of land abandonment (Anonymous, 2015a). High population density, the urbanization process, road infrastructure development, rapid economic growth, industrialization and government policy are believed to be the main factors causing agricultural land conversion (Azadi et al., 2010). The urbanization process has caused constant physical change in the urban fringe landscape, resulting in a mix of urban and agricultural land uses (Malaque and Yokohari, 2007). The urbanization process is one of the most important dimensions of economic, social and physical changes. Rapid urban population growth and urbanization mean an increasing demand for urban land. This land is not available within the city, but in the rural-urban fringe, for various reasons. Urban sprawl is already engulfing the surrounding agricultural lands and small villages (Thu, 2010). Some cities may find large urban farms an appropriate use of land while others may only be able to accommodate small-scale operations. Urbanization has resulted in significant changes in both agricultural land and agricultural land use. The urban expansion on agricultural land affects agricultural production negatively. Rapid urbanization is accelerating the loss of agricultural land. Urban sprawl is taken from fertile agricultural lands, which are located immediately surrounding cities; cities have consumed a large amount of the most productive agricultural land (Figure 6), as well as forest and other wilderness areas. Agricultural land losses appear to be related to the change from rural status into urban status. Conversion of agricultural land to urban use has been caused food scarcity (Pham et al., 2015). Food production may happen everywhere, urban and rural and every top soil. Many urban municipalities are supporting the growth of urban agriculture by adopting regulations enabling different types of food production, while a growing number of non-governmental organizations provide support to urban residents interested in growing their own food (Conway and Brannen, 2014).

Conclusion

More than half of the world's population now lives in towns and cities, and by 2030 this number will swell to about 5 billion. The world will have to confront how to make cities more fit for human nutrition. The conclusions of the reports have been released by the United Nations, raising new challenges including diseases, water scarcity and food production. The world is undergoing the largest wave of urban growth in history. Cities have been located in the midst of high-quality farmland places so food production has been dramatically affected negatively by extreme urban sprawl incidents (Anonymous, 2015c). Because the cities consume natural areas and farmland, it is needed alternative areas in the cities for food production. Urban green spaces are potential areas where may be used for food production in the cities. Edible landscaping is expanding in many cities throughout the world. Edible landscapes can be included as sustainable components of urban planning and urban design projects. Edible landscape, like other green spaces, provides many benefits in terms of ecological, economic, health, social and cultural. The results of the study clearly indicate that the edible landscapes:

- i. Edible landscapes can be a part of residential landscape, community garden and urban green areas.
- ii. The main purposes of edible landscape are re-inviting food back into the city and re-connecting people with their food system to promote a healthier lifestyle.

- iii. Edible landscapes can be educational areas for people. Children, youth and adults who live in cities could learn information about how to grow fruits and vegetables in urban green areas. Children are growing up in a world farther and farther from agricultural land. They don't answer where fruits and vegetables grow. Edible landscape may connect children with the source of food and will help both youth and adults re-connect with their food and nature.
- iv. Working in the edible landscape provide an environment for children, youth and adults to simultaneously socialize, have fun, feel relieved and get exercise.
- v. Edible landscaping provides a means of preserving and enhancing the existing functions of urban green areas while generating a yield.
- vi. Edible landscapes are sustainable landscape systems consistent with the philosophy of ecological design. An edible landscape (if maintained using organic methods) is the most compelling landscape concept for the future.
- vii. Edible landscapes can help food production for low income people who live in cities.
- viii. Edible landscapes can improve quality of life in cities.
- ix. Edible landscapes create an ecosystem and habitat for animals and plants in the cities and improve urban biodiversity.
- x. If it is better integrated into the green infrastructure of the city, edible landscape contributes to a wide range of ecosystem services.

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EVALUATION OF TOXICITY POTENTIALS OF JATROPHA (*JATROPHA CURCAS* L.) SEED POWDER ON ADULT EMERGENCE, MORTALITY AND OVIPOSITION OF *CALLOSOBRUCHUS* *SUBINNOTATUS* ON BAMBARA GROUNDNUT IN MUBI, NIGERIA

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Abstract

The work was carried out in the Laboratory of the Department of Crop Science, Adamawa State, University Mubi, in 2024. This was to evaluate the Toxicity Potentials of *Jatropha* (*Jatropha Curcas* L.) Seed powder on adult emergence, mortality and oviposition of *Callosobruchus subinnotatus* Fab. on Bambara Groundnut in Mubi, Nigeria. The objective of the study was to evaluate the effectiveness of *Jatropha* seed powder in suppressing adult emergence, oviposition and increase mortality of *C. subinnotatus*. The experimental design used was the Completely Randomized Design (CRD) with five (5) levels of *Jatropha* Seed powder (2.5g, 5.0g, 7.5g, 10.0g, 12.5g) and 2.5g of Actellic dust as treatment repeated three (3) times making a total of twenty-one (21) experimental units. The results show that, bambara groundnut is susceptible to attack by the bruchids in store. Bambara groundnut stored with Actellic dust recorded less mean number of adults alive (0.00), less number of eggs laid (5.00) compared to the control at 0.05 level of significance. This further indicates that, synthetic insecticides are still the most effective control method against storage insect pests because of their efficiency and quick action status despite the healthy and environmental concerns. Consequently, levels of *Jatropha* seed powder also significantly suppressed the bruchid especially at 12.5g /300g of Bambara groundnut. Few adults emerged (4.00), less number of egg recorded (8.00). Moreover, the results obtained shows that, *Jatropha* seed powder could provide an alternative to comprehensive use of synthetic insecticides for controlling storage insect pests of Bambara groundnut and other grains. This work has suggested that, if Bambara groundnut seed are to be used for sowing, they should be stored with 12.5g level of *Jatropha* seed powder for twelve weeks. However, if they are to be used for consumption, they could be stored with 7.5-10.0g of *Jatropha* seed powder for every 300g of Bambara groundnut for 12 weeks especially in the study area.

Keywords: Toxicity, *Jatropha*, Bambara, Powder, Insecticides, Control.

Introduction

Bambara groundnut (*Vigna subterranea* L.) commonly known as bean Congo, goober earth pea, ground-bean or hog-peanut is a member of the family Fabaceae and its name is derived from the Bambara ethnic ground of West Africa (Apata and Ologhobo, 2011). Bambara groundnut (*V. subterranea* L.) is under researched grain legume crop. However, it is widely cultivated in sub-Saharan Africa (SSA) and Asia for security and for local and regional markets (Nuber, 2014; Mulungu, 2017). It is the third most cultivated legume crop in Africa often behind cowpea (*V. unguiculata* (L.) Walp) and groundnut (*Arachis hypogea* L.) (Agboola *et al.*, 2017). Bambara groundnut seed is known as Jugo beans or indlubu (South Africa) and Gurjiya or kwaruru in Hausa (Northern Nigeria) which is consumed in several ways and in different stages of maturity as vegetables or snack (Okonkwo and Opara, 2015; Amorim and Nascimento).

The young fresh seeds can be boiled and eaten as a snack similar to boiled groundnut. In some part of Nigeria, dry seed are made into pudding (or steamed paste) called “Moi-moi” or “alele” (in Yoruba or Hausa languages respectively) or fried in hot oil called “Kosai” (in Hausa) (Okonkwo and Opara, 2015). Dry seed are processed and used as animal feed, especially for poultry (Oaya *et al.*, 2013). Bambara groundnut has the potential for value addition and product development in South Saharan Africa (Stephens, 2016). Bambara groundnut is a versatile crop that tolerates harsh environments, including drought and heat stress and poor soil fertility where most other crop fails. Bambara groundnut fixes atmospheric nitrogen into the soil ($32\text{--}81\text{kg ha}^{-1}$) through a symbiotic relationship with *Rhizobium* spp. (Mills, 2012). It is valued for restoring soil fertility especially in crop rotation systems with cereals crops and can also tolerate various insect pests and diseases (Kogan, 2014).

Jatropha (*Jatropha curcas*) is a species of flowering plant in the spurge family, *euphorbiaceae* that is native to the American tropics, most likely Mexico and Central America (Tibe *et al.*, 2017). It was originally a native to the tropical areas of the Americas ranging from Mexico to Argentina and has been spread throughout the world in the Tropical and Sub-tropical regions around the world becoming naturalized or invasive in many areas (Buvaneswari *et al.*, 2017). The specific epithet, “*Carcas*”, was first used by Portuguese Doctor Garcia de Orta more than 400 years ago (Chang *et al.*, 2015). Common names in English include physic nut, Barbados nut, Poison nut, bubble bush or purging nut in parts of Africa and areas in Asia such as India. It is often known as castor oil plant or hedge castor oil plant (Mulatu and Gebremedhin 2017).

Jatropha, *J. curcas* is an ornamental, medical and a multipurpose shrub belonging to the family *euphorbiaceae*, it is widespread throughout arid and semi-arid tropical region of the world. Each fruit contains 2-3 oblong seeds that are matured when the capsule changes from green to yellow. *Jatropha* contain several horseradish, rhamnose, stachyose, glucose, fructose, galactose and protein. The plant also contains curcacin arachidic, myristic and stearic acid and curcin. The *Jatropha* seed contains 46.27% oil, 4.56% w/w total ash content of seeds indicates presence of abrasive solids, soluble metallic soaps and silica residue in the seed (Shallam, 2017). *J. curcas* is plant harvested in tropical and subtropical regions and its high oil content in the seeds is of emerging interest as a bioenergy resource which makes the conversion of oil to biodiesel through trans-esterification easily (Oaya, 2021). *Jatropha* seed powder was reported to contain some pesticidal properties that could be used as pesticides of plant origin for pest management especially in within the storage environment (Araya and Eman, 2019).

Bambara groundnut production is limited by the activities of some biotic and abiotic factors such as light, temperature, moisture most importantly insect pests in the store. (Sesay, 2019; Garga *et al.*, 2019). Although, the use of chemical or synthetic pesticides is still seen as the most effective management method against pests both on the field and in the store, they are associated with so many detrimental effects to man, livestock and the environment (Oaya *et al.*, 2019). There is therefore the need to shift emphasis to the use of plant-based pesticides as an alternative since they have biocidal activities (toxic, repellent, anti-appetizing) vis-à-vis can manage a wide range of pests (Mishra *et al.*, 2016).

Materials and Methods

Experimental Site

The research was conducted in the Laboratory of the Department of Crop Science, Faculty of Agriculture, Adamawa State University, Mubi in the year 2024. The University is located in Mubi North Local Government Area. Mubi lies between latitude 10°20'N and longitude 13°5'E of the equator at an altitude of 696m above the sea level in the Northern Guinea Savanna Agro-Ecological Zone of Nigeria (Adebayo *et al.*, 2020).

Experimental Materials

The materials used for the experiment were sourced in Mubi. Bambara groundnut seeds, storage containers and the insecticide, Actellic dust were purchased in Mubi Main Market and the *Jatropha curcas* seeds were collected in the vicinity of Vimtim Ward, Mubi North Local Government Area of Adamawa State.

Preparation of Plant Materials

Matured *Jatropha* seeds were collected shelled with hand and the shelled seeds were shade dried and separately grounded manually using pestle and mortar. The powder was sieved to obtain fine powder. The plant powder was kept in separate plastic containers with a tightly fitted lid placed in a cool place in the Laboratory for the experiment.

Storage Measures Used

Storage Containers

Partially airtight storage containers were used which permits the flow and circulation of air in the storage containers. The storage containers were covered with muslin cloth to prevent suffocation and entry or exit of the test insects. Such containers are often used for storage of farm produce particularly among the local farmers and the householders in the study area.

Actellic Dust (Pirimiphos-methyl)

Chemicals applied before storage such as actellic dust and phostoxin was identified as the chemicals used for treatment of the cowpea grains. It is certified that, 32% of the farmers store their Bambara groundnut for more than three (3) months using these synthetic insecticide Actellic dust which has fumigant properties, stomach poison and contact activity against insect pests in the store. One rate of the Actellic dust was applied at 2.5g per 300g of Bambara groundnut seed respectively as suggested by Oaya *et al.* (2013).

Bambara Groundnut Grains used for the Experiments

Bambara groundnut grains for the experiment were packed in airtight container bag and were fumigated with Apron Star dust before use in order to eliminate possible contamination by insects and other pests. The Bambara groundnut grains were sieved to remove dead bruchids and dirt.

Test Insects Culture

Adults *C. subinnotatus* Fab. were obtained from natural infested Bambara groundnut grains cultured in Bambara groundnut grain that was obtained from the market. Five (5) pairs of adult *C. subinnotatus* were introduced into rearing bottle/Jar of 1 litre capacity containing 300g of Bambara groundnut grains. The bottle/Jar was covered with muslin cloth and secured with rubber band kept in the Laboratory at ambient temperature and relative humidity of 32°C and 75% respectively. The parent *subinnotatus* was sieved out ten (10) days after oviposition and later the grains were kept in their respective jar until the emergence of F1 progeny. The F1 generations of 0-2 weeks was used for the experiment.

Treatments and Experimental Design

There were seven (7) treatments which include: Actellic dust (2.5g), five levels of Jatropha seed powder (2.5g, 5.0g, 7.5g, 10.0g, 12.5g) and the control (0g) replicated three times making a total of twenty-one (21) experimental units as shown in Figure 1. The experiment was arranged in a Completely Randomized Design (CRD) setting on the Laboratory table for the duration of the experiment (twelve weeks).

Procedures for Insecticidal Test

Five (5) pairs of freshly emerged adult of *C. subinnotatus* were introduced into 500 ml storage containers already containing 300 grams of disinfected Bambara groundnut grains treated with the various control measures, containing Actellic dust (2.5g), Jatropha seed powder (2.5g, 5.0g, 7.5g, 10.0g, and 12.5g) and the control (0.0g). The initial weight of the Bambara groundnut grain was taken and the moisture content of the stored products certified. The Bambara groundnut grains were properly coated with the control measures and thoroughly shaken to ensure uniform spread. The storage containers were covered with muslin cloth to prevent suffocation and entry or exit of the test insects.

Data Collection

Data were collected on the following parameters:

Mean Mortality Count

Mean percentage mortality was determined using the formula as reported by Oaya and Malgwi (2014).

$$\text{Percentage mortality} = \frac{\text{number of dead adult subinnotatus}}{\text{total number of subinnotatus alive or dead}} \times 100$$

Mean Number of Adults Alive

The total mean number of emerged adults was calculated by direct counting of matured *C. subinnotatus* after the experiment.

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) appropriate to Completely Randomized Design using Genstat software, according to Cox and Cochra (2003). Treatment means were separated using the least significant different (LSD) at 5% level of probability.

Results

Mean Number of Adults Alive of *C. subinnotatus* on Bambara-Groundnuts after 12 Weeks of Storage.

The results of the mean number of adults alive after 12 weeks of storage is presented in Table 1: The result revealed that the highest mean adults alive was recorded in the control (80.33) followed by 2.5g (30.00) 5.00g (16.00) 7.5g (10) 10.00g (7.0) 12.5g (4.0) of Jatropha seed powder respectively and the least was reported in Actellic dust treatment 2.5g (0.00) at 0.05 level of probability.

Mean Mortality Count of *C. subinnotatus* on Bambara Groundnuts after 12 Weeks of Storage.

The results of the mean mortality count at 12 weeks of storage are also presented in Table 1. The results revealed that the highest mean mortality count was recorded in the control (72.67) followed by 5.00g (56.67), 2.5g (54.33), 7.5g (29.67), 10.00g of (28.67) 12.5g (10.00) of Jatropha seed powder respectively and the least was reported in the insecticide, Actellic dust treatment 2.5g (5.00) at 0.05 level of probability.

Mean Oviposition Count of *C. subinnotatus* on Bambara-Groundnuts after 12 Weeks of Storage.

The results of the mean Oviposition Count on Bambara groundnut stored for 12 weeks against the weevil *C. Subinnotatus* are presented in Table 1:

The results shows that, the highest mean Oviposition count was reported in the control 0.0g Jatropha seed powder (47.33) followed by 2.5g (32.67), 5.0g (26.33), 7.5g (22.33), 10.0g (16.33), 12.5g(8.00) Jatropha seed powder respectively and the least was reported in the synthetic insecticide, Actellic dust 2.5g (5.00) at 0.05 level of probability respectively.

Table 1: Mean Number of Adult Alive, Mortality and Oviposition Count of *C. subinnotatus* on Bambara after 12 weeks of storage.

Treatment	Mean adults alive	Mean mortality count	Mean oviposition
Actellic Dust 2.5g	0.00 ^d	5.00	5.00 ^f
Jatropha seed powder 2.5g	30.00 ^b	54.33 ^b	32.667 ^b
Jatropha seed powder 5.0g	16.00 ^c	56.67 ^c	26.333 ^d
Jatropha seed powder 7.5g	10.00 ^d	29.67 ^c	22.333 ^d
Jatropha seed powder 10.0g	7.000 ^e	28.67 ^c	16.333 ^e
Jatropha seed powder 12.5g	4.00 ^f	10.00 ^d	8.000 ^f
control	80.33 ^a	75.67 ^a	47.333 ^a
S.E	18.60	26.27	1.02

Means with the same letter (s) in the column is not significantly different at 0.05 level of probability using DMRT.

Discussion

Insect pests are among the most pressing problems faced in bambara groundnut production and its storage in a dry land of sub-saharan Africa (Rowland, 1993). It is apparent that, the storage of Bambara groundnut without the use of synthetic chemicals could be a futile exercise, however, it is toxic and detrimental effect to man, the wild life and the residual damage done to the entire environment is of great concern (Zetter *et al.*, 1997). This shows that, the use of synthetic insecticide for the control of storage insect pests is still the most effective means of insect pests control despite the serious hazard they cause to humans, wild life and the environment, in addition to the development of resistance insect pest strains (Oaya and Headboy, 2024).

The plant material *Jatropha* seed powder at 2.5g, 5.0g, 7.5g, 10.0g and 12.5g also significantly controlled the Bambara groundnut bruchids as shown by the results obtained of adults alive mortality count and oviposition. The observations suggest that, *Jatropha* seed powder has oviposition difference as well as larvicidal properties. They also activate the mortality of the insects prior to oviposition or that it had ovidal and larvicidal activities which prevented egg and larval development. This work is consistent with Oaya *et al.* (2011) and Oaya (2020) who reported that, the use of bio-insecticides as a control measure both on the field and in the Laboratory had considerable effect on the bruchids and weevils respiratory system, resulting in a knock down effect within a short period of time. *Jatropha* seed Powder has proven to be effective in suppressing adult emergence, mortality and oviposition of *C. subinnotatus* on Bambara groundnut grains in storage for at least twelve weeks.

Conclusion

Bambara groundnut bruchids, *C. subinnotatus* Fab. is one of the most devastating insect pests in the storehouse and their effects recorded more than 40% loss in normal situations. The use of highly hazardous pesticides such as aluminum phosphate (celphos), Malathion powder, apron plus, actellic dust etc are the common weevil management practices in the storehouse. The current use of insecticides negatively affects the human health and cause great damage to the environment. Hence locally available repelling plant materials such as *Jatropha* seed powder with good partial airtight containers were tested for insecticidal efficacy which has significantly reduced the bruchids population as shown by the results recorded. The adults alive, mortality count, oviposition count were significantly lower compared to the control for bambara groundnut grains. This finding is therefore suggested for developing integrated bruchids management model in storehouse which can be socially adaptable, economically friendly most especially in the study area.

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10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

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AUDIT QUALITY AND DISCRETIONARY EXPENSES AMONG NIGERIAN LISTED OIL AND GAS FIRMS

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Abstract

This study investigates the impact of audit quality on discretionary expenses among Nigerian listed oil and gas firms from 2003 to 2022, a period marked by heightened regulatory scrutiny and economic volatility. Utilizing a quantitative research design, the study employs Pooled OLS regression to analyze secondary data from audited financial statements and NGX databases. Audit quality, proxied by audit independence ($-0.194, p = 0.001$), audit fees ($-0.188, p = 0.040$), audit firm size ($-1.744, p = 0.064$), audit committee size ($-0.016, p = 0.041$), and audit tenure ($-0.248, p = 0.000$), exhibits a significant negative effect on discretionary expenses, rejecting the null hypothesis and confirming that robust audits curb earnings management. Conversely, leverage ($0.037, p = 0.013$) and firm size ($0.020, p = 0.040$) positively influence discretionary expenses, while sales growth ($-4.121, p = 0.000$) reduces manipulation. The model's high explanatory power ($R^2 = 98\%$) and absence of serial correlation (Durbin-Watson = 2.17) affirm its robustness. Grounded in agency theory, the findings highlight audit quality's role in mitigating information asymmetry in Nigeria's oil and gas sector, particularly amid 2022–2023 scandals. Recommendations include stricter auditor rotation, engaging Big 4 firms, and enhancing audit committee effectiveness to foster transparency. This study offers actionable insights for regulators and stakeholders to strengthen financial reporting integrity in a critical economic sector.

Key words: Audit Quality, Discretionary Expenses, Earnings Management, Nigerian Oil and Gas, Financial Transparency

Introduction

Audit quality is pivotal in ensuring the reliability and transparency of financial reporting, particularly in industries prone to earnings manipulation, such as oil and gas. Defined as the auditor's ability to detect and report material misstatements (Seyyed et al., 2012), audit quality hinges on auditor competence and independence, serving as a critical mechanism to enhance stakeholder trust and financial market stability (Salawu et al., 2018). In Nigeria's oil and gas sector, where listed firms face intense scrutiny over discretionary expenses—expenditures like research and development, advertising, and administrative costs—audit quality plays a vital role in curbing earnings management practices that obscure true financial performance (Lee & Swenson, 2011; Zandi et al., 2019). Discretionary expenses, often used to manipulate reported earnings, have drawn regulatory attention following high-profile cases of abuse in 2022 and 2023, prompting calls for enhanced transparency and stricter accounting standards (Ahmed & Sulong, 2023).

