Agricultural capacity utilization and sectoral performance in Nigeria: An exploratory analysis of output, prices, credit, and household demand, 2010-2024

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Abstract
Agricultural capacity utilization (ACU) is an important indicator of how effectively productive resources are transformed into sustainable agricultural output, particularly in developing economies such as Nigeria. Despite growth in agricultural production, challenges related to seasonal fluctuations, investment stability, subsector performance, and the effectiveness of financing remain. This study examined the distributional characteristics, temporal dynamics (2010–2024), and relationships between ACU and selected agricultural indicators. Quarterly secondary time-series data on agricultural Gross Domestic Product (GDP), Implicit Price Deflator (IPD), Commercial Credit to Agriculture (CCA), Final Consumption Expenditure of Households (FCEH), capital importation, and agricultural subsectors were analyzed using descriptive statistics, graphical trend analysis, and Pearson correlation. Results showed that the mean agricultural GDP was 4,136.87 ± 893.03, while crop production averaged 3,724.07. ACU increased steadily from approximately 20 in 2010 to 100 in 2023 before declining to about 75 in 2024. Strong positive correlations were observed between ACU and agricultural GDP ($r = 0.95$), crop production ($r = 0.93$), livestock production ($r = 0.89$), agricultural IPD ($r = 0.88$), and FCEH ($r = 0.82$), whereas the relationship with CCA was weak ($r = 0.06$). The findings indicate that ACU is more strongly influenced by productive and demand-related factors than by credit availability alone. Policies should prioritize productivity-enhancing infrastructure, mechanization, technology adoption, efficient agricultural financing, and balanced subsector development.

1. Introduction

Agriculture continues to play a significant role in economic development as it is contributing to food security, jobs, household livelihoods, industries inputs and economic diversification. But a rise in agricultural production does not necessarily mean that the productive resources are being used efficiently. The effectiveness with which the land, labour, capital, technology, infrastructure, finance and market opportunities are converted into productive output also determines agricultural performance. Agricultural Capacity Utilization (ACU) is therefore a crucial factor to take into account when interpreting agricultural growth, and determining if such growth is accompanied by an increase in the productive capacity of the farm. The current study, therefore, looks at agricultural capacity utilization and agricultural output, price conditions, financing, household demand and subsector performance in Nigeria.

Nigeria offers a significant context for this review as agriculture is a diverse segment comprising crop production, animal husbandry, forestry, fishing, and others. There are significant differences in their output and price behavior according to the latest data. Livestock, forestry and fishing activities make much smaller contributions to agricultural production compared to crop production. There was also clear temporal and seasonal variation in agricultural performance in the period 2010-2024. Agricultural Gross Domestic Product (GDP) has grown from around 2.600 in 2010 to over 5.600 in 2024, with some seasonality registered. Attention must in addition be paid to the way productive capacity responds to shifting prices, demand, financing, investments and conditions in the subsectors when understanding agricultural performance. Another significant aspect of agricultural performance is price dynamics. Price changes in the agricultural markets may affect the incentives of producers, the demand of households, investment decisions and the allocation of resources. Moreover, finance may also help farmers and/or agricultural businesses to buy productive assets such as machinery, technology, inputs, storage facilities, etc. Demand conditions generated in the household sector can also stimulate production and use of agricultural resources. Therefore, the capacity utilization of agriculture can be described in a wider system where output, prices, financing, consumption and subsector performance are interconnected. In the present study these dimensions are operationalised as agricultural GDP,

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agricultural Implicit Price Deflator (IPD), Commercial Credit to Agriculture (CCA), Final Consumption Expenditure of Households (FCEH) and agricultural subsector indicators.

Empirical studies confirm that productivity and efficient use of inputs are key factors to agricultural development. The analysis of agricultural production was employing economic-mathematical modelling, correlation and multivariate regression [1]. The coefficient of determination (R) of their model was about 99.1% for agricultural production variation. The capital and investment resulted in positive coefficients of 1.47909 and 1.11132, respectively, while the other variables yielded negative coefficients. The researchers found that the use of the capital resources in an efficient manner, capital investment, technology application and resource allocation are essential in sustainable agricultural productions. These results offer significant insights for including capacity utilization as a component of agricultural performance. In Nigeria, assessed crop production and economic growth and found that crop production accounts for about 83.5% of the agricultural Gross Domestic Product (GDP)[2]. The model accounted for 93.2% of the variation in GDP and their Error Correction Mechanism (ECM) showed a significant contribution of crop output to economic performance (β=0.03, p=0.0021). Mechanization and optimization of labour capital combinations were recommended by the study. This evidence is especially important given the fact that the crop production is also the primary agricultural subsector in the present study. The international literature increasingly demonstrates that agricultural productivity depends on more than conventional inputs. Xu et al. (2025) revealed agro-industrial clusters had a significantly positive effect on Agricultural Total Factor Productivity (ATFP) with capital inflow showing a positive effect (β=0.1392, p<0.01). Spatial spillovers made up 63.49% of the total impact, highlighting the significance of value-chain integration and factor mobility. In addition, Ye (2025) found that the digital economy had a strong positive effect on high-quality agricultural development (r=0.815, p<0.01), with the role of agricultural technology innovation and human capital as important transmission mechanisms. Digitalization has had a significant positive effect on agricultural Total Factor Productivity (TFP) (β=0.12, p<0.01) mainly due to innovation and marketization [3].

Other research highlights optimization of resources and structural organization. The heterogeneity in agricultural production and ecological suitability enabled optimal allocation of the agricultural resources [4]. Multiobjective optimization can be applied to simultaneously enhance agricultural output by 3.2% and alleviate environmental pressures via restructuring [5]. The rural digital economy had a positive and significant effect on agricultural production structure upgrading, with agricultural technological innovation, industrial integration, and the overall indicators all being significant at the 1% level [6]. The studies as a whole show that efficient resource utilization, technology, structural organization, investment, and market integration are the key factors to productive performance in agriculture. Time dynamics are also important. The consumption pattern had changed over the years and by 2030, the vegetable consumption per capita will rise from 49.35kg/year to 105.91kg/year using the ARMA (Autoregressive Integrated Moving Average) approach [7]. The use of economic-mathematical models in planning agricultural production was also obtained vegetable production growth rate of 36.6% in the period of 2010-2014 [8]. The present results highlight the need for analyzing agricultural performance taking into account temporal changes as done in quarterly trend analysis.

