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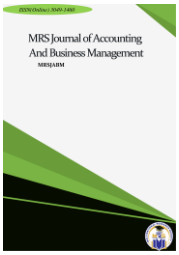

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Nexus between Agricultural Output and Sustainable Development in Nigeria

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Abstract: Abstract

This study explores the role of agricultural output in fostering sustainable development in Nigeria, examining the interplay between agriculture, economic growth, food security, and environmental sustainability. The research employs both qualitative and quantitative methods to investigate the challenges and opportunities within the agricultural sector, using data from credible sources like the Central Bank of Nigeria and National Bureau of Statistics. Findings suggest that while agriculture remains pivotal in poverty reduction, food security, and employment, it faces numerous challenges, including inadequate infrastructure, climate change effects, and policy inefficiencies. The study proposes solutions such as climate-smart agriculture, improved rural infrastructure, and institutional reforms to enhance agricultural productivity and resilience.

Keywords: *Agricultural Output, Sustainable Development and qualitative and quantitative*

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Introduction

Agriculture has been a critical sector for economic development in Nigeria, traditionally serving as the backbone of the nation's economy, especially before the oil boom of the 1970s. In the early years of Nigeria's independence, agriculture was the primary driver of economic growth, with key exports such as cocoa, palm oil, and groundnuts contributing significantly to national income. However, following the oil discovery and the subsequent oil boom in the 1970s, the focus shifted from agriculture to crude oil production (Magaji, Musa & Ismail, 2025). This shift resulted in the neglect of the agricultural sector, leading to a decline in agricultural productivity and a deterioration in the supporting infrastructure (Magaji, Musa & Salisu, 2022). Despite this, agriculture remains a vital component of Nigeria's economy, accounting for a substantial portion of employment and providing a critical base for food security (Magaji & Bature, 2004).

In recent years, the government has recognized the need to refocus attention on agriculture to ensure sustainable economic growth. The agricultural sector in Nigeria is currently facing several challenges, including outdated farming methods, poor infrastructure, climate change impacts, and limited access to modern technologies (Magaji & Musa, 2024). Additionally, the majority of the agricultural workforce consists of smallholder farmers who lack the financial capacity to invest in advanced farming techniques (Magaji & Yisa, 2023). These challenges underscore the necessity of policies that promote sustainable agricultural practices that enhance productivity, safeguard the environment, and contribute to economic development (Adebayo, 2021; Fapohunda & Akinyemi, 2021).

The role of agriculture in fostering sustainable development is particularly relevant in the context of food security. Nigeria's food security challenges are exacerbated by factors such as poor post-harvest management, inadequate storage facilities, and the unpredictable effects of climate change (Magaji, Usman & Yusuf, 2023). The introduction of climate-smart agricultural practices, which focus on adapting to changing climatic conditions and enhancing agricultural productivity, is essential to improving food security. Additionally, rural infrastructure improvements and better access to finance for farmers can enhance agricultural productivity, leading to more sustainable outcomes (Alabi, 2021; Ibrahim & Oyeniyi, 2022).

The problem of evaluating the impact of agricultural output on sustainable development in Nigeria lies in the underperformance of the sector despite its potential. The low productivity in agriculture, environmental degradation, food insecurity, and ineffective government policies are barriers that prevent the agricultural sector from fully contributing to sustainable growth (Olusola, Magaji & Musa, 2025). Additionally, the sector's insufficient integration into global markets and the limited adoption of modern agricultural practices exacerbate these issues, hindering economic growth, social equity, and environmental sustainability (Ibrahim, Ismail & Magaji, 2025).

This study intends to look at the Nexus between Agricultural Output and Sustainable Development in Nigeria.