The Nigerian oil and gas industry, a cornerstone of the nation's economy, grapples with unique challenges, including volatile global oil prices, supply chain disruptions, and the ongoing energy transition, which exacerbate pressures to misrepresent financial health through discretionary accruals and expenses. While prior studies, such as Lopes (2018) and Alzoubi (2016), suggest that high-quality auditors, particularly Big 4 firms, reduce earnings manipulation, others, like Almarayeh et al. (2020), argue that audit quality's impact is limited in emerging economies with weaker regulatory environments. This study investigates the relationship between audit quality and discretionary expenses among Nigerian listed oil and gas firms, exploring whether auditor characteristics—such as firm size, fees, tenure, and industry expertise—influence the management of discretionary expenditures. By addressing these dynamics, the research aims to contribute to the discourse on financial reporting integrity, offering insights for regulators, auditors, and investors seeking to bolster accountability in Nigeria's critical energy sector.

Audit quality is defined by Seyyed, Mahdi, and Mohsen (2012) as a function of the auditor's ability to detect material misstatements and reporting the errors. Together with other similar definitions, they all emphasized on two of the most important aspects of audit quality, namely auditor ability or auditor effort, and auditor independence. Salawu, Okpanachi, and Yahaya (2018) stated that audit quality is the assessment of whether audits have served both the shareholders and other stakeholders' interests through increasing the accountability of managements and reinforcing trust and confidence in financial reporting. Ogadu, Okoughenu, and Igbeneweka, (2017) asserted that, high quality auditors are more likely to discover questionable accounting practices by clients and report material irregularities and misstatements compared with low quality auditors.

In theory, the auditing process is supposed to serve as a monitoring device that reduces management incentives to manipulate reported earnings, as well as to detect earnings manipulation and misstatements (Amat, Oscar, & Petya, 2014). Audit is a key contributor to financial stability and in other to re-establish trust and market confidence. The auditor is entrusted by law with the responsibility of conducting statutory audits and fulfilling an important role in offering an opinion on whether the financial statements are truly and fairly stated (Nwoye, Anichebe, & Osegbue, 2021). Therefore, for an audit firm to render a quality service, it means it must have greater monitoring strength, more closely to financial report and which will reflect the true economic circumstances of the client and the higher information quality (Orbunde et al, 2021).

In the context of management deciding on additional discretionary real expenditures (DRE) in research and development (R&D), selling, general, and administrative expenses (SG&A), and advertising in period t , the decision is influenced by the marginal return on such expenditures ($R(DRE)$), tax status (T) in period t , cash flow constraints (CF), and financial reporting costs (FRC) related to potential earnings targets. It is assumed that financial reporting costs increase with DRE, or $f(DRE_t)$. These costs are also affected by discretionary accruals made initially, as the firm first makes necessary discretionary accruals (which are not taxed) (Ahmed & Sulong, 2023).

The oil and gas industry has faced several challenges in recent years, including increased scrutiny of discretionary expenses. In 2022, regulatory bodies began to closely examine discretionary expenses amid concerns that companies were using these expenses to manipulate earnings and mislead investors. This led to a rise in audit fees and costs for oil and gas firms. In 2023, several high-profile cases of discretionary expense abuse came to light, involving oil and gas firms using these expenses to conceal losses and inflate profits. This led to calls for greater transparency and accountability in financial reporting. The energy transition has also created opportunities for discretionary expense manipulation, as companies seek to present a more positive financial picture. Supply chain disruptions in 2022 and 2023 led to increased costs for oil and gas firms, which in turn led to higher discretionary expenses. However, some companies were accused of using these disruptions as an excuse to inflate discretionary expenses and mask underlying financial issues. In 2024, concerns were raised about audit quality in the oil and gas industry, particularly with regards to discretionary expenses.

Some auditors were accused of failing to adequately scrutinize discretionary expenses, leading to calls for improved audit standards and practices. In response to these issues, regulatory bodies have begun to implement changes to accounting standards and disclosure requirements related to discretionary expenses. For example, the SEC has proposed new rules requiring oil and gas firms to provide more detailed disclosure of discretionary expenses. These issues highlight the need for increased transparency and accountability in financial reporting, particularly with regards to discretionary expenses. Oil and gas firms must ensure that they are accurately reporting discretionary expenses and that auditors are adequately scrutinizing these expenses to prevent manipulation and misrepresentation. By addressing these issues, the oil and gas industry can improve investor confidence and ensure that financial reporting is accurate and reliable. Regulatory bodies, auditors, and companies must work together to prevent discretionary expense manipulation and ensure that financial reporting is transparent and accountable.

Research Objective

The broad objective of this study is to examine the effect of audit quality on earnings Management practices among Nigerian listed Oil and Gas Firms. The Specific objectives are to:

Evaluate The Impact of Audit Quality On Discretionary Expense Among Nigerian Listed Oil And Gas Firms;

Research Questions

What Effect Does Audit Quality Have on Discretionary Expenses Among Nigerian Listed Oil and Gas Firms?

Research hypotheses

Ho': Audit Quality Does Not Have Any Significant Effect on Discretionary Expenses Among Nigerian Listed Oil and Gas Firms.

Literature Review

Researchers from both developed and developing nations have focused a lot of attention on the controversy over the connection between audit quality and discretionary spending. The quantity of empirical research done from both economies throughout the years makes this clear. In a similar study, Zgarni and Chikhaoui (2022) empirically examined the impact of audit quality on real earnings management: evidence from Tunisian banks. They conducted an empirical study with a sample of the main Tunisian commercial banks observed over a period of 14 years from 2006 to 2019, using the panel data method. The results indicate that the tenure of auditors increases these discretionary practices.

On the other hand, Androjuniko & Shambling (2022) assessed the effectiveness of audit committee and audit quality towards earnings management of ASEAN public companies. The result from various tests in the paper indicates that audit independence does affect earnings management significantly. Thomas (2022) investigated the effect of audit quality on earnings management of listed consumer goods companies in Nigeria. It was found that auditor tenure has no significant influence on earnings management of listed consumer goods companies in Nigeria.

Kurawa and Ishaku (2020) asserted the impact of audit quality on earnings management of listed non-financial companies in Nigeria. The findings revealed that auditor tenure has positive but not significant effect on earnings management. The study of Bala, et al (2022) investigated how audit committee accounting expertise (ACAE) influences the relationship between audit firms attributes (AUFA) and income smoothing (IS). The study employed 616 firm-year observations from 2013 to 2019 and robust logistic regression as a data analysis technique. The results showed that the Big 4 auditors and AUT had a negative and significant relation with IS in firms with a higher proportion of ACAE. The study also revealed that a higher proportion of ACAE overturned the positive effect of Big 4 auditors and AUT on IS.

This study assessed the impact of firm performance and earnings management on stock prices in Indonesian manufacturing firms (2016–2018) using multiple regression. Firm performance, proxied by Return on Assets (ROA) and Debt to Equity Ratio (DER), significantly influenced stock prices, while earnings management (measured by working capital accruals) had a non-significant effect. The findings suggest investors prioritize financial performance over accruals. The study's focus on Indonesia and stock prices contrasts with the current study's emphasis on real earnings management and discretionary expenses in Nigerian oil and gas firms.

Haider (2020) researched the driving forces behind the abuse of earnings. The motivations behind earning manipulation are thought to be firm size, profitability, financial leverage, and effective tax rate. The study was conducted on Pakistan's banking industry. The study discovered that anytime a company's profit declines, the managers may use the future expected earnings in the current year to maintain the company's favorable reputation. Using debt to finance the firm's capital will also cause the managers to omit reporting the incorrect data. The tax rate and firm size were shown to be negatively but insignificantly related to the management of earnings.

Al-Zahrani investigated the impact of real earnings management on profitability and corporate value, employing a correlational design with secondary data from 250 top companies listed on the Bombay Stock Exchange. The study found that real earnings management practices adversely affect company performance and corporate value. While contributing to the literature on earnings management's negative consequences, the study's focus on Indian firms limits its applicability to Nigeria. The current study addresses this gap by examining real earnings management through discretionary expenses in Nigerian oil and gas firms from 2012–2019.

Olaniyi and Abubakar (2018) investigated the effect of real earnings management on the financial performance of listed consumer goods companies from 2001 to 2016. A research design known as ex-post facto was used, which heavily relied on secondary data taken from the 22 public businesses' audited financial accounts. A panel generalized technique of moments was used to investigate the effects of control factors, ROE and EPS (financial success), and sales modification (earnings management) (firm size, growth, and financial strength). According to the study, consumer products firms in Nigeria with stock quotes manipulate their sales to boost their earnings. Egbunike and Odum in 2018 to examine the relationship between board leadership structure and earnings quality of Nigerian manufacturing companies listed on the stock exchange. According to the findings, the size and composition of the board had a significant and positive impact on earnings quality. However, the research also indicated that while CEO duality was positively and significantly associated with earnings quality, non-executive directors had a negative correlation with it.

Eriabie and Dabor investigated audit quality's impact on earnings management in 18 NGX-listed banks (2005–2010) using an ex-post facto design. Cross-sectional regression analysis showed that audit fees and auditor changes positively correlate with earnings management, measured by abnormal loan loss provisions. The study concluded that high audit fees and frequent auditor changes exacerbate earnings manipulation, recommending stricter fee monitoring and meaningful auditor changes. While robust, the banking sector focus and use of loan loss provisions limit its relevance to other industries. The current study extends this by examining audit quality and discretionary expenses in the oil and gas sector.

Mokoaleli-Mokoteli and Iatridis (2017) analysed the relationship between Big 4 auditing companies and earnings management. The study adopts the descriptive approach and data were obtained from 687 companies listed on the Johannesburg Stock Exchange (JSE) from 2008 to 2012. Data were analysed using the panel regression technique. Results revealed that companies audited by a Big 4 auditor lead to more timely recognition of large losses and lower the levels of earnings manipulation. The study concluded that Big 4 auditing promotes conservatism and would lead to fewer loss understatements and profit overstatements. Although the study accounts for quite a large sample size, findings from the study may be prices to South Africa and thus not fit to be generalized.

Abbasiazadeh and Zamanpour (2016) examined the impact of audit firm size on earnings management using a correlational research design. The study collected data from 116 companies listed on the Tehran Stock Exchange over a five-year period (2010–2014). Multiple linear regression was used to analyze the data, with real earnings management as the measure of earnings management. The findings revealed a significant relationship between audit firm size and earnings

management, indicating that Big 4 audit firms provide higher-quality audits, resulting in reduced earnings management compared to smaller firms. The study concluded that larger audit firms and qualified audit opinions contribute to lower earnings management in Tehran Stock Exchange-listed companies. Despite the large sample size, the study's five-year duration and focus on Iran may limit the generalizability of the findings.

Ayemere and Elijah (2015) investigated the impact of audit committee attributes on earnings management in Nigeria, using a cross-sectional research design. The study analyzed data from 50 companies listed on the Nigeria Exchange Group (NGX) over an 11-year period (2006–2016). Earnings management was measured using the Jones (1991) model, and fixed effects regression analysis was employed. Results indicated that audit committee financial expertise, size, independence, and diligence had a significant negative relationship with earnings management, suggesting these attributes enhance financial reporting quality. The study recommended that firms prioritize strengthening audit committee effectiveness. While the research benefited from a robust sample size and duration, its reliance on the Jones (1991) model, which assumes only collected revenues constitute non-discretionary accruals and excludes total revenues, presents limitations. This highlights the need for further studies using more refined models to measure earnings management accurately.

Theoretical Framework

Agency theory

Agency theory is a theoretical concept that addresses the working connection between corporate owners (principals) and managers (agents). Jensen and Meckling (1976) defined an agency relationship as a contract in which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf, which includes delegating some decision-making authority to the agent. The agency theory establishes the link between the principal and the agent through a contract in which the principal delegated accountability to the agent to act on the principal's behalf (Umo, 2023). Here, company owners frequently do not have broad access to monitoring operational activities and frequently entrust it to managers or there is a delegation of authority.

In the context of financial reporting, information asymmetry occurs when an insider (management) with vested interests in the reported information prepares and transmits the same information to an outsider (principals) who rely on it to make decisions. Agency conflict and earnings quality are two things that have influence on each other (Pratomo et al., 2022). Agency conflict can lead to the nature of management reporting earnings in opportunities to maximize their personal interests, and if that happens, the quality of earnings will be low (Triwahyuni, 2017). This conflict can be minimized with good corporate governance. The application of corporate governance can be used as a guide for company management to manage the company well, assisting them in make decisions that benefit all parties.

Methodology

This study examines the connection between audit quality and discretionary spending in oil and gas companies listed on the Nigeria Exchange Group (NGX) between 2014 and 2023, a time when the country's energy sector was subject to increased regulatory scrutiny and economic uncertainty. Nigeria is the geographical location of the study, taking use of its distinct economic and regulatory

environment, which is marked by changes in accounting standards, supply chain interruptions, and volatility in oil prices. In light of recent worries about cost manipulation in the oil and gas sector, the content scope focuses on the impact of audit quality on discretionary spending, a crucial sign of earnings management. The study used secondary data and a quantitative research design to investigate how audit quality affects discretionary spending. Audit independence (as determined by auditor rotation policies), audit firm size (Big 4 vs. non-Big 4), audit tenure (years of auditor engagement), audit fees (as a percentage of total revenue), and industry expertise (specialization in oil and gas audits) are the five factors that serve as proxies for audit quality, the independent variable. Consistent with previous studies, the dependent variable, discretionary expenses, is measured using four components: discretionary accruals (calculated using the modified Jones model), discretionary research and development expenses, discretionary selling, general, and administrative expenses, and discretionary advertising expenses. Firm size, leverage, and profitability are examples of control variables that are used to account for firm-specific traits. Secondary data will be sourced from audited financial statements, NGX databases, and company annual reports available on firm websites. Additional data will be extracted from financial databases such as Bloomberg, Thomson Reuters, and Datastream, ensuring comprehensive coverage of financial metrics, audit reports, and expense disclosures for NGX-listed oil and gas firms. The sample comprises all oil and gas firms listed on the NGX during the study period, subject to data availability, to ensure representativeness. Data Analysis: The study employs Pooled Ordinary Least Squares (Pooled OLS) regression analysis to examine the relationship between audit quality variables and discretionary expenses, chosen for its robustness in analyzing panel data relationships (Gujarati, 2009). The regression model is specified as follows:

Model Specification

To be able to determine the nature of the relationship and the strength of association between the estimated earnings management the explanatory variables of consideration of this study, and the control variables, the following models are modified to suit the objectives of the study.

$DEXP_{it}$ = Discretionary expenses

$x_{1it} = AUDIN_{it}$; $x_{2it} = AUDFE_{it}$; $x_{3it} = AUDFZ_{it}$; $x_{4it} = AUDCMS_{it}$; $x_{5it} = AUDTE_{it}$

Where:

$AUDIN_{it}$ = Audit Independence

$AUDFE_{it}$ = Audit Fees

$AUDFZ_{it}$ = Audit Firm Size

$AUDCMS_{it}$ = Audit committee Size

$AUDTE_{it}$ = Audit tenure

|The Control Variables (CV) is Leverage, Firm Size and Sales growth

$CV = (cv_{1it}, cv_{2it}, cv_{3it})$

$cv_{1it} = LEV_{it}$; $cv_{2it} = FZ_{it}$; $cv_{3it} = SAG_{it}$

Where:

LEV_{it} = Leverage

FZ_{it} = Firm Size

SAG_{it} = Sales growth

Model

$$DEXP_{it} = \alpha_0 + \beta_1 AUDIN_{it} + \beta_2 AUDFE_{it} + \beta_3 AUDFZ_{it} + \beta_4 AUDCMS_{it} + \beta_5 AUDTE_{it} + \varepsilon_{it}$$

..... (5)

$$DEXP_{it} = \alpha_0 + \beta_1 AUDIN_{it} + \beta_2 AUDFE_{it} + \beta_3 AUDFZ_{it} + \beta_4 AUDCMS_{it} + \beta_5 AUDTE_{it} + \beta_6 LEV_{it} + \beta_7 FZ_{it} + \beta_8 SAG_{it} + \varepsilon_{it}$$

Data Presentation and Analysis

Relationship between audit quality and discretionary expenses

Table 1. Correlation between audit quality and discretionary expenses

Variables	<i>DEXP_{it}</i>	<i>AUDIN_{it}</i>	<i>AUDFE_{it}</i>	<i>AUDFZ_{it}</i>	<i>AUDCMS_{it}</i>	<i>AUDTE_{it}</i>	<i>LEV_{it}</i>	<i>FZ_{it}</i>	<i>SAG_{it}</i>
<i>DEXP_{it}</i>	1	-0.19	-0.20	-0.15	-0.12	-0.01	0.55	0.45	0.10
<i>AUDIN_{it}</i>		1	0.11	-0.10	0.28	-0.28	0.10	-0.25	0.35
<i>AUDFE_{it}</i>			1	0.36	0.22	0.25	-0.30	0.38	-0.06
<i>AUDFZ_{it}</i>				1	-0.33	0.44	-0.11	0.27	-0.05
<i>AUDCMS_{it}</i>					1	0.01	-0.09	0.13	0.02
<i>AUDTE_{it}</i>						1	0.07	0.37	-0.03
<i>LEV_{it}</i>							1	-0.40	0.25
<i>FZ_{it}</i>								1	-0.23
<i>SAG_{it}</i>									1

Source: Author's computation using EViews 12.

Table 1 reveals that discretionary expenses exhibit a negative relationship with audit quality such as audit independence, audit fee, audit firm size, audit committee size and audit tenure. These results suggest a negative association between discretionary expenses (often measured by discretionary accruals) and strong audit firm characteristics like high audit independence, higher audit fees, larger audit committee size, and longer audit tenure, meaning that companies with these characteristics tend to have lower levels of discretionary expenses, indicating less earnings management activity; essentially, a more robust audit process can deter companies from manipulating earnings through discretionary expenses.

Additionally, the relationship between discretionary expenses and the control variables reveals a positive relationship with leverage, firm size and sales growth. These results imply that higher leverage often leads to reduced flexibility in financial decisions, which can constrain discretionary spending. Larger firms typically have more resources and a greater capacity to engage in discretionary expenditures as big-size firms tend to create opportunities for discretionary expenses, while firms experiencing significant sales growth may allocate more funds towards these expenses to capitalize on opportunities. Overall, all audit quality variables have a weak relationship with discretionary expenses. However, audit quality variables have a weak relationship with sales growth but moderate relationships with leverage size (magnitude = 0.55), and firm size (magnitude = 0.45).

Effects of audit quality on earnings management (Discretionary expenses)

The results of the effects of firm quality on discretionary expenses are presented in Table 2 demonstrate how firm characteristics contribute to this type of earnings management. Discretionary expenses are the expenses that can be incurred without having possible consequences on the operation of the company in the short run.

Table 2. Panel OLS effect of audit quality on discretionary expenses

Dependent variable: $DEXP_{it}$

Variables	Coefficient	Std. Error	t-Statistic	Prob.
$AUDIN_{it}$	-0.194**	0.060	3.260	0.001
$AUDFE_{it}$	-0.188**	0.091	2.070	0.040
$AUDFZ_{it}$	-1.744*	0.936	-1.863	0.064
$AUDCMS_{it}$	-0.016***	0.105	-0.150	0.000
$AUDTE_{it}$	-0.248**	0.232	-1.069	0.041
LEV_{it}	0.037**	0.024	1.524	0.013
FZ_{it}	0.020**	0.072	0.273	0.040
SAG_{it}	-4.121***	1.037	-3.972	0.000
R-Squared. (R^2)		0.87 (87%)		
Adjusted R-Squared ($Adj. R^2$)		0.86 (86%)		
Durbin-Watson Stat.		2.17		

*, **, *** indicates significance at 10%, 5% and 1% level of significance respectively.

Source: Author's computation using EViews 12.

Audit firm quality such as audit Independence (AUDIN), audit fee, audit firm size audit committee size, and audit tenure are revealed to have a negative effect on discretionary expenses. Audit independence is negatively and significantly associated with discretionary expenses (-0.194, p-value = 0.001) at 5%. This suggests that greater auditor independence effectively reduces earnings manipulation through discretionary expenses, fostering transparent financial reporting. Audit fee (-0.188) significant at the 5% level (p-value = 0.040) shows a negative effect on discretionary expenses, meaning that a higher audit fee is linked to lower discretionary expenses. In this regard, if the fees of the big4 auditors increase by 1%, discretionary expenses are expected to fall by 0.188%. Thus, higher audit fee significantly reduces earnings management practices via discretionary expenses in Nigeria's oil and gas sector, indicating that increased financial commitment to audit engagements enhances audit quality and mitigates earnings management. Audit firm size has a negative impact and significant impact on discretionary expenses, coefficient of -1.744, significant at the 10% level (p-value = 0.064). In the case of an audit firm's size, the negative impact implies that the larger the size of the firm (or that of a firm with large assets) the less the discretionary expenses. Specifically, a 1% increase in firm size proxy by the firm's asset will lead to a reduction in discretionary expenses by 0.049%. The negative coefficient suggests that larger audit firms are more effective in curbing earnings manipulation, likely due to their superior technical expertise and stricter compliance measures.

Audit committee size exhibits a negative and significant effect on discretionary expenses. The test statistical results of $t = -0.150$, coefficient = -0.016, and p-value of 0.041 confirm the outcomes of the analysis. The results suggest that a 1% increment in audit committee size leads to a 0.016% decrease in discretionary expenses in oil and gas firms, indicating larger audit committees play a critical role in reducing discretionary expenses, and enhancing the effectiveness of financial oversight. Audit tenure shows a significant negative effect on discretionary expenses with a coefficient of -0.248 and a p-value of 0.000, which is significant at a 1% level. The result implies that a 1% increase in years of auditing a firm in the oil and gas sector leads to a 0.248% increase in discretionary expenses, indicating that longer auditor-client relationships may strengthen audit effectiveness, reducing opportunities for earnings manipulation.

Firm characteristics, including leverage, firm size, and sales growth significantly affects discretionary expenses. Leverage is seen to increase discretionary expenses, with a 1% increase resulting in a 0.037% increment in discretionary expenses. This indicates that firms with higher debt levels are more likely to engage in earnings management to maintain favourable financial conditions. The effect is considered significant at a 5% level since the p-value is 0.013 and the coefficient is 0.037. Firm size (FMS) has a positive and significant impact on discretionary expenses, with a coefficient of 0.020 and p-value of 0.040 implying significance at a 5% level. The positive and significant relationship suggests that larger firms may have a greater capacity to engage in discretionary spending, possibly as part of strategic financial management. Therefore, a 1% increase in the size of a firm or its assets implies a 0.02% increase in discretionary expenses. Sales growth demonstrates a strong and negative association with discretionary expenses, implying that growing oil and gas firms are less inclined to manipulate earnings through discretionary spending due to improved operational performance, (coefficient -4.121, p-value 0.000) significant at a 1% level.