While Nigeria's agriculture has the potential to produce significant food supply, and agricultural output has been observed to have increased in recent years, it is not clear if the increased production has been matched by increased use of available productive capacity. Rather than merely an increase in agricultural output, the question is whether the sector is continually transforming the available financial, productive and market resources into actual capacity. In the current manuscript, it is identified that there are significant variations in agricultural production, prices, credit, consumption, capital inflows and capacity utilization in the period 2010-2024. Previous research offers solid insights into agricultural productivity, production of crops, use of capital, technological change, digitalization, agricultural commercialism, resource optimization, and economic growth. However, these strands of evidence largely examine particular components independently. It is still imperative to have an integrated exploratory assessment where agricultural capacity utilization is at the center while exploring its relationships with output performance, agricultural prices, commercial credit, household demand, and subsector performance in Nigeria. This is significant because an increase in financial resources does not necessarily mean productive use. Similarly, seasonal volatility, inadequate utilization of resources, fluctuating investment patterns, or intersectoral differences could coexist with expanding agriculture production. In order to make more robust causal inferences or to conduct more sophisticated econometric analyses, it is necessary to first empirically test these relationships.

The study is motivated by the need to ascertain if Nigeria's agricultural expansion is going hand in hand with increased utilization of available productive capacity. The review revealed that the use of capital, investment, technical innovation, resource allocation, market integration, and structural transformation can boost agricultural productivity [1]; [6]; [9]; [10]. However, very little study has been conducted in Nigeria on agricultural capacity utilization as an integrated indicator which is taken together with agricultural production, price conditions, credit, household consumption and subsector performance.

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These patterns can be discerned from the manuscript by studying the 2010–2024 period, which is suitable for observing long-term movements and recurring seasonal patterns. The exploratory approach is also intentionally appropriate at this point because it does not assume that the answer lies in causality, but rather sets the parameters of the distribution, temporal patterns, and direction and intensity of the relationships among the variables chosen. This evidence can help to detect relationships that are worthy of further causal and predictive exploration, and offer valuable insights for agricultural financing, investment, mechanization, infrastructure, productivity and value chain policies. The specific objectives are to:

a. Review the distribution pattern of agricultural output, agricultural price indicators, commercial credit and household consumption expenditure in Nigeria;

b. Evaluate growth trends and seasonal fluctuations in agricultural production, agricultural prices, capital imports, and agricultural capacity utilization during the period 2010-2024;

c. determine the direction and strength of relationships between Agricultural Capacity Utilization and selected agricultural and macroeconomic indicators;

d. Compare the relationship between Agricultural Capacity Utilization and the performance of the crop production, livestock, forestry and fishing subsectors; and

e. identify empirical patterns capable of informing policies for improved resource utilization, agricultural financing, investment, productivity, and sustainable agricultural development.

2. Conceptual Framework

The conceptual framework places Agricultural Capacity Utilization (ACU) as the key measure of the ability of the agricultural sector in Nigeria to be productive. Capacity utilization is not just a production indicator, but a reflection of agricultural production, price situation, financing, household demand and performance of subsectors. Thus, the agricultural GDP is an index of the total output performance, and the Implicit Price Deflator for Agriculture reflects the price changes in agriculture. Commercial Credit to Agriculture are the financing conditions in the domestic economy and Final Consumption Expenditure of Households indicates the demand conditions in the economy, whereas agricultural subsector ratios indicate the relative performance of crop production, livestock, forestry and fishing subsectors.

The analysis then continues with the Descriptive Characteristics, followed by the Temporal Dynamics, and then the Correlation with ACU. Investment, capital flows, resource efficiency and productive organization in agricultural performance [1]; [9]. Most importantly, the framework is exploratory; observed correlations suggest associations and do not imply causal effects.

3. Method

The methodological procedures used to investigate the extent of agricultural capacity utilization and its relationship with agricultural output, agricultural price dynamics, credit, household consumption patterns, and subsector performance in Nigeria are described here. The quarterly secondary time-series data was used and the exploratory quantitative method used was descriptive statistics, graphical trend analysis, and Pearson Product-moment correlation analysis. These techniques allowed for the analysis of variability, temporal trends and the magnitude and direction of relationships among the agricultural indicators selected. The methodological structure was developed to be consistent with theoretical objectives of the study and the analysis of results.

3.1. Research Design

The study employed a quantitative, longitudinal, time series research design to investigate the trend of agricultural capacity utilization and some of agricultural and macroeconomic indicators in Nigeria between 2010 and 2024. The longitudinal design was appropriate because it permitted the assessment of agricultural performance across 60 successive quarterly observations from the first quarter of 2010 to the fourth quarter of 2024, thereby capturing long-term movements, seasonal fluctuations and changes in output, prices, investment, household demand and capacity utilization. Agricultural indicators such as Agricultural Capacity Utilization (ACU), agricultural Gross Domestic Product (GDP), agricultural Implicit Price Deflator (IPD), Commercial Credit to Agriculture (CCA), Final Consumption Expenditure of Households (FCEH) and agricultural subsector indicators were considered for the study. The quantitative design allowed the numerical assessment in an objective manner using descriptive statistics, graphical trend analysis and correlation analysis. The utility of quantitative modelling and correlation analysis to understand the dynamics of agricultural production [1]. It also offers empirical evidence to assess if agricultural performance is improving in concert with using the productive capacity available.

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3.2. Source of Data Collection

The data for the study were secondary quarterly time-series data sourced from the national macroeconomic databases which included the Central Bank of Nigeria (CBN) Statistical Bulletin and the National Bureau of Statistics (NBS) for the first quarter of 2010 to the fourth quarter of 2024. The data set included agricultural Gross Domestic Product (GDP), Implicit Price Deflator indexes, Capital Importation into Agriculture (CIA) and Final Consumption Expenditure of Households (FCEH). Agricultural GDP and Implicit Price Deflator (IPD) were derived for agriculture and the major subsectors of agriculture (crop production, livestock, forestry and fishing).

The data were reported on an evenly-spaced quarterly schedule for comparison of changes in time from one quarter to the next during the study period. Data preparation consisted of harmonizing the quarterly series for trend analysis of agricultural GDP, Implicit Price Deflator, capital importation and household consumption expenditure, in the first step. In the second stage, the series of agriculture GDP and the series of Implicit Price Deflator were employed to form sector-specific efficiency ratios as proxies for productive capacity utilization.