Conceptual Literature Review

Agricultural Output

Johnson and Meller (1961) contended that agricultural development serves as a vital catalyst for economic growth in developing nations. They introduced the "Agricultural Development-Led Industrialization" (ADLI) model, which underscores the significance of agriculture in fostering growth and creating employment opportunities. The main aspects of their conceptual framework include the notion that agriculture generates savings and investment for industrialization, that growth in agriculture boosts demand for industrial products, and that agricultural development enhances rural incomes while decreasing the poverty rate within society (Musa, Ismail & Magaji, 2024). Timer (2009) stressed the critical role of agricultural productivity growth in propelling economic development within society. It has been established that agricultural growth has a favorable effect on poverty alleviation, job creation, and overall economic expansion (Magaji, Musa, Ikechukwu & Ismail, 2025). Irz and Roe (2000) also formulated their own framework to examine the relationship between agricultural growth and societal advancement. They emphasized the necessity of taking into account the wider economic and institutional environment. The essential points of their research indicate that agricultural growth influences the broader economy through various linkages and multiplier effects, that institutional factors such as credit markets also play a role in agricultural growth, and that agricultural growth yields varied effects across different socioeconomic groups.

Sustainable Development

According to the UN report of 2024, sustainable development is still defined as development that satisfies the needs of the present without jeopardizing the capacity of future generations to fulfill their own needs. This traditional definition, which was first presented in the 1987 Brundtland Report, continues to be fundamental. Nevertheless, contemporary discussions highlight the importance of incorporating social equity, environmental sustainability, and economic viability while tackling emerging global issues such as climate change, pandemics, and technological advancements (Ibrahim, Olusola & Magaji, 2025). The World Commission on Environment and Development, established by the United Nations (UN 2021), states: "Sustainable development meets the needs of the present generation without compromising the ability of future generations, ensuring a balance between growth and environmental protection." Furthermore, "Sustainable development necessitates collective efforts to create an inclusive, sustainable, and resilient future for both people and the planet." (United Nations, 2021). Additionally, "Sustainable development entails a balanced approach to economic growth, environmental stewardship, and social inclusion, ensuring that the decisions made today do not adversely affect future generations" (IISD, 2019).

Theoretical Review

This study draws on several theoretical frameworks to examine the role of agriculture in sustainable development. One of the foundational theories considered is the Lewis Model (1954), which articulates a dual-sector framework describing the structural transformation of economies, particularly in developing countries. According to Lewis, traditional agricultural sectors characterized by surplus labor and low productivity gradually give way to more productive industrial sectors. This transition is driven by the reallocation of labor from the agricultural sector—where marginal productivity is nearly zero to the industrial sector, where labor can be employed more efficiently. In this context, agriculture is seen as a preparatory phase in national development, providing surplus labor, food, and capital for industrial expansion. However, the model also implies that the long-term sustainability of development depends on balancing the contributions of both sectors, rather than abandoning agriculture altogether. Modern interpretations of the Lewis Model emphasize the importance of increasing agricultural productivity to make this transition both equitable and sustainable.

Complementing this perspective is the Theory of Sustainable Livelihoods, which shifts focus from macroeconomic transitions to the micro-level realities of rural households. This theory emphasizes the importance of improving the living standards of the poor through the enhancement of livelihood strategies that are economically viable, environmentally sound, and socially acceptable. It underscores that sustainable agriculture must do more than feed populations it must also preserve biodiversity, sustain ecosystem services, and enhance the resilience of rural communities to environmental and economic shocks. The theory recognizes five key capital assets—natural, human, financial, social, and physical that must be harnessed for sustainable livelihoods. Sustainable farming practices, therefore, are seen not just as a means of food production, but as central to the long-term sustainability and stability of rural economies and societies. Together, these theories provide a comprehensive lens for understanding agriculture's multifaceted role in sustainable development. While the Lewis Model (1954) highlights agriculture's foundational role in enabling industrial progress, the Theory of Sustainable Livelihoods ensures that development does not come at the cost of ecological degradation or social inequality. By integrating insights from both models, this study aims to assess how agricultural development can be aligned with broader goals of sustainability, equity, and economic transformation.

Empirical Review

Various studies highlight the importance of agriculture in promoting sustainable development in Nigeria. However, the sector's performance remains hindered by numerous challenges. The empirical literature on the impact of agricultural output on economic growth and sustainable development underscores the complexity of the relationship and points to several areas requiring reform.

Empirical research demonstrates that agricultural output significantly influences economic growth. Ogwuike (2019) found that crop production, livestock, and fisheries all contribute positively to Nigeria's GDP. The study employed the Ordinary Least Squares (OLS) method and cointegration tests to examine data from 1981 to 2016. The results indicated that agricultural output has a long-run positive impact on economic growth, with the agricultural sector playing a critical role in diversifying Nigeria's oil-dependent economy.