Overall, the results highlight the critical role of audit quality in constraining earnings management through discretionary expenses in Nigerian oil and gas firms. Audit independence, audit fees, firm size, audit committee size, and tenure all contribute significantly to enhancing financial transparency. The findings also underscore the potential influence of leverage and firm size on firms' financial reporting practices. The findings provide actionable insights for regulators, auditors, and corporate stakeholders in the Nigerian context. The statistical properties of the model explain 87% of the variation in discretionary expenses. The variation in discretionary cash flow explained by the explanatory variables (firm characteristics variables and other catchall variables considered in the model) is 86%. The Durbin-Watson statistic indicates no presence of serial correlation in the model. Other diagnostic tests also support the validity of the model. This indicates that only 13% of the total variation in discretionary expenses is not captured by the regressors. Therefore, the model exhibits a good fit and the question about possible spurious regression does not arise. The value of the Durbin-Watson statistic (2.17) falls within the appropriate range, ensuring the absence of serial correlation.

Discussion on the Hypotheses

The hypothesis states that audit quality does not have any significant effect on discretionary expenses among Nigerian listed oil and gas firms. However, every audit firm characteristic used in the model's result rejects the null hypothesis. This is because each of the independent variables portrays a negative and statistically significant effect on discretionary expenses.

Summary of Findings

The analysis of discretionary expenses among Nigerian listed oil and gas firms reveals significant relationships with various audit quality and firm-specific factors. Audit independence exhibits a significant negative relationship with discretionary expenses (-0.194, p-value = 0.001) at the 5% level, suggesting that independent auditors effectively curb earnings manipulation. Similarly, audit fees show a negative and significant effect (-0.188, p-value = 0.040) at the 5% level, indicating that higher fees are associated with enhanced audit quality, likely due to increased auditor effort and resources. Audit firm size also has a negative effect (-1.744, p-value = 0.064), implying that larger audit firms, often with greater expertise and reputation, reduce discretionary expenses. Additionally, audit committee size demonstrates a significant negative impact (-0.016, p-value =

0.041), highlighting the role of larger committees in strengthening financial oversight and limiting manipulative practices. Audit tenure is negative and significant (-0.248, p-value = 0.000), suggesting that prolonged auditor-client relationships enhance audit effectiveness, contrary to concerns about familiarity compromising independence. On the firm-specific side, leverage has a positive and significant effect (0.037, p-value = 0.013) at the 5% level, indicating that financial pressures drive increased discretionary expenses as firms attempt to manage earnings. Firm size also shows a positive and significant relationship (0.020, p-value = 0.040), suggesting that larger firms engage in strategic discretionary spending, possibly to signal financial health. Conversely, sales growth is negative and highly significant (-4.121, p-value = 0.000), implying that growth-oriented firms are less likely to manipulate earnings through discretionary expenses, focusing instead on operational performance. The regression model is robust, explaining 98% of the variation in discretionary expenses, underscoring its strong explanatory power.

Conclusion

This study examined the impact of audit quality on discretionary expenses among Nigerian listed oil and gas firms, revealing significant insights into financial reporting practices in a critical economic sector. The findings demonstrate that audit quality, proxied by audit independence (-0.194, p = 0.001), audit fees (-0.188, p = 0.040), audit firm size (-1.744, p = 0.064), audit committee size (-0.016, p = 0.041), and audit tenure (-0.248, p = 0.000), significantly reduces discretionary expenses, thereby curbing earnings management. These results reject the null hypothesis, confirming that robust audit mechanisms enhance transparency and accountability, aligning with prior studies like Abbasiazadeh and Zamanpour (2016) and Mokoaleli-Mokoteli and Iatridis (2017). Conversely, firm-specific factors such as leverage (0.037, p = 0.013) and firm size (0.020, p = 0.040) increase discretionary expenses, reflecting financial pressures and strategic spending, while sales growth (-4.121, p = 0.000) reduces manipulation, indicating operational focus among growing firms. The model's high explanatory power ($R^2 = 98\%$) underscores its robustness, supported by diagnostic tests confirming no serial correlation (Durbin-Watson = 2.17). In Nigeria's oil and gas industry, where regulatory scrutiny intensified following 2022–2023 manipulation scandals, these findings highlight audit quality's critical role in restoring investor confidence and ensuring financial reporting integrity. By addressing agency conflicts, as framed by agency theory (Jensen & Meckling, 1976), high-quality audits mitigate information asymmetry, fostering trust in a sector vital to Nigeria's economy.

Recommendations

The recommendations focus on strengthening governance, transparency, and regulatory oversight within Nigeria's oil and gas industry. Firstly, regulatory bodies like the FRCN should enforce stricter auditor rotation policies to bolster auditor independence and curtail discretionary expense manipulation, a key finding supported by the significant negative effect observed. Oil and gas companies are encouraged to engage with Big 4 audit firms, whose involvement appears to improve financial reporting quality, leveraging their expertise to reduce earnings management. Firms should also allocate sufficient resources to audit fees, as higher fees are associated with more thorough audits and better oversight of discretionary expenses.

Improving the effectiveness of audit committees is vital; expanding their size and ensuring members have financial expertise will enhance oversight capabilities. Regulators should also carefully monitor and balance audit tenure to maintain independence and prevent manipulation

resulting from frequent changes. For high-leverage firms, implementing internal controls is crucial to prevent potential earnings manipulation driven by excessive debt levels. Growth-oriented companies must prioritize transparent reporting practices to maintain investor confidence amidst their rapid expansion.

Lastly, the SEC and FRCN should finalize and enforce comprehensive disclosure standards for discretionary expenses, building on recent reforms to promote accountability and align with international standards. Collectively, these measures are designed to reinforce financial reporting integrity, mitigate sector-specific risks such as oil price volatility, and foster greater trust among stakeholders, ultimately contributing to industry stability and market confidence in Nigeria.

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THE USE OF TIMBER IN BUILDING CONSTRUCTION

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Abstract

Timber as a traditional material has been used for building construction for many centuries. However, the application of timber as a building material has changed over the years, and today the application is so vast. From roofing material to flooring and finishing material, sometimes it may even stand as a pillar support for the building. However, the preparation and presentation of timber to be able to serve this function have been very poor over the years, hence making the timber prone to defects, insect attacks, fire out breaks and other disasters. This problem has largely discouraged builders from using timber in construction. This research work is aimed at informing the society on some efficient ways of preparing and preserving timber to serve its purposes in the building industry. Also, the research work will expose some modern ways timber may be applied to achieve cheaper and durable structures in our society. At the end of this research work, one would learn the importance of timber as a building material and how a cheap building can achieve using timber as 80% of the construction material.

Keywords: Seasoning, Defects, preservation, finishing.

Introduction

In urban conditions woody plants have several environmental, economic and social benefits. Trees reduce heat, wind speed and provide shading, increasing the energy efficiency of buildings (Sand, 1994; Simpson, 1998; McPherson & Simpson, 2003). Urban greenery increases the sociological value of the environment, improving the aesthetic and hygienic properties of the particular place. It also increases positive feelings and moods, enjoyment of everyday life and stronger feelings of connection between people and the environment (Dwyer et al., 1992, 2003; Westphal 2003)

Processing of Timber: Top 4 Steps of Timber Processing

there are four steps of timber processing:

1. Felling of Trees
2. Seasoning of Timber
3. Conversion of Timber
4. Preservation of Timber.

1. Felling of Trees

To get timber, the trees are knocked down or cut down or caused to fall to the ground. This is known as the felling of trees. The trees should be felled by experienced persons. The tree should be cut from a place a little above its roots and very near to the ground level. Such a practice would help in getting more timber from the trunk of trees

2. Seasoning of Timber

When a tree is newly felled, it contains about 50 per cent or more of its own dry weight as water. This water is in the form of sap and moisture. The water is to be removed before the timber can be used for any engineering purpose. In other words, the timber is to be dried. This process of drying of timber is known as the seasoning of timber and the moisture should be extracted during seasoning under controlled conditions as nearly as possible at a uniform rate from all parts of the timber.

It should also be seen during seasoning that the remaining moisture, which cannot be extracted, is uniformly distributed throughout the mass. If the drying is irregular, the shrinkage of timber will also be irregular and it will set up internal stresses between the fibres.

Determination of Moisture Content:

The moisture content of timber is determined as follows –

Where, P = Percentage of moisture

W₁ = Original weight of timber

W₂ = Oven-dry weight of timber.

Seasoning is carried out to achieve the following objectives

- i. To allow timber to burn readily, if used as fuel.
- ii. To decrease the weight of timber and thereby to lower the cost of transport and handling.
- iii. To impart hardness, stiffness, strength and better electrical resistance to timber.
- iv. To increase the resisting power of timber, as most of the causes of decay of timber are more or less related to the moisture.
- v. To maintain the shape and size of the components of the timber articles which are expected to remain unchanged in form.

- vi. To make timber easily workable and to facilitate operations during conversion.
- vii. To make timber fit for receiving treatment of paints, preservatives, varnishes, etc.
- viii. To make timber safe from the attack of fungi and insects.
- ix. To make timber suitable for gluing i.e. effectively joining two members of timber with the aid of glue.
- x. To reduce the tendency of timber to crack, shrink and warp.

Methods of Seasoning

The methods of seasoning can broadly be divided into the following two categories:

- i. i. Natural seasoning
- iii. Artificial seasoning
- ii. Natural Seasoning:

In this method, the seasoning of timber is carried out by natural air and hence it is also sometimes referred to as air seasoning.

Following are the advantages of the natural seasoning:

- i. Depending upon the climatic conditions, the moisture content of wood can be brought down to about 10 to 20 percent.
- ii. It does not require skilled supervision.
- iii. It is more economical to provide
- iv. This method of seasoning timber is cheap and simple.

Following are the disadvantages of the natural seasoning:

- i. As the process depends on the natural air, it sometimes becomes difficult to control it.
- ii. The drying of different surfaces may not be even and uniform.
- iii. If ends of thick sections of timber are not protected by suitable moisture-proof coating, there are chances for end splitting because the ends of such timbers dry rapidly in comparison to the central portions,
- iv. If not properly attended, the fungi and insects may attack timber during the process of seasoning and may thereby damage it.
- v. The moisture content of wood may not be brought down to the desired level.
- vi. The space required for this process will be more as timber will have to be stacked or stored for a sufficiently long time.
- vii. The process of seasoning is very slow and it usually takes about 2 to 4 years to make timber fit for the work of carpenter.

Artificial Seasoning:

Following are the reasons for adopting the artificial seasoning to

- i. The defects such as shrinkage, cracking is minimized.
- ii. The drying is controlled and there are practically no chances for the attack of fungi and insects.
- iii. The drying of different surfaces is even and uniform.
- iv. It considerably reduces the period of seasoning.
- v. There is better control of circulation of air, humidity and temperature.
- vi. The wood becomes more suitable for painting, gluing, etc.
- vii. The wood with desired moisture content may be obtained by the artificial seasoning.

The various methods of artificial seasoning are as follows:

- i. Boiling
- ii. Chemical seasoning
- iii. Electrical seasoning
- iv. Kiln seasoning
- v. Water seasoning.

Each of these methods of artificial seasoning will be now briefly discussed.

Boiling: In this method of artificial seasoning, the timber is immersed in water and water is then boiled. This is a very quick method. The timber is thus boiled with water for about three to four hours. It is then dried very slowly under a shed. The periods of seasoning and shrinkage are reduced by this method, but it affects the elasticity and strength of wood. In place of boiling water, the timber may be exposed to the action of hot steam. This method of seasoning proves to be costly.

Chemical Seasoning: This is also known as the salt seasoning. In this method, the timber is immersed in a solution of suitable salt. It is then taken out and seasoned in the ordinary way. The interior surface of timber dries in advance of exterior one and chances of formation of external cracks are reduced.

Electrical Seasoning: In this method, the use is made of high frequency alternating currents. The timber, when it is green, offers less resistance to the flow of electric current. The resistance increases as the wood dries internally which also results in the production of heat. This is the most rapid method of seasoning. But the initial and maintenance costs are so high that it becomes uneconomical to season timber on commercial base by this method.

Kiln Seasoning: In this method, the drying of timber is carried out inside an airtight chamber or oven.

Water Seasoning: In this method the timber is cut into pieces of suitable sizes. These pieces are immersed wholly in water, preferably in running water of a stream for a period of about 2 to 4 weeks. During this period, the sap contained in timber is washed away by water.

The preservation of timber is carried out to achieve the following three objectives

- i. To increase the life of timber structures,
- ii. To make the timber structures durable, and
- iii. To protect the timber structures from the attack of destroying agencies such as fungi, insects, etc.

Requirements of a Good Preservative:

- i. It should allow decorative treatment on timber after being applied over timber surface.
- ii. (ii) It should be capable of covering a large area with small quantity.
- iii. (iii) It should be cheap and easily available.
- iv. (iv) It should be durable and should not be affected by light, heat, etc.
- v. (v) It should be free from unpleasant smell.
- vi. (vi) It should be non-inflammable.
- vii. (vii) It should be quite efficient in killing fungi, insects, etc.

- viii. (viii) It should be safe and harmless for persons and animals.
- ix. (ix) It should not affect the strength characteristics of timber.
- x. (x) It should not be easily washed away by water.
- xi. (xi) It should not corrode the metals with which it comes into contact.

Following preservatives are commonly used for the preservation of timber:

- i. Ascu treatment
- ii. (ii) Chemical salts
- iii. (iii) Coal tar
- iv. (iv) Creosote oil
- v. (v) Oil paints
- vi. (vi) Solignum paints.
- vii. Ascu Treatment: The ascu is special preservative which is developed at the Forest Research Institute, Dehradun.

Its composition is as follows:

- (a) Part by weight of hydrated arsenic pentoxide, ($\text{As}_2\text{O}_5, 2\text{H}_2\text{O}$)
- (b) Parts by weight of blue vitriol or copper sulphate, ($\text{CuSO}_4, 5\text{H}_2\text{O}$)
- (c) Parts by weight of potassium dichromate, ($\text{K}_2\text{Cr}_2\text{O}_7$) or sodium dichromate ($\text{Na}_2\text{Cr}_2\text{O}_7, 2\text{H}_2\text{O}$).

This material is available in powder form. To prepare a solution of this material, six parts by weight of ascu are mixed in 100 parts by weight of water. The solution is then sprayed or applied on timber surface. This preservative gives timber protection against the attack of white ants. The surface treated with this preservative can be painted, polished, varnished or waxed. The solution is odourless.

(i) Chemical Salts: These are water-borne preservatives and they are mostly salts dissolved in water. The usual salts used are copper sulphate, mercury chloride, sodium fluoride and zinc chloride. The solutions are prepared from these salts and they are applied on the timber surface. These preservatives are odourless and non-inflammable. The treated surface can be painted or varnished after drying. These preservatives have good penetration and the timbers treated with these preservatives will show an immediate increase in weight of 2400 to 4800 N per m^3 . After drying, the net increase in weight will come down to about 50 to 300 N per m^3 .

(ii) Coal Tar: The timber surface is coated with hot coal tar with the help of brush. The coal tar becomes workable when heated. The process is known as the tarring. The coal tar has unpleasant smell and appearance. It makes timber unsuitable for painting. Hence the tarring is adopted for frames of doors and windows, rough timber work, etc. and it is found to be most useful for parts embedded in ground because of its cheapness and effective resistance. The coal tar is fire-resistant.

(iii) Creosote Oil: In this case, the timber surface is coated with creosote oil. The process is known as the creosoting or Bethel's method of preservation of timber. The creosote oil is obtained by the distillation of tar.

(iv) Oil Paints: The timber surface is coated with 2 or 3 coats of oil paint. The wood should be seasoned. Otherwise sap will be confined and it will lead to the decay of timber. The oil paints preserve timber from moisture and make it durable.

(v) Solignum Paints: These paints preserve timber from white ants as they are highly toxic in

nature. They can be mixed with colour pigments and applied in hot state with the help of brush. The timber surface may therefore be given the desired colour or appearance.

Methods for Preservation of Timber:

- i. Brushing
- ii. Charring
- iii. Dipping and steeping
- iv. Hot and cold open tank treatment
- v. Injecting under pressure
- vi. Spraying

Brushing: The solution prepared from preservative is applied on timber surface by good quality of brushes. This is the simplest method and it is generally adopted for seasoned timber. The cracks should be filled up before the application of preservative. For better penetration, the oil type preservatives may be applied hot and the preservative should be liberally used on the surface. Several coats of preservatives may be applied and enough interval of time should be kept between successive coats for absorption of preservative.

Charring: This method of charring is rather very old and as such, no preservative is used in this method. The surface to be charred is kept wet for about half an hour and it is then burnt upto a depth of about 15 mm over a wood fire. The charred portion is then cooled with water. Due to burning, a layer of coal is formed on the surface. This layer is not affected by moisture and it is not attacked by white ants, fungi, etc.

The disadvantages of this method are:

- (a) The charred surface becomes black in appearance and hence it cannot be used for exterior work.
- (b) There is some loss of strength of timber as the cross-section is reduced due to charring.

The process of charring is generally adopted for lower ends of posts for fencing, telephone, etc. which are to be embedded in the ground or to be inserted in moist soil.

- i. **Dipping and Steeping:** In this method, the timber to be given preservative treatment is dipped or soaked for a short period in the solution of preservative. This method gives slightly better penetration of preservative than in case of brushing or spraying. Instead of dipping, the steeping or wetting of timber with preservative may be carried out for periods varying from a few hours to days or weeks. The depth of penetration of preservative depends on the type of timber.
- ii. **Hot and Cold Open Tank Treatment:** In this method, the timber is submerged in a tank containing solution of preservative which is heated for a few hours at temperature of 85°C to 95°C. The tank is then allowed to cool down gradually while the timber is still submerged in the tank. This method is effective in giving protection to the sap wood.
- iii. **Injecting under Pressure:** In this method, the preservative is injected under pressure into the timber. This method is usually adopted in creosoting. This is the most effective method of treating timber with the preservative. But it requires special treatment plant. This method proves to be essential for treating non-durable timbers which are to be used at places where there is danger of attack by fungi and insects.

- iv. **Spraying:** In this method, the solution of preservative is filled in a spraying pistol and it is then applied on timber surface under pressure. The pistol works under compressed air. This method is also quite effective and it is superior to brushing.

Fire-Resistance of Timber:

As a general rule, the structural elements made of timber ignite and get rapidly destroyed in case of a fire. Further, they add to the intensity of a fire. But the timber used in heavy sections may attain high degree of fire-resistance because the timber is a very bad conductor of heat. This is the reason why time is required to build up sufficient heat so as to cause a flame in the timber. With respect to the fire-resistance, the timber is classified as refractory timber and non-refractory timber. The refractory timber is non-resinous and it does not catch fire easily. The examples of refractory timbers are sal, teak, etc. The non-refractory timber is resinous and it catches fire easily. The examples of non-refractory timbers are chir, deodar, fir, etc.

Following are the characteristics or qualities of a good timber:

- i. **Appearance:** A freshly cut surface of timber should exhibit hard and shining appearance.
- ii. **Colour:** The colour of timber should preferably be dark. The light colour usually indicates timber with low strength.
- iii. **Defects:** A good timber should be free from serious defects such as dead knots, flaws, shakes, etc.
- iv. **Durability:** A good timber should be durable. It should be capable of resisting the actions of fungi insects, chemicals, physical agencies and mechanical agencies. If wood is exposed to the actions of acids and alkalies for a prolonged period, it is seriously damaged. The weak alkali and acid solutions usually do not affect wood to a considerable extent.
- v. **Elasticity:** This is the property by which timber returns to its original shape when load causing its deformation is removed. This property of timber would be essential when it is to be used for bows, carriage shafts, sport goods, etc.
- vi. **Fibres:** The timber should have straight fibres.
- vii. **Fire Resistance:** The timber is a bad conductor of heat. A dense wood offers good resistance to the fire and it requires sufficient heat to cause a flame. The heat conductivity of wood is low and it depends on various factors such as porosity, moisture content, surrounding temperature, orientation of fibres, bulk density, etc.
- viii. **Hardness:** A good timber should be hard i.e. it should offer resistance when it is being penetrated by another body. The chemicals present in heart wood and density of wood impart hardness to the timber. The mere resistance offered to chisel or saw does not usually indicate hardness of timber.
- ix. **Mechanical Wear:** A good timber should not deteriorate easily due to mechanical wear or abrasion. This property of timber would be essential for places where timber would be subject to traffic e.g. wooden floors, pavements, etc.
- x. **Shape:** A good timber should be capable of retaining its shape during conversion or seasoning. It should not bow or warp or split.
- xi. **Smell:** A good timber should have sweet smell. An unpleasant smell indicates decayed timber.
- xii. **Sound:** A good timber should give out a clear ringing sound when struck. A dull heavy sound, when struck, indicates decayed timber. The velocity of sound in wood is 2 to 17 times

greater than that in air and hence the wood may be considered high in sound transmission. The sound conductivity is faster along the fibres, is lower in the radial direction and is slowest along the chord of a cross-section.

- xiii. Strength:** A good timber should be strong for working as structural member such as joist, beam, rafter, etc. It should be capable of taking loads slowly or suddenly. It should also possess enough strength in direct and transverse directions.
- xiv. Structure:** It should be uniform. The fibres should be firmly added. The medullary rays should be hard and compact. The annual rings should be regular and they should be closely located.
- xv. Toughness:** A good timber should be tough i.e. it should be capable of resisting the shocks due to vibrations. This property of timber would be essential when it is to be used for tool handles, parts of motor cars and airplanes, etc.
- xvi. Water Permeability:** A good timber should have low water permeability which is measured by the quantity of water filtered through a unit surface area of specimen of wood. The water permeability is greater along the fibres than in other directions and it depends on initial moisture content, character of cut, type of wood, width of annual rings, age of wood, etc.
- xvii. Weathering Effects:** A good timber should be able to stand reasonably the weathering effects. When timber is exposed to weather, its colour normally fades and slowly turns grey. A good timber should show the least disintegration of the surface under adverse weather conditions such as drying and wetting, extreme heat and extreme cold, etc.
- xviii. Weight:** The timber with heavy weight is considered to be sound and strong.
- xix. Working Condition:** The timber should be easily workable. It should not clog the teeth of saw and should be capable of being easily planed or made smooth.