Since there were no direct quarterly indicators of agricultural capacity utilization, the study calculated a proxy index of Agricultural Capacity Utilization (ACU). The historical observations in the present study are also arranged on a consistent quarterly basis, which allows a comparison between different periods of agriculture's performance and make assessments about the relationship between capacity utilization and selected indicators. Sector-specific capacity-utilization proxy ratios were constructed from the relationship between the Implicit Price Deflator and corresponding sectoral GDP series. These engineered indicators were subsequently standardized and integrated through PCA to obtain a common composite proxy for agricultural capacity utilization (Equation 1).

$$Ratio_j = \frac{IPD_j}{GDP_j} \tag{1}$$

Where, IPD_j denotes the Implicit Price Deflator for sector j, and GDP_j represents the corresponding sectoral Gross Domestic Product.

The constructed ratios included agriculture ratio, crop production ratio, livestock ratio, forestry ratio, and fishing ratio. To avoid computational instability arising from zero values, a small constant epsilon ($\varepsilon = 10^{-6}$) was added to denominators during ratio computation.

3.3. Study Area Description

The study area is Nigeria, emphasis on productive capacity performance and utilization in agricultural sector. There are several significant subsectors in agriculture that include crop production, livestock, forestry, and fishing, which make up some of the contributions of agriculture and its operating conditions vary significantly. The agricultural production results from the study showed that crop production makes the most dominant part accounting for 3.724.07 while livestock production accounted for 283.74, fishing 86.09 and forestry 42.97 of the mean GDP. Nigeria is a suitable country to study the issue of agricultural capacity utilization as agricultural production is subject to significant time and seasonal fluctuations, and financial, investment, household demand and prices also vary over time. The significance of crop production for Nigeria's agricultural economy and its role in the economic performance. A review of Nigeria from 2010 to 2024 will therefore reveal the performance of the agriculture productive capacity over the years and the changes in agricultural output, agricultural prices, credit availability, agricultural consumption, and subsector performance [2].

3.4. Method of Data Analysis

In this study, descriptive statistics, graphical trend analysis and Pearson product-moment correlation analysis were used. The techniques were used sequentially to characterize agricultural performance, look at temporal dynamics, and identify relationships between Agricultural Capacity Utilization and the selected indicators.

3.4.1. Descriptive Statistical Analysis

The agricultural GDP, crop production, livestock production, forestry, fishing, agricultural and subsector IPDs, CIA and FCEH were computed as descriptive statistics; the arithmetic mean, standard deviation, minimum and maximum values. The arithmetic mean was used to determine the average value of each variable (Equation 2):

$$\bar{X} = \frac{1}{n}\sum_{t=1}^{n} X_t \tag{2}$$

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The observation at the time t is denoted as y and the number of observations is n. The amount of variation was calculated by the sample standard deviation (Equation 3):

$$s = \sqrt{\frac{\sum_{t=1}^{n}(X_t - \bar{X})^2}{n-1}} \quad (3)$$

Where, X_t denotes the value of the function at time t, $\bar{X}$, and n is the number of observations, and represents the sample mean. Where, s is the standard deviation. The observed minimum and maximum values of each of the series were used to determine the lower and upper limits.

3.4.2. Graphical Trend Analysis

A graphical time-series analysis was used to analyze the quarterly changes of the main agricultural indicators over the period 2010–2024. Analysis was carried out on four parameters of agriculture namely, agricultural GDP, agricultural IPD, capital importation into agriculture and Agricultural Capacity Utilization Index. The plots were to see if there were any persistent rises or falls, fluctuations, seasonal trends, peaks, troughs or periods of relative stability.

The approach would be suitable for exploratory measurement of the temporal agricultural behaviour. The instance, highlighted the need to take time dynamics into consideration for agricultural consumption analysis and planning. However, neither the graphical procedure used in the present study should be interpreted as a formal statistical test for structural change, nor should the graphical results be interpreted as the sole basis for such a test [7].

3.4.3. Pearson Product-Moment Correlation Analysis

Pearson product-moment correlation analysis was used to measure the intensity and direction of the linear relationships between the Agricultural Capacity Utilization Index and the selected agricultural indicators. The coefficient was calculated as Equation 4:

$$r_{XY} = \frac{\sum_{t=1}^{n}(X_t - \bar{X})(Y_t - \bar{Y})}{\sqrt{\sum_{t=1}^{n}(X_t - \bar{X})^2 \sum_{t=1}^{n}(Y_t - \bar{Y})^2}} \quad (4)$$

where r_{XY} ranges from −1 to +1. If the values are positive, then there is a direct relationship, if the values are negative then an inverse relationship, and if the values are near zero, then there is not a strong linear association. If any relationships were found, they were considered to be associations, not cause and effect. This correlation analysis in a framework of agricultural production and found high correlation between production and some productive factors. Correlations in the present study were interpreted as association, but not necessarily causality [1].

Because several variables exhibit pronounced temporal trends, the Pearson correlation coefficients are interpreted strictly as descriptive measures of contemporaneous linear co-movement rather than evidence of equilibrium, predictive or causal relationships. No causal inference is therefore drawn from the magnitude of the coefficients. Future confirmatory analysis should examine stationarity, cointegration and dynamic relationships using appropriate time-series econometric techniques.

3.5. Analytical Framework

Analytical framework is a conceptualization of Agricultural Capacity Utilization (ACU) as utilization of the available productive resources and capacity in Nigeria's agricultural sector. An empirical account of its behavior in terms of agricultural production, price conditions, financing, household demand and the relative performance of the subsectors of agriculture is presented. The general form of the relationship is Equation 5:

$$ACU_t = f(GDPA_t, IPDA_t, CCA_t, FCEH_t, RAGR_t, RCROP_t, RLIV_t, RFOR_t, RFISH_t) \quad (5)$$

where ACU_tdenotes Agricultural Capacity Utilization; $GDPA_t$ represents agricultural Gross Domestic Product; $IPDA_t$ denotes agricultural Implicit Price Deflator; CCA_t is Commercial Credit to Agriculture; $FCEH_t$ represents Final Consumption Expenditure of Households; while $RAGR_t$, $RCROP_t$, $RLIV_t$, $RFOR_t$, and $RFISH_t$ represent the agriculture, crop, livestock, forestry, and fishing ratios, respectively. The framework follows three empirical stages:

Descriptive Characteristics → Temporal Dynamics → Correlation with ACU

The framework acknowledges that productive capacity could be linked not just to financial resources but also to output performance, demand, prices and resource utilization efficiency. This view associated agricultural productivity with factor movement, as well as capital inflows, and investment and efficient use of the factors of

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production in agriculture production. The framework is exploratory and as such does not prescribe causal relationships between variables [1]; [9].