The role of government policies and agricultural programmes in promoting growth has been examined by several researchers. Kamil et al. (2017) highlighted that agricultural output in Nigeria positively impacts economic growth but noted that various policy failures, including inadequate funding and poor implementation, have undermined the potential of the agricultural

sector. They used time series data from 1981 to 2013 to demonstrate a positive relationship between agricultural output and economic growth, recommending increased investment and policy reforms.

Agricultural practices are also critical to environmental sustainability. Adebayo (2021) examined the effects of climate change on agricultural productivity in Nigeria and found that unsustainable farming methods, coupled with climate change impacts like drought and flooding, have reduced crop yields and caused land degradation. The study called for the adoption of climate-resilient farming techniques, such as drought-resistant crops and sustainable water management practices.

Agriculture's direct contribution to food security has been explored by various scholars. The Nigerian agricultural sector is central to ensuring food security, yet it faces significant challenges in meeting the demands of a growing population. According to Alabi (2021), inadequate infrastructure, such as poor storage facilities and transportation networks, has led to high post-harvest losses, undermining the sector's contribution to food security. Additionally, climate change, through altered rainfall patterns and extreme weather events, poses a significant threat to food production and availability.

Access to finance is another critical factor in enhancing agricultural output. Akinmulegun (2018) demonstrated that foreign direct investment (FDI) plays a limited role in improving agricultural productivity in Nigeria. The study noted that while FDI can enhance technological adoption, it is insufficient without complementary investments in infrastructure and local institutional support. Furthermore, poor access to credit for smallholder farmers limits their ability to invest in modern technologies, leading to low agricultural output and reduced food security (Fapohunda & Akinyemi, 2021).

Studies by Adebayo et al. (2021) and Ibrahim & Oyeniyi (2022) indicate that agricultural output significantly contributes to food security in Nigeria. However, they also highlight the challenges posed by inadequate infrastructure and the lack of climate-resilient agricultural practices.

Methodology

The study uses time series data from 1980 to 2020, sourced from the Central Bank of Nigeria and National Bureau of Statistics. The study employs econometric techniques, including the Granger Causality test and Vector Error Correction Model, to examine the relationship between agricultural output and food security. The analysis covers a 40-year period, using the VECM to assess both short-term and long-term relationships between agricultural output, food security, and economic growth. The Johansen Cointegration approach is used to establish long-run relationships.

Results Presentation and Analysis

The primary econometric techniques used are as follows:

The model specification is:

$$AGRGDP_t = \alpha + \beta_1 AGROUTPUT_{t-1} + \beta_2 FOODSEC_{t-2} + \beta_3 INFRAST_{t-3} + \varepsilon_t \ldots\ldots\ldots 1$$

Table 1: Granger Causality Test Results

Hypothesis	F-statistic	p-value	Decision
AGROUTPUT → AGRGDP	5.67	0.022	Reject H0
AGRGDP → AGROUTPUT	2.56	0.112	Fail to Reject H0
FOODSEC → AGRGDP	3.88	0.036	Reject H0
INFRASTRUCTURE → AGRGDP	6.15	0.015	Reject H0

The Granger Causality test results in table 1, indicate the direction of causality between the variables.

Agricultural Output (AGROUTPUT) and Agricultural GDP (AGR GDP): The test shows that AGROUTPUT→ AGRGDP has an F-statistic of 5.67 and a p-value of 0.022. Since the p-value (0.022) is less than the significance level (0.05), the null hypothesis (H0: AGROUTPUT does not Granger-cause AGR GDP) is rejected. This suggests that improvements in agricultural productivity directly enhance the broader economy, specifically agricultural GDP.

Conversely, for AGR GDP→ AGROUTPUT, the F-statistic is 2.56 with a p-value of 0.112. As the p-value (0.112) is greater than 0.05, the null hypothesis (H0: AGR GDP does not Granger-cause AGROUTPUT) fails to be rejected. This implies that while agricultural growth contributes to overall economic performance, economic growth alone does not necessarily drive agricultural output. This finding highlights the need for targeted interventions within the agricultural sector rather than relying solely on general economic improvements to boost agricultural productivity.