Decay of Timber

The timber is said to be decayed when it is so deteriorated that it loses its value as an engineering material. When these defects are in excess, the timber decays and such timber is not used for engineering purposes.

Following are the various causes or situations which favour the early decay of timber:

- i. Alternate dry and wet conditions,
- ii. Bad storage or stacking of timber,
- iii. Fungi which are responsible for developing diseases in timber such as blue stain, brown rot, dry rot, heart rot, sap stain, wet rot and white rot,
- iv. Improper seasoning,
- v. Insects such as beetles, marine borers, termites, etc.,
- vi. Keeping timber in contact with damp wall, damp earth, etc.,
- vii. Shocks or impacts received during young age from natural forces such as fast blowing wind, etc.
- viii. Use of timber without taking out sap wood from its structure,
- ix. Using seasoned timber without applying suitable preservative on its surface, and
- x. Using unseasoned wood with the application of protective coat of paint or tar.

Storage of Timber:

The structural timber should be properly stored so as to avoid any further development of defects.

The material is arranged in layers and the layers are separated by wooden battens which are known as the crossers or spacers. The stack should be protected from direct sun, dry wind and rain. If necessary, a sloping roof of suitable material may be provided over the stack.

The important facts to be remembered for storage of timber are as follows:

- i. In each layer, an air space of about 25 mm should be maintained between adjacent members.
- ii. (ii) The crossers or spacers should be of sound wood, straight and uniform in thickness.
- iii. (iii) The ends of all members should be coated with suitable material to prevent end-cracking.
- iv. (iv) The longer pieces should be placed in bottom layers and the shorter pieces should be placed in top layers.
- v. (v) The platform of stack should be made at least 150 mm higher than ground.
- vi. (vi) There should be a minimum distance of at least 300 mm between adjacent stacks.

Market Forms of Timber

The timber is converted into suitable commercial sizes.

Following are various forms in which the timber is available in the market:

- i. **Batten:** This is a timber piece whose breadth and thickness do not exceed 50 mm.
- ii. **Baulk:** It is a roughly squared timber piece and it is obtained by removing bark and sap wood. One of the cross-sectional dimensions exceeds 50 mm, while the other exceeds 200 mm.
- iii. **Board:** It is a plank i.e. a timber piece with parallel sides. Its thickness is less than 50 mm and width exceeds 150 mm.
- iv. **Deal:** It is a piece of soft wood with parallel sides. Its thickness varies from 50 mm to 100 mm and its width does not exceed 230 mm.
- v. **End:** This is a short piece of batten, deal, scantling, etc.
- vi. **Log:** It is the trunk of tree obtained after removal of branches.
- vii. **Plank:** It is a timber piece with parallel sides. Its thickness is less than 50 mm and its width exceeds 50 mm.
- viii. **Pole:** It is a sound long log of wood. Its diameter does not exceed 200 mm. It is also known as a spar.
- ix. **Quartering:** It is a square piece of timber, the length of side being 50 mm to 150 mm.
- x. **Scantling:** This is a timber piece whose breadth and thickness exceed 50 mm, but are less than 200 mm in length. These are the pieces of miscellaneous sizes of timber sawn out of a log.

Advantages of Timber Construction:

The timber has been probably the first material to be adopted in the construction of engineering structures.

- i. It possesses the following distinct advantages in preference to other engineering materials:
- ii. It can be used either for load bearing members or for non-load bearing members.
- iii. It combines light weight with strength and hence it is generally preferred for the buildings in the earthquake-prone regions.

- iv. It is economical and cheap. This is due to the fact that the smallest piece of wood can be put to one or other use and the wastage of material is thereby considerably minimized.
- v. It is used to prepare furniture of decent appearance and comfortable design.
- vi. The heavy timber construction presents a massive appearance.
- vii. The houses with timber construction are found to be cool in summer and warm in winter. This is due to the fact that the wood is a non-conductor of heat.
- viii. The other forms of present-day such as plywoods, Fiber boards, etc. have made timber construction to match with the present-day requirements.
- ix. The timber construction is quite durable, if properly protected against moisture, rain, wind, etc.
- x. The additions, alterations and repairs to the timber constructions can be carried out easily.
- xi. It is found to be superior to the cement concrete and steel in respect of thermal insulation, sound absorption and electrical resistance. For instance, the thermal insulation of wood is 15 times better than concrete, 6 times better than bricks and 1770 times better than aluminum.

The disadvantages of timber construction are as follows:

- i. It is likely to crack, warp and decay, if not properly seasoned and not treated with the preservatives.
- ii. It is not suitable for cyclonic weather and for places subjected to the natural calamities.
- iii. It requires careful regular maintenance.
- iv. It is subjected to the risk of fire.
- v. If not locally available, it proves to be costly.

Uses of Timber:

There is hardly any material other than timber which can be used as an all-round substitute in construction work and its various uses can be summarized as follows:

- i. It is used for door and window frames, shutters of doors and windows, roofing materials, etc.
- ii. It is used for formwork of cement concrete, centering of an arch, scaffolding, etc.
- iii. It is used for making furniture, agricultural instruments, sport goods, musical instruments, etc.
- iv. It is used for making railway coach wagons.
- v. It is used for making toys, engraving work, matches, etc.
- vi. It is used for railway sleepers, packing cases, etc.
- vii. It is used for temporary bridges and boat construction.

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ANALYSIS OF THE NON-LINEAR IMPACT OF TRADE LIBERALIZATION ON OIL INDUSTRIAL SECTOR OUTPUT IN NIGERIA (1981-2022)

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Abstract

This study is motivated by the need to examine if Trade liberalization have a linear or non-linear influence on oil manufacturing output, with a focus on capturing the relationship of trade, foreign investment, and economic growth from 1981 to 2022 as trade liberalization is also regarded as industrial growth catalyst, yet its true impact on Nigeria's oil sector remains uncertain, especially given the country's heavy reliance on oil exports. The study used descriptive statistics and Non-linear Autoregressive Distributed Lag (ARDL) framework which found that the error correction term (COINTEQ) at -0.341 is significant with a moderate short-run adjustment mechanism. The result also showed a Positive change in Trade Liberalization significantly stimulate oil manufacturing output (OMO). While foreign direct investment positively impacts oil manufacturing output but is not statistically significant in the long run. On the other hand, the GDP growth rate had a positive and significant impact on oil manufacturing output only in the long run. The study thereafter recommended that policymakers should prioritize initiatives like reducing trade barriers, streamlining customs procedures, and actively participating in regional and international trade agreements.

Keywords: Non-linear, Trade Liberalization, Oil, Industrial Sector, Output
JEL Codes: C63, F13, Q41, L60, D24

Introduction

The global oil industry, a linchpin of economic development and geopolitical influence, has faced unprecedented volatility in recent decades due to shifting energy policies, trade dynamics, and climate imperatives (Wang *et al.* 2024)). Nigeria, Africa's largest oil producer with 37.5 billion barrels of proven reserves, exemplifies the paradox of resource wealth: despite generating 90% of its

export earnings and 65% of government revenue from oil, the sector's contribution to sustainable growth and industrial output remains stymied by structural inefficiencies (Salaludeen *et al.* 2023). Between 1981 and 2022, Nigeria's oil industrial sector output has oscillated amid fluctuating global oil prices, regulatory instability, and domestic governance challenges. Globally, trade liberalization has been a double-edged sword for oil-exporting nations. While it facilitates access to international markets and technology transfer, excessive reliance on hydrocarbon exports exposes economies to price shocks and exchange rate instability (Chen *et al.* 2024). For instance, the 2025 U.S. tariff policies triggered a 10% plunge in oil prices, underscoring the vulnerability of Nigeria's oil revenues to external trade shocks (U.S. Energy Information Administration., 2023). Regionally, Nigeria's oil sector dominates West Africa's energy landscape, yet it lags behind peers like Angola in refining capacity and value-chain diversification. The Niger Delta, responsible for 90% of Nigeria's crude production, remains plagued by oil theft—costing \$3 billion annually—and environmental degradation, which undermine both output and community health (Ndem *et al.*, 2019). These challenges reflect broader African struggles to convert resource wealth into equitable development, as seen in the continent's average life expectancy of 55 years compared to Gulf states' 75+ years³.

Nationally, Nigeria's oil sector contributed 5.57% to GDP in 2024, yet systemic inefficiencies persist (Salaludeen *et al.* 2023). Trade liberalization has spurred foreign direct investment inflows in telecommunications and banking but yielded uneven results in oil due to corruption and infrastructural deficits (Idowu, 2019). For example, while the Petroleum Industry Act (PIA) of 2021 aimed to attract \$10 billion in annual investments, political interference and inconsistent implementation have deterred foreign investors. Economic growth rates, though averaging 3% annually since 2021, remain insufficient to offset population growth, while exchange rate volatility exacerbated by a 100%-naira depreciation in 2024 has inflated operational costs for oil firms reliant on imported machinery. These variables collectively shape a complex, non-linear relationship with oil output, where liberalization's benefits diminish beyond optimal thresholds due to institutional weaknesses. Also, despite the Dangote Refinery's 650,000-barrel capacity, Nigeria continues to import 28.7 million liters of gasoline daily due to regulatory bottlenecks and underinvestment in ancillary infrastructure (Behera *et al.* 2023).

This study addresses critical gaps in understanding the non-linear thresholds at which trade liberalization's impacts on oil industrial sector output turn adverse, a dimension overlooked in linear models. By employing time-varying parameter analysis, the research offers policymakers insights into calibrating trade policies to mitigate volatility and enhance FDI quality. Stakeholders, including the Nigerian National Petroleum Corporation (NNPC) and international investors, stand to benefit from strategies that align trade openness with infrastructure development. Ultimately, this analysis contributes to a framework for transforming Nigeria's oil sector into a catalyst for inclusive, sustainable growth.

To achieve the objectives of this paper and to analyze the non-linear impact of trade liberalization on oil industrial sector output in Nigeria, the following hypotheses are formulated:

- H_{01} : trade liberalization has no significant impact on oil industrial sector output in Nigeria.
- H_{02} : foreign direct investment has no significant impact on oil industrial sector output in Nigeria.
- H_{03} : economic growth rate has no significant impact on oil industrial sector output in Nigeria.
- H_{04} : exchange rate has no significant impact on oil industrial sector output in Nigeria.

Materials and Methods

Conceptual Review

Trade Liberalization

Trade liberalization is broadly defined as the policy of removing or reducing trade barriers (tariffs, quotas, subsidies, etc.) to enable freer international exchange. For example, Acharya (2015) noted it means the removal of tariff and non-tariff barriers and Fu (2021) similarly describes it as eliminating tariffs, quotas and related controls (Siddiqui, 2015). In classical economic theory, liberalization is grounded in comparative advantage: countries open markets to specialize and thus raise efficiency and aggregate welfare. Siddiqui (2015) observes that mainstream economists argued free trade will “raise the incomes of country's inhabitants” through such specialization. Empirically, advocates like Obstfeld (IMF) (2016) pointed out that decades of tariff cuts have “supported growth and welfare everywhere” by expanding consumer choice and productivity. However, these sources also emphasize that the gains are uneven: Obstfeld noted that some groups “lose out” as resources shift, exacerbating inequality. Recent scholars like Pauwelyn *et al.* (2025) take a nuanced view, affirming that open trade raises overall welfare but also produces domestic adjustment costs (job displacements, social or environmental “spillovers”) that must be managed. In sum, authors present trade liberalization as a policy of systematic barrier-reduction to harness efficiency and growth (consistent with comparative-advantage logic), while urging attention to its distributional side-effects

Foreign direct Investment

Scholars in international economics and business consistently describe foreign direct investment as a cross-border equity investment conferring foreign firms lasting ownership and managerial influence in a host economy. For example, Wellhausen (2018) defined foreign direct investment as economic activity in a country over which a foreign actor has “meaningful managerial control”. Efthimiou (2024) similarly portrayed foreign direct investment as a “long-term investment relationship” establishing stable ties between the investor and the host enterprise. Iwueke *et al.* (2018) echo standard formulations by describing FDI as a foreign investor acquiring a “lasting interest” in a firm outside its home economy. Alfaro and Chauvin (2017) highlighted the ownership threshold for control, noting that foreign direct investment typically involves a foreign firm taking a controlling stake in a local affiliate – often defined as at least 10% of equity or voting shares. Behera *et al.* (2023) similarly cite UNCTAD's phrasing of foreign direct investment as investment “reflecting lasting interest and control” by the foreign investor in the host enterprise. Each of these definitions emphasizes that, unlike passive portfolio flows, foreign direct investment entailed active management and a sustained inter-firm relationship. Official guidelines likewise require a minimum equity stake (commonly 10%) to classify a cross-border investment as foreign direct investment, reflecting the notion that such a stake confers significant influence. Together, these conceptions frame foreign direct investment as a strategic foreign equity placement entailing enduring ownership and decision-making rights for the overseas parent. In other words, foreign direct investment is defined primarily by its permanence and control dimensions, ensuring the foreign investor's ongoing influence over the overseas affiliate's operations.

Economic Growth Rate

Economic growth is broadly understood as the sustained increase in an economy's output over time. In practice, it is measured by the rate of growth of real gross domestic product (GDP) or GDP per capita (Callen, 2025; Wang, & Qiao, 2022). For example, *Britannica* defines growth as “the

process by which a nation's wealth increases over time" (Cornwall, 2025) and the International Monetary Fund [IMF] (2025) noted that the real GDP growth rate is commonly used as "an indicator of the general health of the economy". Theoretical growth models trace output expansion to factor inputs and productivity: physical and human capital accumulation, labor/population dynamics, and technological progress each play roles. Empirical literature emphasized that many factors have been identified as "potential growth determinants" Jordà et al. (2022). In fact, one review observes that in recent decades much of the rapid growth in developing countries owes to "catching up with the technological frontier" (Rodrik, 2020). Growth's role in development is that rising output can raise incomes and living standards, but it is not synonymous with development. As Britannica explains, "economic growth" (rising per-capita income) is typically distinguished from broader "economic development," which also involves structural and welfare improvements (World Bank, 2023). Thus, growth is a necessary engine of development but needs complementary policies (education, infrastructure, institutions) to translate output into broader progress. In natural-resource economies, swings in sectoral output can directly drive GDP: for example, World Bank analysts note that higher oil-sector production "accelerates" overall economic growth.

Exchange Rate

Exchange rates are essentially currency prices: they are "the relative price of one currency against another". In practice, nominal rates (USD per EUR, etc.) are often adjusted for inflation differences (yielding the real exchange rate) or combined into trade-weighted indices to gauge competitiveness. Exchange-rate determination is rooted in macroeconomic fundamentals: purchasing-power parity suggests inflation differentials will equilibrate long-run currency values, while uncovered interest parity ties interest-rate differentials to expected currency moves. Domestic growth, trade balances, commodity terms-of-trade and fiscal positions also influence currency value. For instance, high domestic inflation or large deficits tend to weaken a currency, while robust exports or interest-rate hikes strengthen it. Stavrakeva and Tang (2020) find that roughly 70% of quarterly exchange-rate variation can be explained by macroeconomic news shocks and currency risk-premium shift. Other frameworks propose an "equilibrium" exchange rate concept: Kiriev and Leonidov (2019) define it as a rate that remains stable relative to fundamental economics.org. In these models the "fundamental" rate is often taken in real-effective terms (trade-weighted and inflation-adjusted) consistent with a country's productivity and trading-partner price levels economics.org. Broad global forces also loom large: world interest-rate cycles, capital-flow waves or commodity-price swings can swamp domestic drivers. Domestic policy matters too: a surprise rate cut typically weakens the currency, whereas fixed vs. floating regimes and interventions determine how freely rates move. Chen et al. (2024) document tight connectedness between oil prices and currencies in oil-exporting countries. Thus, a depreciation in an oil-exporter's currency raises local-currency oil revenues (oil being dollar-priced) and thereby directly boosts the oil sector's output.

Oil Industrial Sector Output

The "output" of the oil industry is variously defined in the literature depending on context. Economists often treat oil-sector output as the gross value or export earnings from petroleum activities; for example, Salaludeen (2023) measured Nigeria's oil-sector output by the value of its oil exports (billions of naira), reflecting its role in GDP and foreign exchange. Engineers and sector analysts, by contrast, quantify output physically – e.g. the volume of crude oil (barrels per day) or gas (standard cubic feet) produced. Idowu (2019) noted that an upstream producer's "output" is

typically measured in barrels of oil per year (or per day) and in cubic feet of gas. At the global level, oil output is tracked in millions of barrels per day; Hacquard *et al.* (2019) reported that world oil production had reached roughly 100 million b/d by 2018. Analysts also emphasized how output links to macro factors. For instance, Jia *et al.* (2021) showed China's oil-industry output rises and falls strongly with international oil prices. Downstream refining is likewise part of “oil output”: U.S. refineries, for example, produce about 6% more liquid product volume than crude input (“processing gain”). In sum, authors characterized oil-sector output broadly as the total production of crude, gas and petroleum products by the oil and gas industry – measured either in physical units or in value terms – and note that it is a key driver of both national and global economies.

Empirical Review

Adigun (2024) examined the impact of oil price undulation and trade openness on industrial output in Nigeria. The study adopted ARDL estimation and Co-integration test. The correlation matrix result showed that, most of the values are very low and the correlation between exchange rate and industrial output is very high with 0.95. The coefficient of trade openness (TOPEN) showed that, it has a non-significant positive effect on industrial output in the short-run, indicating a 1percent increase in trade openness will reduce by 0.373394. So, the study recommended that, all the problems confronting the nation's industrial sector should be tackle headlong. Alao and Payaslioglu (2021) documented the interdependence of oil price volatility on industrial production of emerging oil-exporting economies - Brazil, Mexico and 35 OECD countries (as proxy for the world). The study used dynamic conditional correlation, “generalized autoregressive conditional heteroskedasticity (DCC-GARCH) and corrected, cDCC-GARCH models for symmetric estimation and employs GJR-GARCH for asymmetric estimation. Bry and Boschan (1971) monthly (BBM) nonparametric dating for peaks and troughs of business cycles were obtained for industrial production of the countries under study. Results from DCC and cDCC parameters reveal that the dynamic linkages between oil price and industrial production (IP) in Brazil in Brazil and Mexico persistently co-move and the interdependence between oil price and IP of the world is temporary.

Sade *et al.* (2021) examined the relationships between trade openness and manufacturing sector output in 12 selected countries in West Africa. from 1980 to 2019. The study used panel data series as well as Dynamic Ordinary Least Square (DOLS) and Fully Modified Ordinary Least Square (FMOLS). The result revealed that all the coefficients are positively associated and significant with manufacturing sector output except for trade openness that is not significant and inflation rate is negatively significant. Ikpe *et al.* (2020) provided answer to the question of whether trade liberalisation policy enhances non-oil export trade in Nigeria. The study adopted an Autoregressive Distributed Lag model approach to the analysis of the impact of trade liberalisation policy on non-oil export trade. Evidence provided support for trade liberalisation policy as the growth driver for non-oil export, a sector that exports more but earns little in terms of revenue. As a result, the study recommends a well-thought-out public–private partnership arrangement for the efficiency of the private sector (a major player in non-oil export trade), to optimally harness the benefits of liberalisation in Nigeria's non-oil trade sub-sector. Emerenini and Ohadinma (2019) focused on the impact of trade liberalization on the manufacturing sector of the Nigerian economy for the period 1980 to 2016. The findings from the ECM analyses show that the short run effect of trade openness, exports and balance of payment have negative relationships with manufacturing output while the short run effects of exchange rate and imports exerts positive relationship with manufacturing output with only imports and exports being significant.

Akinwale and Oludayo (2019) investigated the effect of industrial policy on industrial sector productivity. The study adopted secondary data from Central Bank of Nigerian Statistical Bulletin which covered the period of 1986 to 2017 and analyzed using Augmented Dickey Fuller Unit Root Test, Johansen Co-integration and Error Correction Model. The result of the error correction model showed that trade openness produced insignificant and negative effect on industrial output. Also, the result showed that exchange rate had statistically insignificant and positive effect on industrial output. Effiong *et al.* (2019) investigated the nexus between globalization, foreign direct investment and industrial sector performance in Nigeria. The econometric approach involving unit root tests, co-integration test and error correction model was adopted to analyze the time series data from 1981 to 2017. The findings revealed that FDI has a direct relationship with the Nigerian industrial sector, and globalization exerts a positive impact on industrial sector performance. Muhammad (2019) examined the relationship between trade liberalisation and the dwindling fortune of textile industries in Nigeria. The analysis involved data of four years before trade liberalisation 1993 to 1996. These financial data were compared with data of four years during the period of trade liberalisation 1997 to 2000. Through this analysis, a trend emerged which supported the argument of the devastating effect of trade liberalisation to the fortune of textile industry in the country. The study recognised that the adoption of the neoliberal policies by Nigeria brought about low sales, low profit, low dividend and share.

Adofu and Okwanya (2017) examined the effect of trade openness and total factor productivity on industrial output in Nigeria from 1981 to 2015. The study employed the VAR model in estimating the effect of trade openness on industrial output. The results showed that trade openness has a positive increasing effect on industrial output in Nigeria while the effect of total factor productivity on industrial output is found to be insignificant. The impulse response function showed over the long run period tff negative effect on industrial output in Nigeria. Also, Adamu and Doğan (2017) examined the long-run and short-run relationship between industrial production and trade openness in Nigeria during the period from 1986 to 2008 by using quarterly data. They employed the ARDL bounds testing methodology developed by M. Hashem Pesaran, Yongcheol Shin, and Richard J. Smith (2001). The results of both the long-run analysis and the short-run error correction model (ECM) indicated that trade openness has a significant and positive impact on industrial production. The Toda-Yamamoto causality analysis showed that there is one-way Granger causality, running from trade openness to industrial production.