3.6. Justification of the Study

The rationale underpinning the study is the determination on whether the increasing agricultural production in Nigeria has been matched by the ability to utilize available productive capacity for the country. The empirical data reveal significant differences in agricultural output, agricultural prices, financing, agricultural consumption and subsectors, and Agricultural Capacity Utilization has also exhibited significant fluctuations over time. Previous studies have highlighted the significance of productivity, technology, capital investment, commercialization and resource allocation in agricultural development. Production factors and that agro-industrial organization and capital inflows are contributing factors to agricultural productivity [1]; [9]. An analysis of agricultural capacity utilization, however, in conjunction with agricultural output, prices, household demand, credit, and subsector performance, offers a wider exploratory perspective for Nigeria. The findings can therefore support policies directed towards improving resource utilization, agricultural financing, productivity, investment, and sustainable agricultural development.

4. Results and Discussion

4.1. Result of the Analysis

The descriptive statistics for agricultural output, price dynamics, agricultural credit and household consumption expenditure in Nigeria is presented in Table 1.

Table 1. Descriptive Statistics of Agricultural Gross Domestic Product, Implicit Price Deflator, Credit to Agriculture, and Household Consumption Expenditure

Variable	Mean	Standard Deviation	Minimum	Maximum
GDP Agriculture	4.136.87	893.03	2.594.76	5.698.27
GDP Crop Production	3.724.07	866.26	2.262.18	5.270.72
GDP Livestock	283.74	34.81	216.10	349.86
GDP Forestry	42.97	6.13	30.16	53.77
GDP Fishing	86.09	16.40	58.21	125.46
Implicit Price Deflator (IPD) – Agriculture	157.97	55.87	100.00	285.74
Implicit Price Deflator (IPD) – Crop Production	155.25	54.82	99.46	281.49
Implicit Price Deflator (IPD) – Livestock	159.91	35.78	100.00	251.03
Implicit Price Deflator (IPD) – Forestry	141.85	29.69	100.00	259.33
Implicit Price Deflator (IPD) – Fishing	270.88	196.17	100.00	642.67
Commercial Credit to Agriculture (CCA)	33.99	41.83	0.00	197.85
Final Consumption Expenditure of Households (FCEH)	83.996.01	31.977.42	36.452.43	141696.75

The results reveal that GDP Agriculture has an average value of 4.136.87 with considerable variation (SD = 893.03) and a range of 2.594.76 to 5.698.27, which shows the substantial fluctuations in the agricultural performance over time. Crop Production had the highest mean value of output (3.724.07) and Forestry had the lowest (42.97) among the agricultural subsectors. The IPD to fishing showed the highest volatility (Mean = 270.88; SD = 196.17) with a maximum value of 642.67 indicating high price volatility in the fishing subsector. Further, the Commercial credit to Agriculture (CCA) had a large variation (SD = 41.83) and its mean of 33.99 suggested a lack of uniformity in agricultural credit usage. The mean value of Final Consumption Expenditure of Households (FCEH) was high at 83.996.01 with high standard deviation (SD = 31.977.42), reflecting the rising demand of households in consumption of agricultural products. These findings suggest that although Nigeria's agriculture is growing, significant differences in output, prices, access to credit and consumption patterns still exist, and policies are needed to support price stability, agricultural financing, and productivity, in terms of agricultural subsectors. Figure 1 shows upward trend in Nigeria's quarterly Agricultural Gross Domestic Product (GDP) from approximately 2.600 in 2010 to over 5.600 by 2024, indicating sustained long-term growth in agricultural output.

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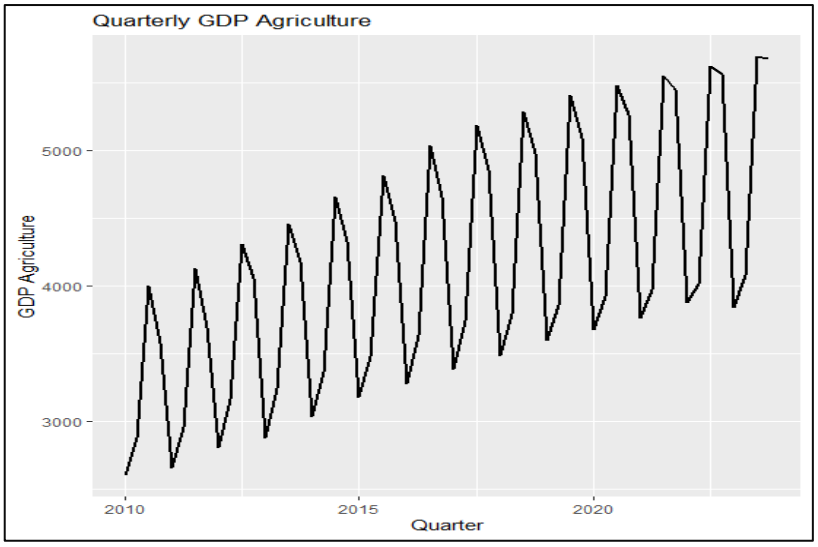

Figure 1. Quarterly Trend and Seasonal Pattern of Agricultural Gross Domestic Product in Nigeria (2010–2024)

The series also shows strong seasonal variation, with peaks and troughs repeating themselves from year to year. From 2010 to 2024, Peak agricultural GDP grew from ~4.000 to >5.600, and Trough values increased from ~2.600 to >3.900 during this time. The increase in the output suggests the improvement of productivity in agriculture and also in the level of market demand and contribution of the sector to the economy. The weather/seasonality trend, however, suggests continued reliance on climatic conditions and production cycles. The results suggest that, while the agricultural sector has grown considerably, irrigation, storage facilities, mechanization and value chain development continue to be key investments in securing a replacement of the seasonal fluctuations and maintaining agricultural capacity utilization in Nigeria. The quarterly trend of the agricultural Implicit Price Deflator (IPD) in Nigeria from 2010 to 2024 is shown in Figure 2.