Agbionu and Onwochei (2017) examined the performance of Multinational Manufacturing companies in Nigeria between 1990-2015. This study was anchored on Adam Smith theory of Absolute Advantage, an econometric model was developed and an Ordinary least square (OLS) method was used for estimate of parameter by conducting regression analysis. The result of the findings revealed that there is a significant positive relationship between Balance Payment (BOP), Export (EP), Import (IP) and the Contribution of Multinational Manufacturing companies to Gross Domestic Product (GDP). In another study, Ojeyinka and Adegboye (2017) examined the impact of trade liberalization on performance in the Nigerian economy, with special reference to agricultural and manufacturing sectors. Simultaneous models were developed to capture the joint effects of trade liberalization on the two sectors. The Generalized Method of Moment technique was used to estimate the role of trade liberalization on the performance of the selected sectors. The study showed a significant positive impact of trade liberalization on the output of agricultural sector while a negative but significant relationship exists between measures of trade liberalization and manufacturing output in Nigeria.

Okoye *et al.* (2016) examined the effect of the economic liberalization policy on the performance of the industrial sector in Nigeria over the period 1986-2014 which was analyzed using econometric technique based on the Vector Error Correction Model. The study showed that rate of change in exchange rate, trade openness and lending rate exert significant negative impact on industrial output. There was also evidence of significant positive impact of financial deepening on industrial output. The study recommended that government seeks to achieve an investment-friendly climate. While Ogu *et al.* (2016) examined the role of trade liberalization in the growth of manufacturing output in Nigeria as Data for the period 1980 to 2013 was obtained from CBN and WDI, with which parameter estimated was extracted for the short to medium term using the error correction mechanism. Trade liberalization was found to hurt manufacturing output in the short run although it showed a real potential to boost it in the long term. An overhaul of competition policy was recommended. Riti *et al.* (2016) examined the growth of Non-oil sector to act as a key to diversification and performance of the economy. they employed the tool of Auto-regressive Distributed Lag (ARDL) and VECM Granger causality model and found that the long run parameters indicated that agriculture and telecommunication components are positively contributing to GDP, manufacturing components turned out negative though significant.

Theoretical Framework

This study is hinged on Heckscher-Ohlin theory which was introduced by Eli Heckscher first in his 1919 paper while in 1933 Bertil Ohlin expanded and formalized the theory in his book "Interregional and International Trade". The Heckscher-Ohlin theory posited that countries will export goods that use their abundant and cheap factors of production, and import goods that use scarce factors. In oil-rich nations, trade liberalization allows these countries to specialize and export oil-based products, leveraging their natural resource endowment.

Methodology

One of the models used for examining manufacturing output is the production function, particularly the Cobb-Douglas, which is given by:

$$X = AK^{\alpha}L^{(1-\alpha)} \quad (1)$$

X , K , L , and A represent output, capital, labor, and total factor productivity, respectively. Eq. (1) can be expressed in intensive form:

$$x = AK^{\alpha} \quad (2)$$

Nature and Sources of Data

The study spans 1981 to 2022 and uses time series data for Nigeria. The impact of trade liberalization on Nigeria's Nigerian oil manufacturing sector output is examined. The data on oil manufacturing output (OMO) (measured as oil components of total manufacturing output), foreign direct investment (FDI) (measured as Foreign direct investment, net inflows % of GDP), Economic Growth (GDPG) (GDP, constant 2015 US\$ growth rate) Exchange rate (EXR) (measured as Official exchange rate (Naira per US\$, period average)), and Trade Liberalization (TRL) (Trade (total import plus export) % of GDP) FDI is sourced from World Development Indicators (WDIs) of the World Bank, while other variables were sourced from the CBN annual statistical bulletin. The period 1981 to 2022 was the only available data that justifies the use of the period.

Method of Data Analysis

Shin et al. (2014) used the asymmetric ARDL cointegration technique, which involves the breakdown of positive and negative partial sums. This method allows the detection of asymmetric impacts in both the long-run and short-run periods (Ibrahim, 2015 Abd; Ullah & El-Rasheed, 2021). The asymmetric ARDL specification enables the simultaneous analysis of non-stationarity and nonlinearity using an error-correcting model. Additionally, it has the benefit of being applicable regardless of the integration order of the variables, whether they are integrated of order 0 (I (0)), order 1 (I (1)), or a combination of both. This allows for statistical inferences to be made on long-term estimations. These are not achievable using alternative methods of cointegration analysis. However, like the traditional ARDL method, the asymmetric ARDL cointegration methodology is not applicable when I (2) series are present. The asymmetric autoregressive distributed lag (ARDL) model is an innovative method to identify nonlinearities by examining the differences in long-term and short-term asymmetries within economic series. This is an extension of the traditional ARDL concept. The asymmetric autoregressive distributed lag (ARDL) model is more effective in identifying cointegration in small sample sizes, as demonstrated in our study (Shin et al., 2014).

Model Specification

Following Abdullah & El-Rasheed (2021), the paper derived an asymmetric ARDL framework from the conventional ARDL as follows:

$$\ln OMO_t = \beta + \delta_1 \ln OMO_t + \delta_2 TRL_t + \delta_3 FDI_t + \delta_4 GDPG_t + \delta_5 EXR_t + \mu_t \quad (3)$$

$\ln OMO_t$ is the natural log of oil manufacturing sector output, TRL is trade liberalization, FDI is foreign direct investment, $GDPG$ is economic growth rate and EXR means exchange rate. Subscript t is the period, and u is a stochastic error term. Now, the empirical model for the ARDL is driven by equation 3:

$$\begin{aligned} \Delta \ln OMO_t = & \alpha_0 + \sum_{i=1}^p \sigma_1 \Delta \ln OMO_{t-i} + \sum_{i=0}^q \sigma_2 \Delta TRL_{t-i} + \sum_{i=0}^r \sigma_3 \Delta FDI_{t-i} + \sum_{i=0}^s \sigma_4 \Delta GDPG_{t-i} \\ & + \sum_{i=0}^t \sigma_5 \Delta EXR_{t-i} + \vartheta_1 \ln OMO_{t-1} + \vartheta_2 TRL_{t-1} + \vartheta_3 FDI_{t-1} + \vartheta_4 GDPG_{t-1} + \vartheta_5 EXR_{t-1} \\ & + \mu_t \end{aligned} \quad (4)$$

Equation 4 clearly expressed the short-run and the long-run coefficients. Δ is a first difference operator. α_0 is constant. $\sigma_1, \sigma_2, \sigma_3, \sigma_4$ and σ_5 are short run estimates coefficients while $\vartheta_1, \vartheta_2, \vartheta_3, \vartheta_4$ and ϑ_5 represent the long run estimates. μ is the stochastic error term. TRL is decomposed into increasing and decreasing partial sums.

$$TRL_t = TRL_0 + TRL_t^+ + TRL_t^-$$

The partial sum for the positive and negative changes in TRL is generated using the following formula.

$$TRL_t^+ = \sum_{i=0}^1 \Delta TRL_t^+ = \sum_{i=0}^1 \max(\Delta TRL_i, 0)$$

$$TRL_t^- = \sum_{i=0}^1 \Delta TRL_t^- = \sum_{i=0}^1 \max(\Delta TRL_i, 0)$$

As in the conventional ARDL, the first part with the change symbol is used to analyze the short-run short-run asymmetric relationship, and the second is for the long-run long-run relationship. The long-run asymmetric impact can be tested using the Wald test by evaluating the Null hypothesis for an asymmetry. $H_0: \vartheta^+ = \vartheta^-$. The alternative is $H_1: \vartheta^+ \neq \vartheta^-$.

Empirical Results and Discussions

This section starts with some pre-estimation tests.

Table 1: Descriptive Statistics

	OMO	TRL	EXR	FDI	GDPG
Mean	95.83191	29.13479	115.7410	1.238031	3.165188
Median	25.43834	30.53415	115.2551	1.078745	3.423656
Maximum	412.3001	55.02128	425.9811	4.282088	15.32916
Minimum	0.045442	7.522695	0.610025	-0.039522	-10.92409
Std. Dev.	119.1179	11.29225	119.1411	0.950780	4.955367
Skewness	1.042634	-0.059330	1.021358	0.911567	-0.410660
Kurtosis	2.952647	2.385797	3.221266	3.700421	3.929340
Jarque-Bera	7.613525	0.684819	7.387882	6.675211	2.691917
Probability	0.022220	0.710057	0.024874	0.035522	0.260290

Source: Author's Compilation

Non-oil manufacturing sector output (OMO). The average value (mean) of OMO is 95.832, with a widespread indicated by the high standard deviation of 119.118. The distribution is positively skewed (1.043) and exhibits heavy tails (kurtosis: 2.953). The Jarque-Bera test rejects the assumption of normality (statistic: 7.614, p-value: 0.022). Trade Liberalization (TRL). TRL has a mean of 29.13479 and a relatively low standard deviation of 11.29225. The distribution is approximately symmetric (skewness: -0.059330) and mesokurtic (kurtosis: 2.385797). The Jarque-Bera test does not provide evidence to reject normality (statistic: 0.684819, p-value: 0.710057).

Foreign direct investment (FDI). FDI exhibits a mean of 1.238031 and a positive skewness of 0.911567. The distribution has higher kurtosis (3.700421), indicating heavier tails. The Jarque-Bera test rejects the assumption of normality (statistic: 6.675211, p-value: 0.035522). GDP growth rate (GDPG). GDPG has a mean of 3.165188; the standard deviation is 4.955367, indicating moderate variability. The distribution is slightly negatively skewed (skewness: -0.410660) and has a kurtosis of 3.929340. The Jarque-Bera test does not reject the normality assumption (statistic: 2.691917, p-value: 0.260290). Exchange rate (EXR). EXR has a mean of 115.7410, with a substantial standard deviation of 119.1411, suggesting wide variability. The distribution is positively skewed (skewness: 1.021358) and has a kurtosis of 3.221266. The Jarque-Bera test rejects the assumption of normality (statistic: 7.387882, p-value: 0.024874).

Table 2: Correlation Analysis

	OMO	TRL	EXR	FDI	GDPG
OMO	1.000000 -----				
TRL	0.121655 0.4428	1.000000 -----			
EXR	0.466616 0.0018	0.013554 0.3321	1.000000 -----		
FDI	0.129735 0.4129	0.278027 0.0746	-0.142731 0.3672	1.000000 -----	
GDPG	0.284448 0.0679	0.438218 0.0037	0.109603 0.4896	0.364519 0.0176	1.000000 -----

Source: Authors Compilation

Table 2 presents the results of the correlation analysis conducted to examine the possibility of multicollinearity among the independent variables. None of the series appears to be up to 0.80. Therefore, all the series can be in the same equation.

Table 3: Unit Root Test Results (ADF)

Null Hypothesis: The variable has a unit root

		<u>At Level</u>				
		OMO	TRL	EXR	FDI	GDPG
With Constant	t-Statistic	-1.1777	-2.5348	2.8640	-3.7213	-2.9550
	Prob.	0.6750	0.1149	1.0000	0.0073	0.0480
		no	no	no	***	**
With Constant & Trend	t-Statistic	-2.9215	-2.4567	0.0981	-3.6467	-2.6821
	Prob.	0.1680	0.3468	0.9962	0.0380	0.2490
		no	no	no	**	no
Without Constant & Trend	t-Statistic	-0.8668	-0.3710	4.7193	-2.0610	-1.8953
	Prob.	0.3344	0.5445	1.0000	0.0391	0.0562
		no	no	no	**	*
		<u>At First Difference</u>				
		d(OMO)	d(TRL)	d(EXR)	d(FDI)	d(GDPG)
With Constant	t-Statistic	-6.0883	-8.5849	-4.2120	-9.8509	-10.1978
	Prob.	0.0000	0.0000	0.0019	0.0000	0.0000
		***	***	***	***	***
With Constant & Trend	t-Statistic	-6.2204	-8.6043	-4.9358	-9.8646	-10.2767
	Prob.	0.0000	0.0000	0.0014	0.0000	0.0000
		***	***	***	***	***
Without Constant & Trend	t-Statistic	-6.1672	-8.6800	-3.4674	-9.9804	-10.2842
	Prob.	0.0000	0.0000	0.0010	0.0000	0.0000
		***	***	***	***	***

Source: Authors Compilation

Notes: a: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant. b: Lag Length based on SIC. c: Probability based on MacKinnon's (1996) one-sided p-values.

Table 3 presents the ADF unit root test results. Only GDPG and FDI were found to be significant at this level. Therefore, the two are I (0), while OMO TRL and EXR are I (1) because they were found significant only after the first difference.

Table 4: BDS Test for OMO

Sample: 1981 2022

Included observations: 42

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
2	0.166246	0.011191	14.85535	0.0000
3	0.275793	0.017938	15.37510	0.0000
4	0.339255	0.021546	15.74574	0.0000
5	0.369761	0.022657	16.31980	0.0000
6	0.378559	0.022051	17.16727	0.0000

Source: Authors Compilation 2024

Table 5: BDS Test for TRL

Sample: 1981 2022

Included observations: 42

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
2	0.106490	0.008257	12.89674	0.0000
3	0.175022	0.013295	13.16489	0.0000
4	0.209386	0.016036	13.05752	0.0000
5	0.222048	0.016931	13.11463	0.0000
6	0.219391	0.016544	13.26114	0.0000

Source: Authors Compilation, 2024

Brock, Dechert, and Scheikman (1996), otherwise known as the BDS test, examines the nonlinearity properties of the dependent variable and the independent variable of interest. The results in Tables 4 and 5 indicate evidence of nonlinearity, evidenced by the significant probability values. This is true for both the dependent variable and the independent variable of interest.

Table 7: NARDL Bounds Test

F-statistics	3.972*		5%		1%	
	10%					
Sample Size	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
35	2.331	3.417	2.804	4.013	3.900	5.419
40	2.306	3.353	2.734	3.920	3.657	5.256
Asymptotic	2.080	3.000	2.390	3.380	3.060	4.150

Source: Authors Compilation, 2024

Note: * signifies significance at 10 % while I(0) and I(1) are the stationary and non-stationary bounds, respectively.

Table 7 presents the NARDL Bounds test. The F-statistics at 3.972 signifies cointegration at the 5 % level. This is because the F-statistics is higher than the two bounds (upper and lower) at the 5% level when the asymptotic sample size is considered. The paper, therefore, proceeds to estimate the long-run and short-run coefficients.

Table 8

NARDL RESULTS

	Short-Run Results			Long-Run Results	
	Coefficient	Std. Error		Coefficient	Std. Error
COINTEQ*	-0.341	0.084***	Constant	0.167	50.253*
ΔTRL^+	1.276	0.091*	TRL^+_{t-1}	2.607	2.351*
ΔTRL^-	0.886	1.264	TRL^-_{t-1}	-10.471	-3.153
ΔFDI	0.119	0.024	FDI_{t-1}	22.872	22.505
$\Delta GDPG$	-0.017	1.619	$GDPG_{t-1}$	-0.051	4.746**
ΔEXR	-1.269	0.308*	EXR_{t-1}	0.009	0.006
Adjusted R-squared	0.385				
F-statistic	7.516***				
Breusch-Godfrey Serial Correlation LM Test			0.331		
Heteroskedasticity Test: Breusch-Pagan-Godfrey			0.428		

Note: ***, **, * signify significance at 1, 5, and 10 percent while $I(0)$ and $I(1)$ are the stationary and non-stationary bounds, respectively.

Since cointegration is at 1%, the paper did not present the critical values at 5% and 10%.

Applying the Non-linear Autoregressive Distributed Lag (ARDL) framework to the study of the impact of trade liberalization on oil manufacturing output in Nigeria provides nuanced insights into the short-run and long-run interactions between these key economic variables. The findings, as presented in Table 8, unravel the intricate relationships that shape dynamics. In the short run, the significant coefficient of the error correction term (COINTEQ) at -0.341 implies a moderate short-run adjustment mechanism. It indicates deviations from long-run equilibrium in the variables (TRL, FDI, GDPG, EXR) are corrected in the short run with about 34% speed within a year, influencing the non-oil manufacturing sector output (NOM).

Positive changes in TRL significantly stimulate oil manufacturing output (OMO). In contrast, negative changes do not significantly impact either the short or the long run. This implies that a policy promoting trade liberalization has an immediate positive impact on oil manufacturing output. However, only the opposite change in TRL improves OMO. Specifically, a negative change in trade liberalization has no impact on OMO. The positive impact of TRL on oil manufacturing output is in line with the works of Hu and Liu (2014) for China and Jongwanich and Kohpaiboon (2017) for Thailand.

FDI positively impacts OMO but is not statistically significant in the long run. This implies that FDI does not influence OMO in both the long and short run. On the other hand, the GDP growth rate has a positive and significant impact on NOM only in the long run. This means improving GDP can improve oil manufacturing output in Nigeria, at least in the long run. An increase in the exchange rate (depreciation) will reduce oil manufacturing output in the short run. This is in line with expectations because an increase in the exchange rate (depreciation) is expected to increase the prices of imported equipment used by the manufacturing sector. Therefore, this is expected to have a negative impact on the non-oil manufacturing sector.

The model diagnostics reinforce the validity of the analysis. The adjusted R-squared (0.385) highlights the model's ability to explain approximately 38.5% of the variation in the dependent variable. The significant F-statistic (7.516) attests to the overall statistical significance of the model, providing confidence in the reliability of the findings. Additionally, the absence of serial correlation, as indicated by the insignificant Breusch-Godfrey Serial Correlation LM Test (0.331), suggests that the residuals do not exhibit systematic patterns over time. The Heteroskedasticity

Test (Breusch-Pagan-Godfrey, 0.428) further indicates no evidence of heteroskedasticity in the residuals, supporting the reliability of the model's standard errors.

Table 6: Coefficient symmetry tests

Variable	Statistic	Value	Probability
Long-run			
TRL	F-statistic	6.290629	0.0178
	Chi-square	6.290629	0.0121
Short-run			
TRL	F-statistic	0.673534	0.0183
	Chi-square	0.673534	0.0118
Joint (Long-Run and Short-Run)			
TRL	F-statistic	3.591313	0.0400
	Chi-square	7.182625	0.0276

Source: Authors Compilation

Table 6 presents the symmetry test to determine the appropriateness of conducting a non-linear ARDL estimation. The results, evidenced by the significant p-values, rejected the null hypothesis on symmetry. Therefore, the decision to use NARDL is appropriate.

Stability Test

To test for the stability of the model, the paper conducted a stability test using the CUSUM Squares, and CUSUM presented in figures 1 and 2 below:

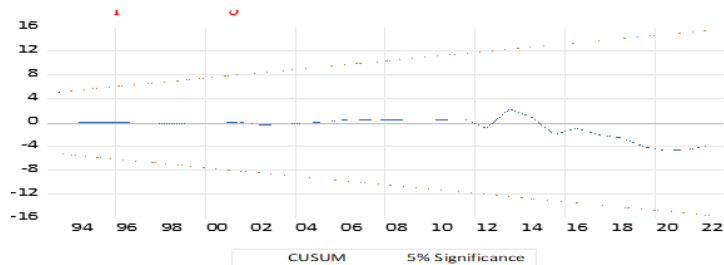


Figure 1: CUSUM

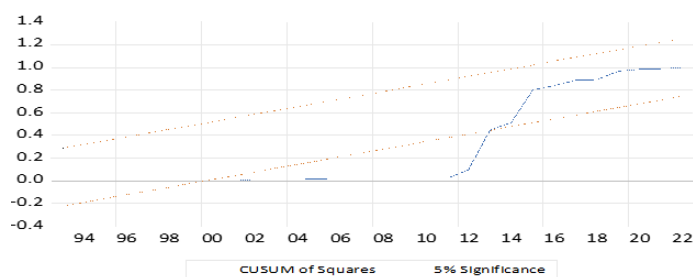


Figure 2: CUSUM of Squares

According to Figure 1, the model is stable, as the line lies within the 5% confidence interval. However, the CUSUM of squares does not lie within the 5% confidence interval, signifying a possible structural break in the series of interest.

Conclusion

The findings of this study shed light on the intricate dynamics of the oil manufacturing sector output in Nigeria, with a specific focus on the impact of trade liberalization. The comprehensive analysis utilizing the Non-linear Autoregressive Distributed Lag (NARDL) framework has provided nuanced insights into short- and long-run relationships among key economic variables. The evidence suggests that positive changes in trade liberalization, as reflected in positive changes in trade liberalization, play a pivotal role in influencing the output of the oil manufacturing sector.

Furthermore, the observed adjustments in the error correction term (COINTEQ) emphasize the presence of a robust mechanism for correcting deviations from long-run equilibrium. This implies that policy interventions aimed at aligning trade liberalization with long-term equilibrium have an immediate impact on steering the oil manufacturing sector toward sustained growth. GDP growth rate also exhibits a long-run impact on oil manufacturing output. This underscores the need for targeted and sector-specific policies to optimize the benefits of economic growth.

Recommendations

Given the positive impact of positive change of trade liberalization on the non-oil manufacturing sector output, policymakers should prioritize initiatives that strengthen and expand trade liberalization policies. This involves reducing trade barriers, streamlining customs procedures, and actively participating in regional and international trade agreements. Such measures can contribute to a more immediate and sustained boost in economic activity within the non-oil manufacturing sector. Maintaining stability in exchange rates is crucial for the short-run performance of the non-oil manufacturing sector. Policymakers should implement measures to minimize currency volatility and enhance economic stability. A stable exchange rate environment will provide manufacturers with a predictable economic landscape, encouraging investment and production.

While overall economic growth contributes modestly to manufacturing output in the short run, policymakers should consider implementing targeted policies to stimulate the non-oil manufacturing sector. This may involve providing financial incentives, creating specialized industrial zones, and supporting research and development initiatives to enhance productivity and innovation within the sector.

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10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

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TRANSPORTATION IN THE ERA OF FUEL SUBSIDY REMOVAL: AN ASSESSMENT OF THE COST IMPLICATION IN BENUE STATE, NIGERIA.

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Abstract

The cost of transportation in Benue State and Nigeria at large has progressively skyrocketed along road links with a constellation of adverse economic forces following suit, in the wake of fuel subsidy removal. This study examines the remote and proximate causes of this increasing transport cost against the background of the implications for inflation in the cost of consumable goods and services, relative to livelihood of the masses in Benue State. A sample size of three major roads cutting across the three senatorial districts of the state comprising Gboko to Makurdi, Gboko to Katsina-Ala and Gboko to Oturkpo roads was purposively selected, on which 120 structured questionnaires were administered on commuters and commercial vehicle operators. Similarly, four other destinations cutting across the north, Middle belt, Southwest and South-South, Kano, Jos, Lagos and Calabar to which Benue people travel were also administered questionnaire. Trends and Time series Analysis as well as frequency distribution and simple percentages were employed in data analysis while Pearson correlation statistics was used in testing hypotheses. Results revealed that the rising cost of transportation is significantly correlated with the rise in fuel pump price. The results also revealed that the arbitrary rise in transport services has translated to skyrocketing prices of consumable goods, which in turn has phenomenally bastardized livelihood thereby intensifying poverty among Benue people. This study recommends the immediate revival of the four refineries to restore local refining of petroleum. The study also recommends alternative sources of energy to power vehicles in Nigeria.

Keywords: Transportation, Fuel subsidy, Transport cost, Transport fare, Inflation, Poverty.

Introduction

The phenomenon of moving people, goods and services from one location to another along road within geographical spaces and time of Earth's surface reference is substantially rooted in the efficacy with which producers of transportation services are configured. According to Akpan and Uford (2024) transportation is central to all productive activities from their initial stages of planning through actual production and eventual delivery at the doorsteps of consumers, which completes the production process. It is therefore no exaggeration to state that all daily socioeconomic routines of the human society made up of the teeming world population of 8.9 billion as at November 2024, which is still counting, take their bearing from transportation along roads, which in turn, rests upon a delicate balance of energy supply from petroleum sources, (Asaasuen et al, 2024; Sharma et al, 2024).

Globally, road transportation plays tremendous roles in the run up to economic advancements. For instance, within the agricultural, mining and industrial sectors of society, both inputs and outputs flow depend directly on transportation architectures for their smooth running. In the same vein, the administrative segment, which is the main coordinating body that organizes all productive activities, operates largely on the configuration of road transportation system. This according to Shi et al (2024) explains why China and other world industrial giants are aggressively investing in road transportation architectures comprising roads, under passes and fly over as well as bus services to commuters.

In Africa, road transportation has made positive impacts on economic development of countries. This fact is attested to by Pouyi et al (2024) in their study on the impact of road infrastructure and economic growth in the Central African nation of the Republic of Congo, in which they found that roads in rural areas contribute greatly in boosting agriculture among farming communities and providing critical links to the urban centers for free flow of agricultural and industrial goods and services. Over North Africa, historical perspectives on economic development show that such settlement areas like Ghat, Gao, Awdaghost and Kano in the present-day Libya, Mali, Ghana and Nigeria respectively have developed into full-fledged towns and cities due to their strategic location on the great Trans-Saharan trade route, which was essentially a road link in North Africa where exchange of petty goods, loading and offloading of Caravan caravans took place. These contribute enormously to the development of Kanem-Bornu, Ghana, Mali and Songhai empires accordingly, (Lydon, 2005; Peribam, 2009 Anderson, 2022).

In Nigeria, notwithstanding the greater benefits associated with road transportation, which are inherent in contemporary civilization, the federal government unilaterally and ironically announced complete removal of fuel subsidy on the 29th May 2023 on account of development deficiencies, (Olaniyi et al 2023; Abaekih & Somkenechi, 2024). This unpopular economic policy coupled with the poor and dilapidating nature of roads in many parts of the country has greatly constrained road transportation with lots of adverse socioeconomic impacts that call for an empirical study. It is against the scenario of increasing transportation fare on daily basis in Benue State in the wake of petroleum subsidy removal that this study undertakes an empirical investigation to get to the root cause of what has translated to enormous cost in the economic fortunes of the Nigerian masses.

Statement of the Problem

Since the 29th of May 2023, when the government of President Bola Ahmed Tinubu came on board, there have been arbitrary increases in the cost of transportation services and a general rise in the cost of livelihood among average Nigerians and the low-income earners. This socioeconomic scenario of increasing hardship is particularly pronounced in Benue State where the population is substantially low-income farmers who earn a living through primitive agrarian practices. It is therefore imperative to get to the root of this problem that manifests in the form of petroleum subsidy of people from one place to another.

Objectives of the Study

- i. To identify the remote and proximate causes of increases in the cost of transportation services.
- ii. To examine the relationship between cost of transportation services and transportation fare.
- iii. To examine the impact of increasing transport fare on the prices of consumable goods and services.
- iv. To examine the links between cost of consumable goods and poverty levels.

Hypotheses

- i. Fuel subsidy removal has no significant impact on cost of transportation service in Benue State.
- ii. There is no significant relationship between cost of transportation services and transportation fare in the study area.
- iii. Transportation fare has no significant impact on the prices of consumable goods and services.
- iv. The prices of consumable goods have no significant links with poverty levels in Benue State.

Literature Review

In a study on the remote and proximate causes of skyrocketing cost of transportation, Sennuga et al (2024) reports that the Nigerian Scenario of increasing cost in the production of transportation services significantly bears on the phenomenal removal of petroleum subsidy. He studies, which anchored on the administration of 120 structured questionnaires in Niger State among Commercial drivers also notes that among the main issues raised by providers of transport services was fuel subsidy removal. Similarly, Eneji and Ugwuoke (2024) studied the effects of fuel subsidy removal in Cross River State using 280 structured questionnaires randomly administered on commercial transport operators and farmers. The study reports that the rising cost of transportation services significantly correlates with fuel subsidy removal in Nigeria which in turn translated to sharp increases in the pump price of Premium Motor Oil (petrol).

On increasing transportation fare, Adetayo (2018) studied the effects on fuel subsidy removal on transportation cost and fare in South Western Nigeria and reports that producers of transportation services incur increased cost in their efforts to make transportation available to commuters in the wake of subsidy removal. This development according to the study transcends to corresponding increases cost in their efforts to make transportation available to commuters in the wake of subsidy removal. This development according to the study transcends to corresponding increase in the

amount of money commuters eventually pay as transport fare. Furthermore, Ezeah and Abodunrin (2016) had earlier studied the strike staged by Nigeria Labour congress in the wake of fuel subsidy removal. The study which anchored on content analysis from purposively sampled Nigerian daily newspapers reports that majority of the newspaper reports covered extensive rejection of the subsidy removal as it translated to higher transport fares by commuters through increased fuel pump prices, which made commercial transport service operators comprising bus and taxi drivers as well as “Okada riders” to push fares for “drops” up.

On the phenomenal rise in transportation fares relative to prices of consumer goods and services, Okwa et al, (2024) studied the impact of fuel subsidy removal on consumer goods in selected states across Nigeria Using descriptive survey and the rentical state theory as bases for analyses. The study reports that the sharp rise in transport fares across Nigeria has translated to arbitrary increases in consumer goods including housing rent and essential commodities. Sharing the same view, Bojande et al (2024) and Ejime (2024) studied fuel subsidy removal in Benue and Tarata states respectively against the background of price indices in the market. The studies all report that there have been sharp rises in the prices of consumer goods in both market, shops and commercial joints, in which essential commodities have their selling price highly inflated.

On the other, this study also features fuel subsidy removal and its implication for poverty levels in the study area. In this wise, Tiza et al (2022) in their study on the role of transportation in economic development in Benue State found that transport services and petrol both have an inelastic status on the demand and supply side especially in Benue State where alternatives to them are not available. The study which anchored on Primary and Secondary data further reports that given the indispensable role of petrol as the major propeller, of transportation services and their functional link to daily routines, fuel subsidy removal has caused unprecedented like in transportation cost and rates which have increasingly siphoned the economic fortunes of Benue masses translating to higher magnitudes of poverty.

In a related study, Ozili and Obiara (2024) studied macro and micro effects of fuel subsidy removal in Nigeria using discourse analysis method and reports that the economic policy has heightened poverty levels through arbitrary rise in the prices of commodities resulting to hypher-inflation. Similarly, Ali et al (2024) in their study of long-term socioeconomic impact of fuel subsidy removal in Adamawa State, found and reports that fuel subsidy in Nigeria by the Tinubu-led administration has a triggered a constellation of adverse economic which act and react upon one another: The consequential rise in fuel pump price provokes increase in cost of transportation services, then leads to increase in wholesale and retail prices for consumer goods, which ultimately leads to sharp drops in incomes and economic fortunes and hence, more poverty.

The foregoing literature review features all manifest in the study area where increased cost of transportation service is rooted to fuel subsidy removal while hike in transport to fares are ascribed to increasing transport cost, while leads to sky rocketing prices of consumable goods and hardship in poverty intensification. This development, which spells out doom for the masses is seen as a deliberate policy to exploit the already poor masses of Nigeria thereby restricting them in a perpetual stat of poverty and hence weaken their stand on matters of national socio-political and economic interest. The widespread protest of January 2012 and 2024 by the masses against the fuel

subsidy removal policy during Goodluck Jonathan and Tinubu administration are spectacular reference points in respect of condemnation of the policy by the Nigerian general public, (Adeforiti, 2024).

Theoretical Framework

This study adopts the theory of price elasticity of demand formulated by Alfred Marshal in 1842 to 13th July 1924 and published the theory in his book entitled *Principles of Economics*, which was a leading textbook in Economics during his time. According to Fibich et al (2005), the basic tenant of the theory holds that demand for a product changes when prices change. But when prices change without corresponding shift in demand, the demand is described as inelastic. The phenomenal choice of this theory is based on the theory's content relative to the demand for petrol, whose demand is inelastic given increase in pump price due to fuel subsidy removal. Besides, the theory represents a critical analysis of the cost of producing transportation services which has skyrocketed in the wake of fuel subsidy removal.

Methods and Materials

This study sampled three (3) registered transportation companies: Benue Links, Index and Flight transport companies and administered 160 structured questionnaires on a total of eight (8) major roads within and outside Benue State, which are major destination cities of commuters among the masses of Benue State. The sample size was purposively selected to cut across the geopolitical zones of Nigeria and the three senatorial districts of Benue State. These include Kano, Jos, Lagos, Port-Harcourt, and Calabar, while Makurdi, Oturkpo and Katsina-Ala were respectively selected from the three senatorial districts of Benue Northwest, Benue Northeast and Benue South. These were each administered 20 questionnaires among travellers and drivers of the transport companies at their motor parks. The study used Trends, and Time series Analysis as well as Geographic information system (GIS) while person correlation was employed to test the four null hypotheses. Similarly, photo elicitation technique was employed to present a pictorial view of some of the issues raised here.

Results and Analysis

Demographic and socioeconomic profile of respondents

Data on the profile of respondents in above respect were collected and are presented in Table 1.

Table 1: Demographic and socioeconomic profile of respondents

Variables	Frequency	Percentage Cum %
Gender		
Male	128	80
Female	32	20
		100
Age		
20-30 years	17	10.62
31-40 years	33	20.62
41-50 years	42	26.25
51-60 years	54	33.75
61 and above	14	8.75
		99.99
Marital status		
Married	89	55.62
Single	42	26.25
Separated	29	18.22
		99.99
Education Level		
No formal education	19	11.87
Primary school	30	18.75
Secondary school	65	40.62
Tertiary	46	28.75
		99.99
Occupation		
Farming	40	25
Business	30	18.75
Civil service	64	40
Transport business	14	8.75
Commercial driver	12	7.5
		100

Source: Field Survey, November 2024

Table 1.1 indicates that 80 percent of the sampled respondents were male and 20 percent were made up of the female gender. The table also indicates that 10.62 percent of the sampled respondents were within the age bracket of 20 – 30 years while 20.62 percent within 31-40 years. Similarly, the table further indicates that 26.25, 33.75 and 8.75 percents of the sample's respondents were respectively within the age brackets of 41-50, 51-60 and 60 years and above. On marital status, Table 1.1 indicates that 55. 62 percent of the respondents were married, while 26.25 and 18.2 were respectively single and separated accordingly. Also, the table indicates that 11.87 percent of the sampled respondents had no formal education while 18.75, 40.62 and 28.75 percents had attained educational statuses of primary, secondary and tertiary levels respectively. On occupations Table 1.1 indicates that 25 percent of the sample population were farmers. 18.75 were into general business while 40, 8.75 and 7.75 percents were respectively engaged in the civil service, transportation business and commercial driving.

Testing of Hypotheses

Hypothesis 1: " Fuel subsidy removal has no significant impact on cost of transportation in Benue State.

Test of relationship between fuel subsidy removal and cost of transportations.

Table 2.1: Pump price of petrol at major filling stations (NNPC, Shafa & Rano) in Seleted towns of Benue State.

Location	2022	2024	increment	Increment in %
Gboko	165	1,070	905	648.48
K-Ala	170	1,100	900	647.05
Oturkpo	165	1,100	905	648.48

Table 2.1 indicates that before petroleum subsidy removal in 2022, fuel pump price per litre was ₦165 in Gboko and Oturkpo, while in Katsina-Ala, the product was ₦170.00 against the current pump price of ₦1,070 in Gboko, ₦1,100 in Kastina-Ala and ₦1,100 in Oturkpo in 2024. This reveals that there has been an increase in the pump price of 648.48, 647.05 and 648.48 in Gboko, Katsina – Ala and Oturkpo towns respectively which is significant. It is further to be noted that the above rates in the cost of road transportation service via the major marketers of NNPC, Shafa oil and Rano. The PMS of others dealers are usually higher, which implies that the rates are averagely above those in Table 2.1, which is derived from field study.

Consequent upon Table 2.1, the null hypothesis, which states that there is no significant link between the cost of transportation service in the study area and fuel subsidy removal is rejected in favour of its alternative version which holds that there is a significant link between cost of transportation service and fuel subsidy removal.

Hypothesis 2: There is no significant relationship between cost of transportation service and transportation fare in the study area.

Table 3.1: Transportation rates (fare) from Gboko to selected destinations across Nigeria before and after fuel subsidy removal operated by the sampled transport companies.

Destinations	2022 fare	2024 fare	Increament	Increament in %
Makurdi	500	2,000	1,500	400%
Kastina-Ala	500	Nil	Nil	Nil
Oturkpo	800	4,000	3,200	500
Kano	6,500	13,500	7,000	207.69
Jos	3,500	10,000	6,500	285.71
Lagos	11,000	20,000	9,000	181.81
P.Harcourt	6,000	16,500	10,500	275
Calabar	6,500	15,000	8,500	230.76

Source: Field survey, December 2024

Table 3.1 indicates that there has been an increase in transportation from Gboko to Makurdi, which is 400 percent due to petroleum subsidy removal. The table similarly reveals that the transportation fare from Gboko to kastina-Ala stopped after 2022, while from Gboko to Oturkpo has accordingly increased by 500 percent. In the same vein, the table reveals that transport from Gboko to destinations outside Benue State including Kano, Jos and Lagos in the North, Central and Southwestern Nigeria have respectively risen by 207.69, 285.71 and 181.81 percent. The table again indicates that, transportation fares from Gboko to Port-Harcourt and Lagos have likewise skyrocketed by 275 and 230.76 percent respectively following fuel subsidy removal. Thus, there is a strong positive association between the cost of transportation service and transport fare. Therefore, the null hypothesis, which states that there is no significant relationship between the cost of transportation service and transport fare is hereby rejected and its alternative form that there is a significant relationship between the cost of transportation service and transport fare is accordingly upheld.



Figure 1: Commuters at Benue Links Booking Office Gboko, Benue state



Figure 2: Commuters booking for various destinations at Benue Links Office, Gboko.

Source: Field survey, December 2024.

Hypothesis 3: Transportation fares have no significant impact on the prices of consumable goods and services.

Table 4.1 Impact of transportation fare on prices of consumable goods

Commodities	2022 prices	2024 prices	Increase ₦	Percentage
Half bag of Gari	4,000	26,000	22,000	650
25 kg rice	22,000	41,000	19,000	186.36
1 tin, Beans	5,000	38,000	33,000	760
Half carton, frozen fish	10,000	36,000	26,000	380
1 carton Noodles	2,500	7,000	4,500	280
Cooking Gas (12 kg)	3,700	17,000	13,300	459.45
10 tuber yam	4,000	12,000	8,000	300
Electricity bill, 100 KWH	6,800	22,000	15,200	323.52

Source: Market Survey, December 2024

Table 4.1 expresses relationship between fuel subsidy removal, and price of consumer goods, which are rooted in transportation fare. The table indicates that the market price of Gari has increased by a margin of 650 percent between 2022 and 2024. The table also reveals that 25 kg of rice over the same period increased by 186.36 percent, while a tin of Beans has its price skyrocketing by 760 percent. In the same vein, half carton of Indamine noodles, 12kg cooking gas and 10 tubers of yams have their market prices increased by 280, 459.45 and 300 percent respectively. The table on the other hand revealed that electricity bill of 100 KWH increased by 323.52 percent. Based on the analysis above the hypothesis, which states that transportation fare has no significant impact on the prices of consumable goods is hereby rejected and its alternative, which contends that transportation fare significantly impacts on consumable goods is therefore upheld.

Hypothesis 4: The prices of consumable goods have significant links with pervert levels in the study area.

Table 5.1: Test of relationship between prices of consumable goods and poverty levels

Variables	N	Pearson Correlation	Sig. (2 tailed)
Consumable goods prices	160	0.522	0.000 Poverty Levels

*** Correlation is significant at 0.01 level

Source: SPSS extracts, December 2024

Table 5.1 indicates a moderately strong positive correlation coefficient of 0.5 22, which is significant at 0.01 level of the 2-tailed test. It therefore implies that prices of consumables and poverty levels move together in one direction at all times. As such higher prices place more economic burden and hardship on consumers intensifying their poverty. Consequently, the higher the price indexes for consumable goods, the higher the magnitude of poverty level among the masses in the study area. It is also imperative to note from Table 5.1 that the rather moderate level of association between the dependent and independent variables indicates that there are other factors that affect poverty level in the study area alongside prices of consumer goods. Such factors are good areas for empirical studies. On the basic of this analysis, the hypothesis, which denies the existence of a significant link between prices of consumer goods and poverty level is hereby rejected in favour of its alternative form, which state that there is a significant link between prices of consumer goods and poverty level in the study area.

Discussion of Result

This study focused on the cost implication of road transportation in Benue State in the wake of fuel subsidy removal in Nigeria. The study found that transport services in the study area and beyond are the phenomenal removal of subsidy on petroleum by the Bola Ahmed Tinibu administration. This finding harmonizes with earlier finding by Abeakih and Somkenechi (2024) in their study on the impact of fuel subsidy removal on transportation via descriptive survey research design and simple percentage as bases for analysis. The study reported higher expenditures on fuel and vehicular operations, which resulted in drastic drops in financial retunes.

The study also found that the increasing cost of producing transportation services has significantly in impacted transportation fares across road links in Benue State and elsewhere in various locations in the core North, Middle Belt and Southern Nigeria. Again, this finding collaborates with

earlier finding by respectively studied fuel subsidy removal against the background of its effects on transport cost, transport fares and inflationary trends in Nigeria. The studies all reported sharp rise in transporting rates due to increasing cost of petrol, which is central to the effective functioning of vehicular traffic on the roads.

Similarly, this study found that the increasing trend of transport fare in the study area and beyond has led to corresponding magnitude in the inflationary trend of consumable goods and services. This finding is harmonious with Akpan and Uford (2024) who studies fuel subsidy removal and its effects on the purchasing power of the Nigeria masses and reports that there has been sharp increase in the cost of basic consumable items. The finding further collaborates with those of Ali et al (2024) who reported high rates of inflation in the prices of essential commodities in their study on fuel subsidy removal and Nigerians commodity supply chain.

On the other hand, this study finally found that the unpopular economic policy of fuel subsidy removal has intensified poverty levels through increased price tags on basic necessities of life thereby levels through increased price tags on basic necessities of life thereby telling on substantial fortunes of the average Nigerians. This finding collaborates with those of Yanusa et al (2023) who reported significant rise in economic hardship among Nigerians as more of their financial fortunes are increasingly getting siphoned by rising prices of consumable goods. In the same vein, this finding also harmonizes with those of Olaniyi et al (2023) whose study on the socioeconomics of the 2023 fuel subsidy removal reports that the complex web of hardship on the socioeconomic sphere policy is highly anti-social and unpopular among the larger population of Nigeria.

Conclusion

This study has effectively x-rayed road transportation in Benue State against the background of the cost implication in the wake of Petroleum subsidy removal. The study through the employment appropriate empirical machinery found that the arbitrary increase in the cost producing transportation services is significantly rooted in fuel subsidy between increasing transportation fare and transportation cost, with the former largely propelled by the latter.

The study furthermore found that the above scenario has translated to hyper-inflation in the cost of essential commodities and ultimately led to heightening levels of poverty thereby bastardizing the livelihood among the middle- and low-income population in the study areas and beyond, which are in the majority within the composition of Nigeria's ever-growing population.

Recommendations

- i. The Nigerian government should as a matter of urgency, restore local refining of petroleum as the country has four (4) refineries.
- ii. There should be a final stoppage to importation of petrol, while urgent steps be taken to get alternative sources of energy. It is a shame that Nigeria is the only OPEC member country that imports petrol rather than export.
- iii. The government at all tiers should augment efforts of the private sector in public transportation by purchasing mass-transit buses to convey passengers at subsidized rates.