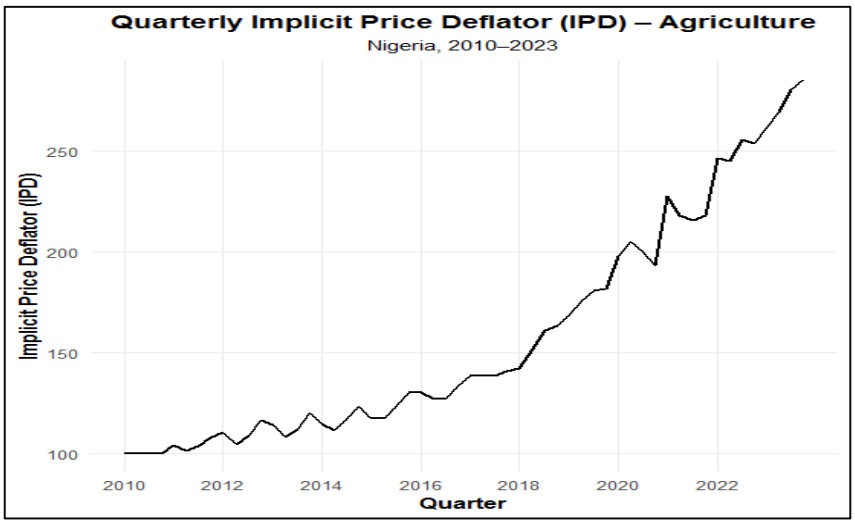

Figure 2. Quarterly Implicit Price Deflator (IPD)–Agriculture, Nigeria (2010–2024)

Agricultural output's price level showed a significant increase from around 100 in 2010 to 280 in 2024. There are some moderate fluctuations throughout the series but the sharp rise is visible after 2019. This pattern indicates increasing agricultural price pressures rather than growth in physical agricultural production. The continuous rise could be attributed to the cost of production, price of inputs, exchange rate conditions, short supply and inflationary pressures. The graph, however, doesn't tell us which factors are specifically responsible for this increase, which is why the analysis is exploratory. The outcome, therefore, emphasizes the need to take into account the dynamics of agricultural prices when assessing productive capacity and the demand of the household in Nigeria. The Commercial Credit to Nigerian agriculture sector between the period 2010 and 2024 as presented in Figure 3 shows significant fluctuation in the quarterly capital importation into agriculture sector.

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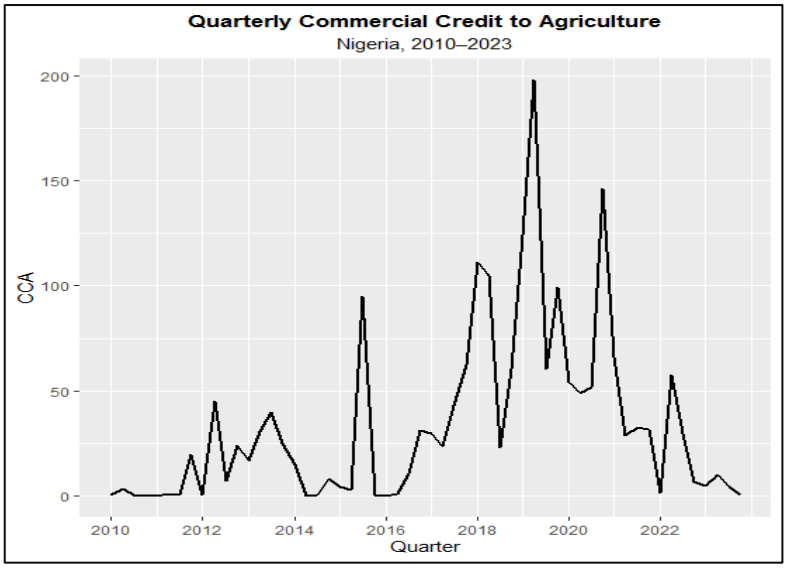

Figure 3.Quarterly Trend of Commercial Credit to Agriculture into Nigeria's Agricultural Sector (2010–2024)

Commercial Credit into agriculture was highly volatile, remaining generally low during the earlier years before increasing sharply after 2017, reaching a major peak of approximately 198 units in 2019 and another notable peak of approximately 146 units in 2021. The series is, however, very volatile, with some quarters having sharp drops to virtually zero. The variations indicate irregular investment movements into agriculture even during the time when there was substantial capital inflow. The volatility observed suggests that agricultural investment continues to be sensitive to macroeconomic uncertainties, policy changes and investor confidence. This means that investment policies need to be stable, and financial access and infrastructure need to be strengthened, with the creation of a more predictable investment climate that will attract long-term investment into agriculture to ensure sustained growth in agricultural capacity utilization. Figure 4 illustrates the quarterly movement of the Agricultural Capacity Utilization (ACU) Index in Nigeria from 2010 to 2024.

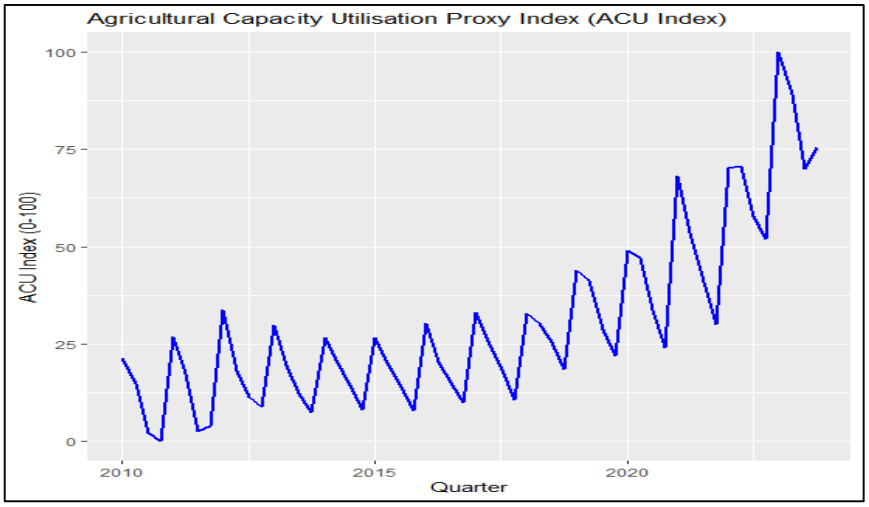

Figure 4. Dynamics of Agricultural Capacity Utilization in Nigeria

The index has a clear upward trend, rising from around 20 in 2010 to 100 in 2023 and then leveling off to around 75 in 2024. There are also some persistent annual variations, with peaks and troughs in the data corresponding to the agricultural production cycle. Significantly, after 2019, the capacity utilization increased, reaching peak values between approximately 45 and 100, showing great progress in agricultural productivity and resource utilization. The general tendency indicates higher efficiency of the sectors, higher level of production growth, and a higher degree of integration of productive factors. The continuous volatility suggests, however, that agricultural capacity utilization is still subject to seasonal conditions as well as to financial constraints and market dynamics. The findings culminate the need for investments that can ensure high utilization of agricultural machinery, and long-term agricultural growth in Nigeria through investments in agricultural infrastructure, agricultural mechanization, irrigation system, and access to credit. Table 2 shows

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that the Agricultural Capacity Utilization (ACU) Index is positively correlated with most agricultural productivity measures.

Table 2. Correlation Matrix Coefficients among Agricultural Capacity Utilization Indicators and Selected Macroeconomic Variables in Nigeria

Variables	ACU Index	GDP Agriculture	IPD Agriculture	CCA	FCEH	Ratio Agriculture	Ratio Crop	Ratio Livestock	Ratio Forestry	Ratio Fishing
ACU Index	1.00	0.13	0.88	0.06	0.82	0.95	0.93	0.89	0.77	0.75
GDP Agriculture	0.13	1.00	0.53	0.16	0.54	-0.09	-0.13	0.18	0.09	0.59
IPD Agriculture	0.88	0.53	1.00	0.15	0.92	0.79	0.76	0.75	0.57	0.92
CCA	0.06	0.16	0.15	1.00	0.29	0.10	0.10	0.03	-0.13	0.13
FCEH	0.82	0.54	0.92	0.29	1.00	0.72	0.69	0.75	0.57	0.79
Ratio Agriculture	0.95	-0.09	0.79	0.10	0.72	1.00	0.99	0.77	0.61	0.65
Ratio Crop	0.93	-0.13	0.76	0.10	0.69	0.99	1.00	0.74	0.59	0.62
Ratio Livestock	0.89	0.18	0.75	0.03	0.75	0.77	0.73	1.00	0.74	0.62
Ratio Forestry	0.77	0.09	0.57	-0.13	0.57	0.61	0.59	0.74	1.00	0.39
Ratio Fishing	0.75	0.59	0.92	0.13	0.79	0.65	0.61	0.62	0.39	1.00

Notes: ACU = Agricultural Capacity Utilization Index; GDP = Gross Domestic Product; IPD = Implicit Price Deflator; CCA = Credit to Agriculture; FCEH = Final Consumption Expenditure of Households.

Improvements in agricultural productivity, output prices, and household demand, as measured by the ACU Index, are closely related to higher capacity utilization, with the strongest relationships to Ratio Agriculture (r = 0.95), Ratio Crop (r = 0.93), Ratio Livestock (r = 0.89), IPD Agriculture (r = 0.88), and Final Consumption Expenditure of Households (FCEH) (r = 0.82). The Commercial Credit to Agriculture (CIA) is related to the Agricultural Credit Utilization (ACU) with low correlation (r = 0.06) which implies that the credit inflows to agriculture have not been proportionately utilized productively. Close association between the components of Ratio Agriculture and Ratio Crop (r = 0.99) further indicates the leading role of crop production in agricultural performance. Furthermore, the coefficient of correlation between IPD Agriculture and FCEH is 0.92, while the coefficient of correlation between IPD Agriculture and Ratio Fishing is 0.92, demonstrating that price developments in agriculture have a large impact on the consumption and productivity of the sector. The results show that agricultural capacity utilization in Nigeria is more dependent on productivity growth, output performance, and market demand than on credit availability, highlighting the importance of policies that could increase productivity, value-chain efficiency, and market reach in the agricultural subsectors.

Because the sectoral ratios constitute the underlying indicators from which the composite ACU Index was constructed, their correlations with ACU are interpreted as measures of component alignment with the composite index rather than as independent relationships. By contrast, correlations between ACU and external macroeconomic indicators are interpreted as descriptive evidence of contemporaneous co-movement.

4.2. Discussion of Findings

The results show significant differences between the performance and dynamics of Nigeria's agricultural sector between 2010 and 2024. The average output of agricultural Gross Domestic Product (GDP) was 4.136.87 with a standard deviation of 893.03, and the largest share was from crop production with average output of 3.724.07. The price variability was very high for fishing, as the Implicit Price Deflator (IPD) mean was 270.88 and the standard deviation was 196.17 and the maximum value was 642.67. The patterns shown here illustrate that agricultural expansion has been accompanied by significant price volatility and subpectoral differences. The dominance of crop production that crop production is an important dimension of agricultural performance in Nigeria, and observed that crop production had a positive and significant impact on economic growth ($\beta = 0.03$, $p = 0.0021$) [2]. That agricultural production is well correlated with the major productive inputs and their model accounted for 99.1% of output variation [1]. The results of the present study therefore corroborate the need to improve agricultural production to be accompanied with efficient use of resources, productivity growth and targeted interventions to specific sectors.

The temporal findings also support continued agricultural expansion, to a large extent seasonally dependent. The annual variation of agricultural GDP was observed to be in a range between 2600 and 5600 per quarter and the peaks and troughs were also evident throughout the period as the GDP continued to increase from 2010 to 2024. In fact, the agriculture index of the IPD rose from about 100 in 2010 to about 280 in 2024, showing significant fluctuations in agricultural prices over time. The results is a need to consider temporal dynamics in the planning of agricultural production and consumption as vegetable consumption is projected to increase from 49.35 to 105.91 kg per capita annually [7]. They that their economic-mathematical models were able to show that agricultural production did increase measurably, particularly for vegetables, where they found that production in 2010–2014 increased 36.6% [8]. Despite this seasonality found in the Nigerian data, the fact that it remains strong suggests that production-cycle vulnerability has not been removed by growth. Therefore,

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irrigation, mechanization, storage, more efficient technology, and better infrastructure for agriculture are still key to bringing more regular productive capacity into existence from the observed growth in output.