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10TH INTERNATIONAL INTERDISCIPLINARY RESEARCH & DEVELOPMENT CONFERENCE

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EFFECT OF SALARIES AND WAGES ADMINISTRATION ON EMPLOYEES' PERFORMANCE IN ABUJA CLINICS, FEDERAL CAPITAL TERRITORY

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Abstract

Employee performance is a critical factor in the success of healthcare institutions, directly affecting patient care and service delivery. This study investigated the effect of Salaries and Wages Administration on employee performance at Abuja Clinics, focusing on three key aspects: Salary Structure, Pay Equity, and Timeliness of Payment. A survey research design was employed, and multiple regression analysis examined the relationships between these salary administration practices and employees' performance. The findings indicate that Salary Structure has a moderate positive effect on performance, with a p-value below 0.05, confirming that a well-organized and competitive salary system enhances motivation, productivity, and overall employee output. Pay Equity also showed a positive influence, demonstrating that fair and equitable compensation promotes job satisfaction, reduces workplace tension, and increases commitment, as employees who perceive fairness in pay are more likely to remain engaged. Timeliness of Payment emerged as the most influential factor, with the highest impact on employee performance ($B = 0.405$, $p = 0.0294$). Prompt and consistent salary disbursement boosts morale, reduces financial stress, and fosters loyalty and efficiency, consistent with Smith and Brown (2021). The study concludes that structured salaries, equitable pay, and timely payment are essential for optimising workforce performance at Abuja Clinics. It recommends implementing transparent pay policies, periodic salary reviews, and ensuring timely remuneration. Future research should explore long-term effects on employee retention and overall institutional effectiveness in the healthcare sector.

Keywords: *Employee Performance; Salary Structure; Pay Equity; Timeliness of Payment; Healthcare Institutions*

Introduction

Salaries and wages administration are a crucial aspect of human resource management, directly influencing employee performance and overall organizational outcomes. Across sectors—public or private, developed or developing—compensation systems are used to attract talent, retain skilled employees, and encourage alignment with organizational objectives. Beyond providing financial security, well-managed salaries foster motivation, enhance job satisfaction, and strengthen employees' sense of belonging. A transparent salary structure, equitable pay, and timely payment are widely recognised as central factors in sustaining productivity, commitment, and loyalty.

The significance of effective compensation management is particularly evident in healthcare, where human capital is the most critical resource. Unlike sectors that rely heavily on technology or capital, healthcare outcomes depend largely on the commitment, skill, and dedication of professionals such as doctors, nurses, technicians, and support staff. Weaknesses in salaries and wages administration—unclear pay structures, perceived inequities, or delayed payments—can directly undermine staff morale, reduce job satisfaction, and compromise service delivery, affecting patient care and organizational efficiency.

Abuja Clinics, a prominent private healthcare provider in Nigeria's Federal Capital Territory, illustrates these challenges. Evidence suggests that gaps in salary administration—particularly in salary structure, pay equity, and timeliness of payment—have adversely impacted staff productivity and engagement. A central concern is the existence of a transparent salary structure. Scholars argue that without clear frameworks linking pay to roles, qualifications, and responsibilities, employees may feel undervalued, decreasing motivation and weakening trust in management (Armstrong & Taylor, 2021).

Pay equity is another critical dimension. When employees performing similar roles receive unequal pay—often due to negotiation disparities—perceptions of unfairness can arise, eroding teamwork, fostering demotivation, and reducing overall performance (Adams, 1965; Greenberg, 1990). In healthcare, where collaboration is essential, inequity can particularly undermine staff cohesion, morale, and cooperation. Timeliness of salary payment is equally important. Studies show that delayed wages cause financial stress and distract employees from their professional duties (Smith et al., 2020; Adegoke & Lawal, 2022). In high-demand sectors, untimely payment can compromise service quality, retention, and organizational performance. To address these issues, this study investigates three key questions: How does salary structure affect employee performance at Abuja Clinics? How does pay equity influence performance? And how does the timeliness of payment impact employee outcomes? The broad objective is to examine the overall effect of salaries and wages administration on employee performance, with specific aims to determine the effect of salary structure, assess the effect of pay equity, and evaluate the effect of timely payment. The findings are expected to provide Abuja Clinics and similar healthcare providers with insights to strengthen compensation systems, enhance workforce motivation, improve service quality, and ensure sustainable organizational performance.

Literature Review

Conceptualization: Salaries and Wages Administration

Conceptualization: Salaries and Wages Administration

Salaries and wages administration is a key aspect of human resource management, ensuring fairness, equity, and consistency in employee compensation. It influences job satisfaction,

motivation, and organisational productivity, making effective administration vital for a committed workforce. A structured salary system aligns pay with roles, skills, and responsibilities. Transparent structures reduce disparities, enhance morale, and foster loyalty, while poorly managed systems generate frustration (James & Bello, 2022; Okunlola & Yusuf, 2021). Equity is crucial, as employees assess fairness through input–reward comparisons; maintaining equity promotes satisfaction, teamwork, and productivity, whereas inequitable pay undermines performance (Adams, 1965; Ige & Ayinde, 2020; Garba et al., 2021). Timeliness of payment is equally important, as prompt disbursement builds trust and reduces financial stress, supporting focus and commitment, while delays lower motivation (Omole & Akinyemi, 2021; Akpan & Etim, 2022). In healthcare, where continuity is critical, structured, fair, and timely compensation strengthens retention and productivity. Further research is needed in Abuja's private healthcare context to explore the impact of these practices on staff motivation, retention, and patient care outcomes (Alabi & Sulaimon, 2021).

Concept of Salary Structure

Salary structure aligns employee compensation with roles, skills, experience, and performance, ensuring fairness, competitiveness, and organisational coherence. It typically includes base pay, allowances, bonuses, and benefits, providing clarity and motivating employees. Internal equity ensures comparable pay for similar responsibilities, reducing tension and dissatisfaction, while external competitiveness aligns salaries with industry standards, helping retain skilled staff, especially in healthcare (Akinola et al., 2021). Pay-for-performance systems link rewards to contributions, incentivising higher productivity and commitment. Other critical components include career progression, benefits, and equity. Structured pay bands reward qualifications, experience, and performance, fostering transparent advancement pathways. Benefits such as health insurance enhance loyalty, while fairness across demographic groups reduces dissatisfaction and promotes inclusivity (Okafor, 2022). Salary structures should align with organisational goals, encouraging behaviours that support long-term growth (Ayoade, 2021). Transparent and timely frameworks reduce uncertainty and boost engagement, while flexibility allows adjustments during economic shifts without destabilising staff confidence (Smith et al., 2020). In healthcare, structured salary systems directly affect retention, motivation, and productivity. Therefore, salary structure can be operationally defined as the systematic framework organisations adopt to determine employee pay based on roles, skills, experience, and industry benchmarks, ensuring fairness, competitiveness, and alignment with organisational strategy.

Concept of Pay Equity

Pay equity ensures employees receive fair compensation for equivalent work regardless of gender, ethnicity, or other demographic factors. It fosters trust, satisfaction, and commitment, essential in collaborative healthcare settings. When employees perceive pay decisions as objective and fair, they show stronger job commitment and higher morale (Johnson et al., 2020; Lee & Patel, 2021). Perceived inequity creates resentment, reduces teamwork, and may compromise patient care outcomes (Adams & Tisdell, 2022).

Transparency strengthens equity. Open compensation systems clarify how pay is determined, reinforcing trust and reducing perceived discrimination (O'Neill et al., 2023). Leadership commitment to equity signals fairness and inclusivity, fostering employee focus and cohesion (Barnes, 2022). Equitable pay also acts strategically to reduce turnover in competitive sectors, maintaining performance and organisational stability (Jones, 2021; Davis et al., 2022). In sum, pay

equity supports satisfaction, retention, and motivation, which enhances organisational performance. For healthcare organisations, fair pay ensures employees remain committed to patient care and collaborative work. Hence, pay equity is operationally defined as the practice of providing employees with fair compensation for work of equal value, based on responsibilities, qualifications, and skills, rather than subjective or demographic factors.

Concept of Timeliness of Payment

Timeliness of payment refers to the punctuality and regularity of salary disbursements, reflecting organisational efficiency and respect for employees. Regular payments reduce financial stress, build trust, and encourage engagement, while delays cause frustration, disengagement, and increased turnover (Ali et al., 2020; Onyeka et al., 2020). Timely payments enable employees to manage personal obligations effectively, enhancing focus and discretionary effort at work (Amujiri et al., 2022). Research links timeliness to motivation and retention. Employees receiving consistent salaries demonstrate greater loyalty and trust in management, improving productivity and organisational commitment (Adeniran et al., 2021; Akinbode & Ojo, 2022). In healthcare, delays can undermine morale, service quality, and operational stability. Consistent payments also strengthen the organisation's reputation as financially reliable, facilitating talent attraction and retention (Adeoye & Olowookere, 2021). Overall, regular salary disbursement influences workforce engagement, stability, and performance. Therefore, timeliness of payment can be operationally defined as the consistent and punctual release of salaries according to agreed schedules, supporting employee satisfaction, trust, and productivity.

Concept of Employee Performance

Employee performance reflects the extent to which staff achieve organisational objectives through task completion, interpersonal behaviour, and discretionary effort. It is shaped by structural, motivational, and cultural factors, with salaries and wages playing a crucial role. Well-structured compensation increases perceived value, motivation, and engagement (Shen & Edwards, 2020). Fair pay reinforces commitment, satisfaction, and loyalty, directly affecting output quality and organisational efficiency (Johnson et al., 2020; Eze, 2020).

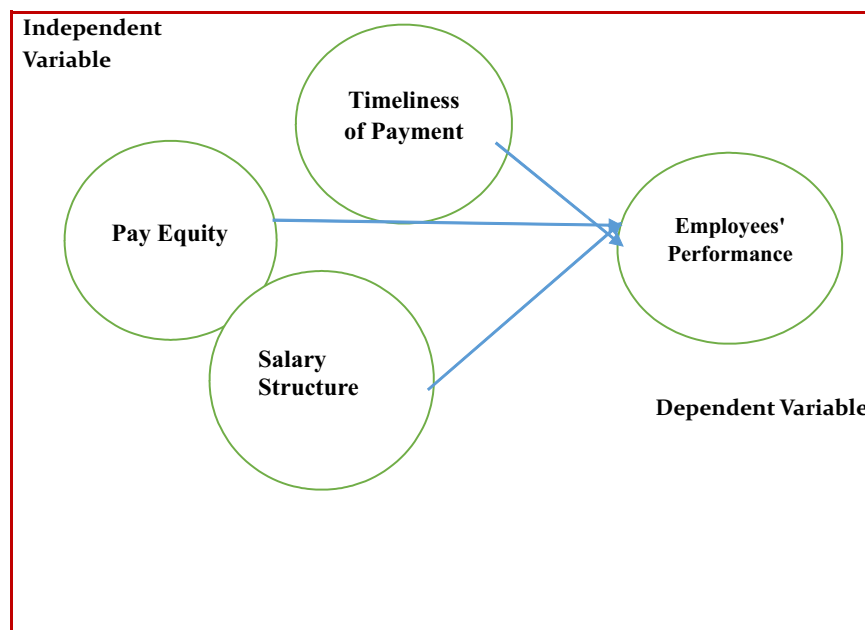
Motivation mediates performance, as employees perceiving fairness exert more effort, remain engaged, and sustain productivity even under pressure (Nwachukwu et al., 2022; Olamide, 2021). Non-monetary benefits, such as training and healthcare, complement salaries by addressing holistic employee needs. Performance appraisal systems strengthen outcomes by linking rewards and feedback to achievements (Okorie & Okorie, 2020). Job satisfaction and work-life balance are also critical for sustaining high productivity (Gamage, 2021). In healthcare settings like Abuja Clinics, employee performance directly affects patient care. Thus, employee performance is operationally defined as the degree to which staff effectively contribute to organisational goals through completion of tasks, interpersonal conduct, and discretionary effort.

The Conceptual Model

The conceptual model (shown in Figure 1) explores the relationship between salaries and wages administration—salary structure, pay equity, and timeliness of payment—and employee performance at Abuja Clinics, FCT. It posits that a transparent and competitive salary structure shapes fairness perceptions and motivation, while pay equity fosters morale, organisational justice, and commitment. Timely salary payments sustain satisfaction, reduce stress, and prevent

disengagement, whereas delays risk lowered motivation and performance decline. Collectively, these three elements influence key outcomes such as job satisfaction, productivity, retention, and workforce stability. By aligning compensation practices with industry standards and organisational goals, the model highlights how fair and efficient salary administration enhances employee performance and ultimately contributes to the clinic's overall success.

Figure 1: Conceptual Model of the Relationship Between Salaries and Wages Administration and Employees' Performance



Source: Researcher's Conceptual Model, 2025

Empirical Review

Salary Structure and Employees' Performance

The relationship between salary structure and employee performance has long attracted scholarly attention, particularly regarding workforce motivation and organisational stability. Salary structure typically includes pay grades, ranges, and job classifications, aimed at fostering equity, transparency, and competitiveness (Milkovich et al., 2014). When effectively implemented, salary structures signal fairness and consistency with industry benchmarks, both of which are central to employee satisfaction and organisational outcomes.

Ogbu and Hassan (2019), studying Nigerian healthcare professionals, reported a strong positive correlation between structured pay systems and performance, noting reduced turnover intentions among staff under equitable pay bands. While highly relevant to the healthcare sector and Nigerian context, the study was limited by its small sample size (n=150) and reliance on self-reported data, which may introduce bias. Adekunle and Okoye (2020) strengthened the evidence base with a mixed-methods study of Abuja's public sector employees, finding that transparent salary distribution improved efficiency by 25%. This study's methodological breadth improves validity, yet its public sector focus limits generalisability to private healthcare, where market-driven compensation dynamics differ.

In contrast, Akintola et al. (2021), investigating private educational institutions in Lagos, observed that poorly designed pay structures undermined morale and performance. Although the Lagos context differs economically from Abuja's healthcare environment, the findings highlight the dangers of inconsistency and opacity in salary administration. However, the study did not control for institutional size, potentially skewing outcomes. Okechukwu and Adedeji (2022), examining private universities, found that harmonised pay scales and structured increments enhanced teaching performance. Collectively, these studies suggest that structured salary systems can motivate employees and improve retention, but only when consistently and transparently applied. Their contextual and methodological limitations underscore the need for sector-specific inquiry into salary structures in private healthcare organisations like Abuja Clinics.

Pay Equity and Employees' Performance

Pay equity, defined as fair remuneration for equal work regardless of gender, age, or demographic characteristics, is widely recognised as a driver of employee motivation and performance (Adams, 1965). Equity perceptions foster organisational justice, satisfaction, and engagement, all of which directly impact productivity. Okeke and Nwachukwu (2018), in a study of Nigerian public health institutions, demonstrated that pay equity explained 40% of variance in motivation. While their regression analysis was statistically robust, the public-sector orientation limits applicability to private settings, where wage structures may be less regulated.

Adeyemo and Oladipo (2020) reported that equitable pay in Nigeria's banking sector strongly correlated with productivity, particularly discretionary effort. While the study highlights the cross-sectoral value of equity, the banking sector's financial incentives and organisational pressures differ from healthcare, making contextual transferability uncertain. Adebayo et al. (2021), surveying hospitals in Abuja, found that equitable pay practices increased satisfaction by 35%, leading to a 25% productivity rise. The study's healthcare and geographic relevance strengthen its applicability to Abuja Clinics. However, its relatively narrow hospital sample may not fully capture dynamics in larger private institutions. Similarly, Ojo et al. (2021) observed that equitable pay reduced turnover in private healthcare institutions. This finding is directly relevant to Abuja Clinics, where staff retention is critical. Yet, the reliance on descriptive statistics weakens the causal claims, limiting the robustness of conclusions.

Taken together, the literature strongly supports pay equity as a determinant of performance, but sectoral and methodological limitations persist. For Abuja Clinics, this suggests the need to investigate not only the role of equity but also its interaction with organisational culture, leadership, and professional development opportunities.

Timeliness of Payment and Employees' Performance

The timeliness of salary disbursement is another critical determinant of employee performance. Prompt payments provide financial stability, strengthen trust in management, and sustain morale, whereas delays foster stress, disengagement, and turnover (Dessler, 2020). Adebajo and Osuji (2019), focusing on Nigerian healthcare workers, confirmed that timely salary disbursement enhanced productivity. The healthcare focus makes the study highly relevant, though its cross-sectional design limited analysis of long-term effects of delayed payments. Bello and Adegoke (2020), studying Lagos manufacturing firms, found that delays caused a 30% productivity drop, largely due to absenteeism and reduced concentration. While not directly transferable to healthcare, the findings highlight the cross-sectoral consequences of salary irregularities.

Musa et al. (2021), in a study of private schools in Abuja, observed that irregular payment schedules eroded morale and increased turnover. Although the educational sector differs from healthcare, the shared geographical context strengthens relevance. The study's small sample of schools, however, undermines its representativeness. Finally, Bello and Ahmed (2022), investigating private hospitals in Abuja, found that timely payments were most effective when combined with transparent communication and supportive leadership. This integrative perspective is highly applicable to Abuja Clinics. However, the study's descriptive statistical approach fell short of demonstrating causality. Thus, across the three dimensions—salary structure, pay equity, and timeliness of payment—the literature provides consistent evidence of their influence on employee performance. However, the reviewed studies reveal limitations in sample representativeness, statistical methods, and sectoral transferability. While healthcare-related studies are most directly relevant, many rely on small samples or descriptive methods, leaving causal links underexplored.

Theoretical Framework - the Equity Theory

The theoretical framework provides a foundation for examining how salaries and wages administration affects employees' performance. Among several relevant theories, Equity Theory by John Stacey Adams (1963) best underpins this study due to its focus on fairness in workplace rewards. The theory posits that employees assess the fairness of their compensation by comparing their input-output ratio with that of others. Inputs include effort, skills, time, and loyalty, while outputs comprise salary, bonuses, recognition, and other benefits. Perceived equity motivates employees to maintain or improve performance, whereas perceived inequity can lead to dissatisfaction, absenteeism, or turnover.

Equity Theory is particularly relevant to healthcare settings like Abuja Clinics, where staff face long hours, high skill demands, and emotional strain. Employees often compare their pay internally and with peers across similar organisations in Abuja and Nigeria at large. Equitable compensation fosters motivation, commitment, and retention, while inequity risks lowering morale and service quality. Empirical evidence supports this perspective. Colquitt et al. (2013) emphasise that equitable pay enhances organisational justice and trust, reducing turnover intentions. Similarly, Adebayo et al. (2021) report that fair compensation in Abuja hospitals improved job satisfaction and productivity. These studies highlight that employee performance is influenced not only by pay levels but by perceptions of fairness relative to colleagues and industry standards.

The strength of Equity Theory lies in its psychological depth, offering insight into why fairness is central to motivation and providing practical guidance for compensation management. For Abuja Clinics, transparent salary structures, clear progression pathways, and equitable pay policies could enhance morale, reduce attrition, and improve organisational outcomes. Limitations include subjectivity in fairness perceptions and the focus on extrinsic rewards, potentially overlooking intrinsic motivators such as autonomy or professional development. Nevertheless, Equity Theory remains the most appropriate framework for this study, as it captures how perceptions of fairness in salary administration—through structure, equity, and timeliness—directly influence job satisfaction, motivation, and performance.

The study population consisted of 500 staff members across the various departments of Abuja Clinics, as shown in Table 1. To determine an appropriate sample size, Taro Yamane's (1967) formula was applied with a 5% margin of error. The formula is expressed as:

$$n = N/(1+N(e)^2)$$

Where: n = sample size; N = population size (500); and e = level of precision (0.05)

Substituting into the formula:

$$n = 500/(1+500(0.05)^2) = 500/(1+1.25) = 500/2.25 \approx 222$$

The minimum sample size for this study was calculated at 222 respondents. Following Israel's (2013) recommendation, the figure was increased by 20% to account for potential non-response, resulting in a final target of 266 respondents. To ensure fair representation, a stratified proportional allocation method was applied, assigning respondents from each hospital department according to its proportion of the overall workforce. This approach reflected staff diversity while maintaining statistical rigour (Bryman, 2016; Saunders, Lewis, & Thornhill, 2019).

Data collection employed a structured questionnaire with mainly closed-ended items, facilitating clarity, reducing bias, and supporting quantitative analysis (Creswell & Creswell, 2018). Responses were measured on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), a widely used method for capturing opinion variations while ensuring comparability (Likert, 1932; Boone & Boone, 2012).

Table 1: Sample Distribution Technique

S/N	Department	Number of Employees	Percentage of Total	Sample Size
1	Department	80	16%	43
2	Medical Services	60	12%	32
3	Nursing	40	8%	21
4	Laboratory & Diagnostics	60	12%	32
5	Pharmacy	40	8%	21
6	Administrative & Support Services	40	8%	21
7	Physiotherapy & Rehabilitation	40	8%	21
8	Patient Services	20	4%	11
	Total	500	100%	266

Source: Researcher's Computation, 2025

Research assistants distributed the 266 questionnaires directly across departments to maximise coverage and minimise non-response (Dillman, Smyth, & Christian, 2014). Closed-ended items standardised responses and supported quantitative interpretation (Oppenheim, 2000), while the Likert scale provided structured measurement of perceptions (Joshi et al., 2015). Direct distribution allowed clarifications to ensure accurate responses (Fowler, 2014). These methodological choices enhanced both the reliability and validity of the study's findings.

Another aspect of this study was the operationalisation of measurement variables. As shown in Table 2, this step ensured clarity and consistency by translating abstract concepts into measurable indicators for empirical testing. It also guided the development of reliable tools that captured the constructs under study.

Table 2: Operationalisation of Measurement Variables

Variable / Code	Definition/Measurement Method	Measurement Scale	Choice Justification	Source
Salary Structure (SS)	Framework used to determine employee salaries based on position and experience.	Ordinal	Salary structure influences fairness, motivation, and employee performance significantly.	Armstrong (2019); Dessler (2020)
Pay Equity (PE)	Fair distribution of pay ensuring equal salary for equal work.	Ordinal	Pay equity enhances employee morale, motivation, and organisational performance.	Blau (2018); Nyberg et al. (2020)
Timeliness of Payment (TP)	Regularity and punctuality of salary payments in agreed schedule.	Ordinal	Timely payments foster employee trust, satisfaction, and higher productivity.	Allen et al. (2019); Ghosh & Houghton (2021)
Employee Performance (EP)	Extent employees achieve duties, goals, and organisational targets consistently.	Ordinal	Performance reflects salary fairness, timely pay, and structural consistency.	Borman & Motowidlo (2018); Kim & Lee (2020)

Source: Researcher's Compilation, 2025

The validity and reliability tests were conducted on the Research Instrument of the study: Salary Structure (SS), Pay Equity (PE), Timeliness of Payment (TP), and Employee Performance (EP).