One of the more significant results is the difference in the behavior of capital inflows and agricultural capacity utilization. Capital importation into agriculture was very sporadic and reached as low as 19 units before 2019 and 146 units in 2021 in individual quarters and around 20 units in general during the earlier years. Overall, the Agricultural Capacity Utilisation (ACU) Index rose from around 20 in 2010 to 100 in 2023 but fell to around 75 in 2024. The results showed that capital and investment are relevant positive factors affecting agricultural production, which identified capital inflow as a significant contributor to Agricultural Total Factor Productivity (ATFP) ($\beta = 0.1392$, $p < 0.01$) [1]; [9]. The findings which show that productivity gains are not only related to increases in inputs but also to technology, innovation, human resources and structural transformation [3]; [10]. Thus, the combination of higher capacity utilization and volatile investments indicates that sustainable agricultural growth will need to have predictable financing while at the same time ensuring that productive resources are deployed efficiently.

The correlation results provide the strongest evidence regarding the factors associated with agricultural capacity utilization. The Agriculture Ratio ($r = 0.95$), Crop Ratio ($r = 0.93$), Livestock Ratio ($r = 0.89$), agricultural IPD ($r = 0.88$) and agricultural Final Consumption Expenditure of Households (FCEH) ($r = 0.82$) were all strongly positively correlated with ACU, while Commercial Credit to Agriculture (CCA) was weakly correlated with capacity utilization ($r = 0.06$). Furthermore, the Agriculture and Crop ratios were almost perfectly correlated ($r = 0.99$), and the agricultural IPD was well correlated with both FCEH and Fishing Ratio ($r = 0.92$ each). This is especially notable for the relationship between the weak CCA and the ACU as it implies that higher credit availability does not necessarily lead to higher utilization of productive capacity. The of factor mobility and value-chain integration, and technological innovation and industrial integration as key mechanisms for agricultural production upgrading [9]; [6]. The allocation of agricultural resources, and that agricultural restructuring can have a dual effect on production and resource efficiency [4]; [5]. The present findings collectively indicate that the utilization of Nigeria's agricultural capacity seems to be more related with production performance, price conditions, household demand, productivity rather than only credit availability.

The findings on Agricultural Capacity Utilization (ACU) in Nigeria demonstrate that capacity utilization correlates weakly with commercial credit ($r = 0.06$) but strongly with output, price dynamics, and household demand. This indicates that financial infusion alone is insufficient for sectoral growth without robust structural, technological, and managerial frameworks [11]; [12]. Just as targeted risk management and self-regulatory skills drive success in enterprise and academic domains [13]; [14], agricultural productivity requires efficient resource optimization and skill development. Furthermore, enhancing agricultural capacity mirrors findings on modernizing educational and technological ecosystems, where digital tools, search engine optimization, and blended learning environments significantly boost performance [15]; [16]. Analogous to how computer animations, virtual classrooms, and science process skills elevate student achievement [17]; [18]; [19]; [20], agricultural modernization relies heavily on technological adoption, digital economy integration, and innovative pedagogical or technical frameworks. Ultimately, achieving sustainable agricultural development and structural transformation demands comprehensive policy interventions that prioritize infrastructural readiness, AI-driven green innovations, and systemic capacity building over mere capital allocation [21]; [22]

5. Conclusion

This study analyzed the dynamics of agricultural capacity utilization and agricultural sector performances in Nigeria from 2010 to 2024 with emphasis on agricultural output, price dynamics, financing, demand of agricultural products by households, investment in agriculture and subsector performances. The analysis shows that a significant expansion of the agriculture sector took place during the study period, but with significant seasonal variations, price volatility, uneven investment flows, and variation in growth across subsectors of agriculture. Agricultural capacity utilization, in the sense of indicator, is thus more of a reflection on the relationship between productive performance, the market, the utilization of resources and the sectoral structure, than on the availability of financial resources. The results highlight the need to measure agricultural development not just in terms of total output but also to see if productive resources, available at a particular time, are being productively utilized, so as to increase sustainable agricultural output.

The major findings indicate that the mean of agricultural Gross Domestic Product (GDP) was 4.136.87, with standard deviation of 893.03, and the crop production had the highest mean in the agricultural output of 3.724.07. There was the highest price variation in the case of fishing as the Implicit Price Deflator (IPD) mean price of 270.88, standard deviation price of 196.17, and maximum price of 642.67. Even though there has been a seasonal variation, agricultural GDP has risen from about 2600 to above 5600 in 2024. Agricultural Capacity Utilization (ACU) likewise rose from around 20 in 2010 to 100 in 2023, dropping back to about 75 in 2024. ACU was strongly correlated with the agriculture ratio (0.95), crop ratio (0.93), livestock ratio (0.89), agricultural IPD (0.88) and the Final Consumption Expenditure of Households (0.82), but only weakly with Commercial Credit to Agriculture (0.06).

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The upward trajectory of the ACU proxy indicates a substantial improvement in the composite measure of agricultural capacity utilization, particularly after 2019. The increase reflects stronger combined movements in the underlying sectoral indicators incorporated into the index, although it should not be interpreted as a direct technical-efficiency measure. Strong linkages of capacity utilization, subsector performance, agricultural prices and household demand highlight the need for investments in productivity, efficient resource utilization, market development and robust agricultural value chains. Commercial credit has a negligible relationship with the capacity utilization, indicating that the funding should be assessed on the basis of its productive utilization, and not simply volume. Thus, policy interventions should focus on mechanization, infrastructure for storage and processing, technology adoption, stable investment environment and market access. Special focus should also be paid to minimizing seasonal production constraints and supporting non-crop subsectors for a more balanced agricultural development. In summary, the agricultural expansion observed in Nigeria is a bedrock for enhanced capacity utilisation and sustained agricultural expansion will depend on coordinated policies that mobilise existing financial, physical, technological and market resources into stable and efficient agricultural production.

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Data Availability

The datasets generated during and/ or analysed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

The authors declare that no artificial intelligence (AI) or AI-assisted tools were used in the preparation of this manuscript.

References

[1] V. A. Tofiq, N. M. Gabil, M. T. Zahid, R. M. Jabbar, A. H. Vahid, and M. K. Haji, "Modeling and forecasting of production of an agricultural product," *Journal of Law and Sustainable Development*, vol. 11, no. 7, pp. 1–18, 2023, doi: 10.55908/sdgs.v11i7.625.

[2] M. C. Uzonwanne, C. C. Mbah, C. I. Obi, and F. C. Onyedibe, "The impact of crop production on the economic growth of Nigeria," *Journal of Advanced Research in Economics and Administrative Sciences*, vol. 4, no. 2, pp. 1–12, 2023, doi: 10.47631/jareas.v4i2.603.