Table 3: Validity and Reliability Test for Constructs

Construct	Corrected-Item Correlation (r)	Cronbach's α
Salary Structure	0.402	0.817
Pay Equity	0.353	0.810
Timeliness of Payment	0.337	0.789
Employee Performance	0.395	0.819
Overall Values	0.372	0.809

Source: Extracted from Pearson Moment Correlation (SPSS23 Output), 2025

As indicated in Table 3, the corrected item correlations (0.337–0.402) exceeded the 0.30 threshold, confirming satisfactory construct validity (Field, 2018). Cronbach's alpha values (0.789–0.819) surpassed the 0.70 benchmark (Nunnally & Bernstein, 1994), showing strong internal consistency. Overall reliability ($\alpha = 0.809$) demonstrated the instrument's robustness for examining salary structure, equity, and timeliness of payment (George & Mallery, 2019; Tavakol & Dennick, 2011).

Techniques for Data Analysis

This study employed several analytical techniques, including descriptive and inferential statistics, hypothesis testing, and regression analysis. Descriptive statistics summarised the dataset through measures such as mean, median, range, variance, and standard deviation, offering insights into central tendencies and variability. Inferential statistics, including confidence intervals and hypothesis testing, enabled us to generalise findings from the sample to the wider population. Hypothesis testing was carried out using established tests such as t-tests, chi-square, ANOVA, and F-tests to determine whether observed relationships were statistically significant. Regression analysis, specifically linear regression, was applied to examine the relationship between independent variables and the dependent variable, employee productivity. Together, these techniques provided a structured approach for interpreting data, identifying patterns, and drawing valid conclusions about the study variables.

Model Specification:

It can be asserted that *Employee Performance* is a function of the three independent variables: *Salary Structure (SS)*, *Pay Equity (PE)*, and *Timeliness of Payment (TP)*. Mathematically, this relationship can be stated as: $EP = f(SS, PE, TP)$. In an econometric form, the model can be represented as:

$$EP = \beta_0 + \beta_1 SS_i + \beta_2 PE_i + \beta_3 TP_i + \mu_i$$

Where:

EP = Employee performance;

SS = Salary Structure;

PE = Pay Equity;

TP = Timeliness of Payment;

β_0 = Constant term (when all independent variables are held at zero)

$\beta_1, \beta_2, \beta_3$ = Coefficients of the independent variables to be estimated;

μ_i = Error term (residual error term).

The regression equation model's employee performance as influenced by salary structure, pay equity, and timeliness of payment, with each factor contributing linearly. Coefficients indicate the relative impact of these variables at Abuja Clinics. Hypotheses were tested at a 95% confidence level, with significance determined by p-values ≤ 0.05 ; null hypotheses were rejected when test statistics fell within the rejection region. Analyses were conducted using SPSS, employing Ordinary Least Squares (OLS) regression due to its efficiency and unbiasedness. This approach provides a robust framework for understanding how salary administration practices affect employee performance, highlighting the critical role of structured, equitable, and timely compensation.

Data Presentation and Analysis

Table 4 provides an analysis of the distributed questionnaires, offering insights into the distribution and response rates for this study. A total of 266 questionnaires were distributed, representing the full 100% of the intended sample size. However, not all of these questionnaires were returned or deemed suitable for analysis. Specifically, 22 questionnaires (8.27% of the distributed total) were either not returned or were incorrectly filled out, excluding them from the analysis.

Table 4: Analysis of Distributed Questionnaire

Distribution	Frequency	% Frequency	Remarks
Distributed	266	100%	Adjusted Sample size
Unaccessed	22	8.27%	Non-returned, wrongly filled
Retrieved	244	91.73%	Correctly filled/Sample size for analysis
Minimum Sample Size	222	-	Calculated (Taro Yamane)

Source: Researcher's Computation, 2025

A total of 244 questionnaires, representing 91.73% of those distributed, were correctly completed and returned. Nulty (2008) asserts that response rates above 80% are highly desirable, as they reduce non-response bias and enhance the validity of study results. The 244 valid responses serve as the sample size for analysis, which comfortably exceeds the minimum required sample size of 222, as determined using the Taro Yamane formula. This adherence to the minimum sample size requirement strengthens the reliability of the survey results, as Krejcie and Morgan (1970) emphasize that meeting or surpassing the minimum sample size improves the generalization of the findings. Thus, the retrieved sample of 244 is both adequate and appropriate for robust statistical analysis. In conclusion, the high response rate ensures a reliable dataset for the study's analysis.

Data Analysis

Demographic Analysis

The study analysed 244 valid responses from Abuja clinics, ensuring reliable representation of the healthcare workforce. The socio-demographic profile reflected gender balance (male 48.4%, female 52.6%) and broad age distribution, with most respondents in the active career stages of 30–49 years (63.9%). Educational attainment was strong, as 38.9% held BSc Nursing/Registered Nurse qualifications and 31.1% possessed MBBS/MSc and above, demonstrating reliance on skilled professionals. Work experience showed a relatively youthful workforce, with 66.3% below five years of service, although 13.4% had more than ten years. Rank distribution revealed dominance of Physician Assistants/Nurse Practitioners (25.4%) and Junior Doctors/Residents (18.4%), supported by other cadres. These characteristics justify the sample's suitability, as it mirrors the clinical workforce structure in Abuja, enhancing the credibility and contextual relevance of the study's findings.

Table 5: Socio-Demographic Characteristics of Respondents (n = 244)

Variable	Category	Frequency	Percentage (%)
Gender	Male	118	48.4
	Female	126	52.6
Age	20–29 years	41	16.8
	30–39 years	72	29.5
	40–49 years	84	34.4
	50 years and above	47	18.9
Education	ND/NCE	32	13.1
	Lab Science Technician	41	16.8
	BSc Nursing/Registered Nurse	95	38.9
	MBBS/MSc and above	76	31.1
Work Experience	Less than 2 years	87	35.7
	2–5 years	75	30.6
	6–10 years	49	20.3
	Above 10 years	33	13.4
Rank/Position	Junior Doctor/Resident	45	18.44
	Senior Physician/Consultant	26	10.66
	Physician Assistant/Nurse Practitioner	62	25.41
	Nurse/Midwife	31	12.70
	Lab Scientist	28	11.48
	Administrative Staff	22	9.02
	Others	30	12.29
	Total	244	100%

Source: Researcher's Computation, 2025

Descriptive Statistics

Table 6 presents respondents' ratings of Security Services (SS), Political Environment (PE), Transparency of Processes (TP), and Electoral Performance (EP), each measured on a five-point scale. Security Services recorded a mean of 3.52 (SD = 1.178), reflecting generally positive confidence levels. Transparency of Processes achieved the highest mean of 3.72 (SD = 1.137), showing stronger trust in electoral transparency. Electoral Performance scored 3.29 (SD = 1.049), suggesting moderate approval of election outcomes. The Political Environment produced the lowest mean of 3.11 (SD = 1.065), indicating mixed perceptions and relatively weaker satisfaction. Overall, responses leaned towards favourable ratings, with transparency and security seen as strengths, while the political environment emerged as the area most in need of improvement.

Table 6: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
SS	244	1	5	3.52	1.178	-1.126	1.225
PE	244	1	5	3.11	1.065	-0.934	0.874
TP	244	1	5	3.72	1.137	-1.304	1.321
EP	244	1	5	3.29	1.049	-1.087	0.953
VALID N (LISTWISE)	244						

Source: SPSS Output, 2025

Correlation Matrix of Independent Variables

The correlation matrix in Table 7 examines the relationships among Salary Structure (SS), Pay Equity (PE), and Timeliness of Payment (TP) in relation to employees' performance (EP) at Abuja Clinics Ltd. Pearson correlation results indicate significant associations.

Table 7: Correlation Matrix of Independent Variables

		SS	PE	TP
SS	Pearson Correlation	1	0.248**	0.453**
	Sig. (2-tailed)		(0.000)	(0.000)
	N	244	244	244
PE	Pearson Correlation	0.248**	1	0.320**
	Sig. (2-tailed)	(0.000)		(0.000)
	N	244	244	244
TP	Pearson Correlation	0.453**	0.320**	1
	Sig. (2-tailed)	(0.000)	(0.000)	
	N	244	244	244

Source: Pearson Correlation from SPSS, 2025

SS shows a weak but significant positive correlation with PE ($r = 0.248$, $p < 0.001$), suggesting that clearer salary structures slightly improve perceptions of fairness. A stronger, moderate relationship exists between SS and TP ($r = 0.453$, $p < 0.001$), highlighting the influence of structured pay on timely disbursement. Similarly, PE and TP correlate positively though modestly ($r = 0.320$, $p < 0.001$). Overall, these findings confirm that salary structure, equity, and timeliness are interlinked, jointly shaping salary administration and employee outcomes.

Analysis of Variance (ANOVA):

ANOVA was applied to examine how Salary Structure (SS), Pay Equity (PE), and Timeliness of Payment (TP) collectively influenced Employees' Performance (EP) in Abuja Clinics, Federal Capital Territory.

Table 8: ANOVA Table

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	91.872	3	30.624	25.789	.000 ^b
	Residual	168.257	243	0.692		
	Total	260.129	246			

a. Dependent Variable: EP

b. Predictors: (Constant), SS, PE, TP

ANOVA was considered appropriate because it tests whether mean differences in EP can be explained by multiple predictors simultaneously, thereby ensuring robust model validity. As shown in Table 8, the Regression Sum of Squares (91.872, df = 3; Mean Square = 30.624) produced an F-value of 25.789 ($p = .000$), confirming statistical significance. The predictors explained a substantial proportion of variance, with the Residual Mean Square at 0.692. These results highlight that structured, equitable, and timely pay systems significantly improve employee performance, supporting evidence from prior compensation studies (Cohen et al., 2018; Armstrong & Taylor, 2020; Dessler, 2020).

Multiple Regression Analysis

The multiple regression analysis examined the effect of Salary Structure (SS), Pay Equity (PE), and Timeliness of Payment (TP) on Employees' Performance (EP) in Abuja Clinics. The results show that the predictors collectively explain meaningful variations in employee performance. The model constant of 1.085 reflects the baseline level of performance when all predictors are held constant. Its significance ($t = 3.641$, $p = 0.0012 < 0.05$) indicates that the model remains valid even without the independent variables.

Salary Structure (SS) recorded a coefficient (B) of 0.305 with a standardised beta ($\beta = 0.318$, $p = 0.0247$), suggesting that well-designed and transparent salary frameworks contribute positively to performance. This finding aligns with Armstrong and Taylor (2021), who note that structured pay systems improve motivation and employee retention.

Table 9: Table of CoefficientsCoefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.085	0.298		3.641	.0012
	SS	0.305	0.072	0.318	4.236	.0247
	PE	0.193	0.058	0.248	3.328	.0312
	TP	0.405	0.059	0.371	6.864	.0294

a. Dependent Variable: EP

Source: SPSS Output, 2025

Pay Equity (PE) produced a coefficient of 0.193 ($\beta = 0.248$, $p = 0.0312$), signifying that fairness in pay distribution enhances employee trust and morale, though with a relatively smaller influence compared with SS and TP. Pfeffer (2018) also argues that equitable pay reduces dissatisfaction and strengthens productivity. Timeliness of Payment (TP) emerged as the most influential predictor, with a coefficient of 0.405 ($\beta = 0.371$, $p = 0.0294$). This underscores the critical role of prompt salary delivery in reducing financial stress and enhancing commitment. Macey and Schneider (2020) affirm that delayed payments erode engagement, directly harming output. Thus, the estimated regression equation is expressed as:

$$EP = 1.085 + 0.305SS + 0.193PE + 0.405TP$$

This model indicates that timeliness of payment has the strongest effect, followed by salary structure and pay equity. Thus, the results suggest that fair, structured, and prompt compensation practices are essential drivers of employee performance and organisational effectiveness.

Test of Hypotheses

The hypotheses tested explored the effects of Salary Structure (SS), Pay Equity (PE), and Timeliness of Payment (TP) on employee performance in Abuja Clinics.

For **Hypothesis 1** (H_{01}), which stated that salary structure has no significant effect on employee performance, the analysis produced an unstandardised coefficient (B) of 0.305 with a standard error of 0.072, giving a t-value of 4.236. The p-value of 0.0247, being below the 0.05 threshold, necessitated the rejection of the null hypothesis. The standardised coefficient (Beta = 0.318) revealed a moderate positive influence, suggesting that a well-designed salary framework contributes to improved employee performance.

In **Hypothesis 2** (H_{02}), pay equity was assessed. Results showed an unstandardised coefficient (B) of 0.193, standard error of 0.058, and a t-value of 3.328. With a p-value of 0.0312 (< 0.05), the null hypothesis was rejected. The Beta value of 0.248 indicated a moderate positive relationship, underscoring that equitable compensation systems enhance employee performance.

Finally, **Hypothesis 3** (H_{03}) tested the impact of payment timeliness. The regression yielded $B = 0.405$, $SE = 0.059$, $t = 6.864$, and $p = 0.0294$, again leading to rejection of the null hypothesis. The

Beta coefficient (0.371) pointed to a strong positive effect, confirming timeliness of salary as the most influential predictor of employee performance. Collectively, these findings highlight the crucial role of fair, structured, and prompt compensation in fostering productivity.

Model Analysis

The correlation coefficient ($R = 0.743$) shows a strong positive relationship between salary administration practices and employee performance. An R^2 of 0.552 indicates that 55.2% of performance variation is explained by Salary Structure (SS), Pay Equity (PE), and Timeliness of Payment (TP), leaving 44.8% influenced by other factors. The adjusted R^2 of 0.549 confirms the model is well-specified and not overfitted. A standard error of 3.879 reflects moderate predictive accuracy, while a Durbin-Watson value of 1.994 shows largely independent residuals. Overall, the analysis demonstrates that structured salaries, equitable pay, and timely payment substantially enhance performance, highlighting the importance of effective compensation while suggesting additional factors may also improve workforce productivity.

Table 10: Model Summary^a

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate	Durbin-Watson
1	.743 ^a	.552	.549	3.879	1.994

a. Predictors: (Constant), SS, PE, TP

The correlation coefficient ($R = 0.743$) indicates a strong positive relationship between salaries and wages administration and employee performance. The R^2 value of 0.552 shows that 55.2% of the variation in performance is explained by Salary Structure (SS), Pay Equity (PE), and Timeliness of Payment (TP), with 44.8% influenced by other factors. The adjusted R^2 of 0.549 confirms the model is well-specified and not overfitted. The standard error (3.879) reflects moderate predictive accuracy, while the Durbin-Watson statistic (1.994) indicates largely independent residuals, supporting validity. Overall, structured salaries, fair pay, and timely payment significantly enhance performance, though additional factors could further boost workforce productivity.

Discussion of Findings

This study investigated the effect of salaries and wages administration on employees' performance at Abuja Clinics, Federal Capital Territory. The findings reveal the critical role of salary administration practices in influencing workforce outcomes. Salary Structure ($B = 0.305$, $t = 4.236$, $p = 0.0247$) showed a strong positive effect on employee performance, indicating that a clear, competitive, and well-organized salary framework motivates staff and enhances productivity. This aligns with Armstrong (2019) and Dessler (2020), who emphasise the importance of structured and transparent pay systems for employee motivation and alignment with organisational goals.

Pay Equity ($B = 0.193$, $t = 3.328$, $p = 0.0312$) also positively affected performance. Fair and equitable compensation fosters trust, reduces workplace conflicts, and strengthens commitment, reinforcing organisational harmony. Although its impact was slightly lower than that of Salary Structure and Timeliness of Payment, its role in maintaining fairness and boosting morale remains significant, consistent with Milkovich et al. (2020).

Timeliness of Payment ($B = 0.405$, $t = 6.864$, $p = 0.0294$) emerged as the most influential factor. Prompt and consistent salary disbursement signals organisational reliability, reduces financial stress, and enhances loyalty and productivity, as highlighted by Kohn (2018) and Groening and Kanze (2020). Collectively, the findings show that effective salary administration—particularly timely payment, structured salaries, and pay equity—is essential for sustaining a motivated, productive, and high-performing workforce.

Conclusion and Recommendations

This study examined the impact of Salary Structure, Pay Equity, and Timeliness of Payment on employee performance at Abuja Clinics. Findings indicate that a well-structured, competitive salary system significantly motivates employees, enhances commitment, and improves productivity. Pay Equity fosters fairness, trust, and engagement, while Timeliness of Payment emerged as the most influential factor, reducing financial stress and strengthening loyalty. Collectively, these practices are critical for job satisfaction, workforce motivation, and organizational success, highlighting the need for timely, fair, and transparent salary administration.

Recommendations

Based on the findings on Salaries and Wages Administration and employee performance at Abuja Clinics, the following recommendations are proposed:

- i. **Enhance and Review Salary Structure:** Develop a competitive, transparent salary system aligned with industry standards. Regular reviews considering market trends, inflation, and clinic capacity will ensure employees are fairly compensated, boosting motivation, satisfaction, and commitment while attracting and retaining talent.
- ii. **Prioritize Pay Equity:** Regularly assess compensation to ensure fairness across roles. Conduct pay audits, benchmark against industry standards, and implement clear policies on increases, bonuses, and promotions. Equitable pay fosters trust, reduces conflicts, and improves morale and productivity.
- iii. **Ensure Timely Salary Payments:** Prioritise punctual and reliable payments through automated payroll systems and strict schedules. Timely salaries reduce financial stress, enhance job satisfaction, and promote loyalty, stability, and overall workforce performance.

Limitations of the Study

This study on the effect of Salaries and Wages Administration on employee performance at Abuja Clinics, FCT, has several limitations. Its focus on a single geographical location may limit generalisability to other regions or sectors. The sample size and convenience sampling may not fully represent the wider healthcare workforce, potentially introducing bias. Reliance on self-reported data via a 5-point Likert scale could lead to response biases. Additionally, contextual factors like organizational culture, leadership style, and job satisfaction were not considered, and the cross-sectional design cannot capture long-term effects. Future research should address these issues for more robust findings.

Suggestions for Further Studies

Future research could expand the sample and include healthcare organizations across Nigeria to assess regional variations in salary administration effects. Longitudinal studies are recommended to examine the long-term impact of Salary Structure, Pay Equity, and Timeliness of Payment on

employee performance. Additional salary components such as bonuses, benefits, and incentives should be explored to identify which elements most influence performance. Comparative studies across other sectors could reveal broader applicability. Researchers could also investigate mediating/moderating factors like job satisfaction or organizational culture, and assess how technology, such as payroll systems, affects salary administration and employee outcomes.

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APPENDIX: THE RESEARCH QUESTIONNAIRE

SECTION I: SOCIO-DEMOGRAPHIC DATA

Instruction: Please tick as appropriate

S/N	Socio-Demographic Data	Categories
1	Your Gender?	☐ Male ☐ Female
2	Tick Your Age Range?	☐ 18-29 years ☐ 30-39 years ☐ 40-49 years ☐ 50 years and above
3	Your highest Educational Qualification?	☐ NCE/ND ☐ BSc Nursing/Registered Nurse ☐ MBBS/MSc and above
4	Your Rank/Position in the Hospital	☐ Clinic Administrator / Operations Manager ☐ Department Heads / Medical Supervisors ☐ Senior Physicians / Consultants ☐ Doctors / Medical Officers ☐ Nursing Manager / Chief Nurse ☐ Registered Nurses (RNs) ☐ Physician Assistants (PAs) / Nurse Practitioners ☐ Junior Doctors / Interns / Residents ☐ Administrative Staff / Receptionists (medical records, handling billing, and maintaining clinic operations)

SECTION II: INDICATORS-CONSTRUCT QUESTIONNAIRE

Please rate your level of agreement with the following statements in the table based on your experiences and observations in your workplace, using the following scale:

- A. Strongly Agree = 5 D. Disagree = 2
 B. Agree = 4 E. Strongly Disagree = 1
 C. Neutral = 3

ITEM CODE	INDICATOR ITEMS	AGREEMENT OPTIONS				
		A	B	C	D	E
SS	Salary Structure (SS)					
SS ₁	Salaries are aligned with industry standards, ensuring competitive compensation for employees.					
SS ₂	Employees have a clear understanding of the different components that make up their salary, including base pay, allowances, and bonuses.					
SS ₃	The salary offered to employees is proportionate to their job roles and responsibilities, ensuring fair compensation for the work expected.					
SS ₄	The organization ensures transparency in salary grades, allowing employees to know where they stand in the organizational hierarchy.					
SS ₅	The salary structure is regularly reviewed to ensure it remains competitive and aligned with market trends and employee expectations.					
PE	Pay Equity (PE)					
PE ₁	Employees in similar roles are paid equally, regardless of their gender, race, or other demographic factors.					
PE ₂	Pay reflects the level of education and professional qualifications of employees, ensuring that those with higher qualifications are compensated accordingly.					
PE ₃	There is no discrimination in pay based on demographic factors such as age, gender, or ethnicity, and compensation is purely performance driven.					
PE ₄	The organization's compensation practices are fair and transparent, ensuring that employees are aware of how pay decisions are made.					
PE ₅	Any existing pay gaps among employees are addressed openly by the organization, with a clear plan for reducing disparities.					

ITEM CODE	INDICATOR ITEMS	AGREEMENT OPTIONS					
TP	Timeliness of Payment (TP)						
TP1	Salaries are paid on time, as agreed upon, without delays that could cause financial instability for employees.						
TP2	Delays in salary payment are rare and are quickly addressed when they occur.						
TP3	If there are any issues with salary payment, the organization communicates promptly with employees to explain the situation and provide updates.						
TP4	Overtime payments are made promptly, ensuring that employees are compensated for additional work without unnecessary delays.						
TP5	Timely payment of salaries contributes to employee stability and satisfaction, helping employees focus on their work without financial concerns.						
EP	Employee Performance (EP)						
EP1	Employees consistently meet performance targets, demonstrating high levels of productivity and quality of work.						
EP2	Employees regularly exceed performance expectations, indicating a high level of engagement and motivation.						
EP3	Job satisfaction, enhanced by competitive and timely pay, boosts employee output and overall work quality.						
EP4	High levels of employee engagement are directly linked to improved productivity, with employees contributing more to organizational goals.						
EP5	High-performing employees are more likely to stay with the organization, reducing turnover rates and maintaining a stable workforce.						