[3] J. He, Z. Wei, and X. Lei, "Unveiling the digital revolution: Catalyzing total factor productivity in agriculture," *PLOS ONE*, vol. 20, no. 3, Art. no. e0318333, 2025, doi: 10.1371/journal.pone.0318333.

[4] X. Li, X. Xu, and R. M. Yin, "Spatial optimization of agricultural production from the perspective of 'Greater Food Concept' in Yangzhou, China," *Ecological Indicators*, vol. 169, Art. no. 112805, 2024, doi: 10.1016/j.ecolind.2024.112805.

[5] D. Duan, "Study on sustainable agricultural structure optimization method based on multiobjective optimization algorithm," *Computational Intelligence and Neuroscience*, vol. 2022, Art. no. 5850684, 2022, doi: 10.1155/2022/5850684.

[6] F. Wang, H. Wang, and L. Xiong, "Does the digital economy exhibit multiplier effects? A case study on the optimization of agricultural production structure in rural digital economy," *International Journal of Agricultural Sustainability*, vol. 22, no. 1, Art. no. 2386821, 2024, doi: 10.1080/14735903.2024.2386821.

[7] J. M. Maganga, "ARIMA consumption forecasting models and ATDC technological optimizations: The case of rice, maize and vegetable production in Mozambique," *Scientific African*, vol. 28, Art. no. e02762, 2025, doi: 10.1016/j.sciaf.2025.e02762.

[8] T. O. Tolgon, G. M. Gulamzhan, D. K. S. Dilara, A. B. T. Akmalina, and E. S. K. Elmira, "Optimization of production and realization of main types of crop products on the basis of modeling," *Journal of Engineering and Applied Sciences*, vol. 14, no. 14, pp. 4826–4833, 2019.

[9] W. Xu, S. Zhou, and H. Lei, "Agro-industrial clusters, spatial effects and agricultural total factor productivity: An empirical analysis based on county-level panel data from China," *International Review of Economics and Finance*, vol. 102, Art. no. 104395, 2025, doi: 10.1016/j.iref.2025.104395.

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ISSN: 3110-1577

[10] L. Ye, "Digital economy and high-quality agricultural development," *International Review of Economics and Finance*, vol. 99, Art. no. 104028, 2025, doi: 10.1016/j.iref.2025.104028.

[11] B. O. Onyiorah, "Artificial intelligence skill development as a predictor of job readiness among business education undergraduates in tertiary institutions in Anambra State, Nigeria," *Journal of Investment Development, Economics and Accounting*, vol. 2, no. 2, pp. 114–126, 2025.

[12] N. C. Emeasoba, C. N. Nwatarali, J. N. Victor-Igwe, and B. O. Onyiorah, "Cultural and psychological school environment as correlate of academic achievement of secondary school English language students in Enugu State," *Cuestiones de Fisioterapia*, vol. 55, no. 1, pp. 80–92, 2026.

[13] N. C. Emeasoba, B. O. Onyiorah, V. N. Eneogwe, J. N. Victor-Igwe, C. C. Akpa, C. Adieze, C. A. Akudolu, C. N. Nwatarali, M. N. Ndom-Uchendu, F. U. Ikpeama, and V. S. Paul-Mgbeafulike, "Influence of debt and risk management skills on the management of small and medium scale enterprises (SMEs) in Umuahia Metropolis, Abia State, Nigeria," *Veredas do Direito*, vol. 23, no. 8, Art. no. e236253, 2026.

[14] N. N. Rita and H. N. O., "Students' self-regulatory skills as correlate of their academic achievement in biology in public secondary schools in Anambra State," *UNIZIK Journal of STM Education*, vol. 8, no. 2, pp. 180–191, 2025.

[15] F. A. Okoro, B. O. Onyiorah, and N. C. Emeasoba, "Business educators' perception of search engine and email marketing skills required for self-employment by business education students in South-South, Nigeria," *International Journal of Business and Entrepreneurship Education*, vol. 2, no. 2, pp. 90–100, 2025.

[16] C. Okelue, N. O. Henrietta, and M. I. Alado, "Gender dynamics and infrastructural challenges on the implementation of blended learning in higher education," *International Journal of Research and Innovation in Social Science*, vol. 9, no. 3, pp. 2276–2284, 2025.

[17] O. H. Nnalue, R. N. Nnorom, and N. O. Christian-Ike, "Computer animation as vehicle for enhancing secondary school students' academic achievement in biology," *UNIZIK Journal of Educational Research and Policy Studies*, vol. 17, no. 1, pp. 92–102, 2024.

[18] N. O. Christian-Ike, O. H. Nnalue, and M. O. Obili, "Perception and attitudes of basic science teachers towards the use of virtual classroom in Awka Education Zone," *Journal of Science Education and Research*, vol. 3, no. 1, pp. 45–60, 2025.

[19] M. C. Obikezie, E. D. Onyebuch, E. E. Akachukwu, and O. H. Nnalue, "School locations and gender variables on students' science process skills as a predictor of academic achievement in senior secondary school," *Eureka: Journal of Educational Research*, vol. 4, no. 1, pp. 1–7, 2025.

[20] O. M. Chukwunazo, A. E. Ebele, O. H. Nnalue, U. V. Amobi, and D. E. Uche, "Undergraduate students' science process skills as predictor of academic achievement in science education courses," *Journal Plus Education*, vol. 38, Special Issue, pp. 371–384, 2025.

[21] C. A. Ofozoba, P. C. Okafor, N. G. Ikegbusi, F. U. Manafa, J. U. Egwu, C. M. Nwobu, S. O. Okafor, M. A. Onafowope, V. K. Olofinkua, J. O. Adeagbo, and O. V. Gbaeprekumo, "AI-driven service-learning to enhance students' understanding of green nanomaterials in sustainability education," *Multidisciplinary Reviews*, vol. 8, no. 12, Art. no. 2025429, 2025.

[22] B. C. Anakpua, C. O. Inweregbuh, C. O. Odimkpa, C. J. Enemuo, C. A. Ofozoba, P. A. Isidi, U. F. Muogbo, O. H. Nnalue, R. E. Obiadazie, and O. C. Okudo, "Enhancing STEM education through AI-driven service-learning: Fostering student understanding of nanotechnology-based green materials for sustainability," *International Journal of Environmental Sciences*, vol. 11, no. 20S, 2025.

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