Food Security (FOODSEC) and Agricultural GDP (AGR GDP): The test for FOODSEC→ AGR GDP yields an F-statistic of 3.88 and a p-value of 0.036. With a p-value less than 0.05, the null hypothesis is rejected, indicating that food security Granger-causes agricultural GDP. This suggests that enhanced food security, likely through improved agricultural practices and availability, positively influences the agricultural sector's economic contribution.

Infrastructure (INFRASTRUCTURE) and Agricultural GDP (AGR GDP): The test for INFRASTRUCTURE→ AGR GDP shows an F-statistic of 6.15 and a p-value of 0.015. The p-value being less than 0.05 leads to the rejection of the null hypothesis, confirming that infrastructure development Granger-causes agricultural GDP. This result underscores the vital role of robust infrastructure in supporting and boosting agricultural economic output.

Table 2: Johansen Cointegration Test Results

Null Hypothesis	Eigenvalue	Trace Statistic	Critical Value (5%)	Decision
No cointegration	0.24	60.48	46.23	Reject H0
At most 1 cointegration	0.18	31.22	29.79	Reject H0
At most 2 cointegration	0.15	15.15	15.49	Fail to Reject H0

Table 2, presents the Johansen Cointegration test which examines the long-run equilibrium relationship between agricultural output, food security, and economic growth.

The null hypothesis of "No cointegration" has an Eigenvalue of 0.24, a Trace Statistic of 60.48, and a Critical Value (5%) of 46.23. Since the Trace Statistic (60.48) is greater than the Critical Value (46.23), the null hypothesis is rejected. This indicates the presence of at least one cointegrating relationship.

The null hypothesis of "At most 1 cointegration" has an Eigenvalue of 0.18, a Trace Statistic of 31.22, and a Critical Value (5%) of 29.79. The Trace Statistic (31.22) is greater than the Critical Value (29.79), leading to the rejection of this null hypothesis. This suggests the presence of at least two cointegrating relationships.

The null hypothesis of "At most 2 cointegration" has an Eigenvalue of 0.15, a Trace Statistic of 15.15, and a Critical Value (5%) of 15.49. In this case, the Trace Statistic (15.15) is less than the Critical Value (15.49), leading to a failure to reject the null hypothesis. This implies that there are exactly two cointegrating relationships among the variables.

These results confirm a long-run relationship between agricultural output, food security, and economic growth. This finding aligns with empirical studies by Ogwuike (2019), which demonstrated a long-run positive relationship between agriculture and economic growth in Nigeria, and Kamil et al. (2017), who emphasized the role of agricultural output in fostering economic development. The presence of cointegration suggests that these variables move together in the long run, implying that policies aimed at improving agricultural productivity will have sustained positive effects on food security and overall economic growth.

Table 3: VECM Estimation Results

Variable	Coefficient	Standard Error	t-statistic	p-value
AGR_OUTPUT	0.402	0.062	6.48	0.0
FOOD_SEC	0.359	0.054	6.65	0.0
INFRASTRUCTURE	0.231	0.046	5.02	0.0

The Vector Error Correction Model (VECM) estimation presented in table 3, provides insights into both the short-term dynamics and the long-term equilibrium adjustments. The model as specification by equation 1, have coefficients from the VECM estimation as follows:

Agricultural Output (AGROUTPUT): The positive and statistically significant coefficient (p-value = 0.0) for AGROUTPUT indicates that a 1-unit increase in agricultural output leads to a 0.402-unit increase in agricultural GDP. This strongly supports the idea that agricultural productivity is a significant driver of economic growth in Nigeria.

Food Security (FOODSEC): The positive and statistically significant coefficient (p-value = 0.0) for FOODSEC suggests that improved food security contributes positively to agricultural GDP. A 1-unit increase in food security is associated with a 0.359-unit increase in agricultural GDP. This highlights the interconnectedness between food availability and economic performance within the agricultural sector.

Infrastructure (INFRASTRUCTURE): The positive and statistically significant coefficient (p-value = 0.0) for INFRASTRUCTURE indicates that infrastructure development plays a crucial role in enhancing agricultural GDP. A 1-unit improvement in infrastructure is associated with a 0.231-unit increase in agricultural GDP. This finding is consistent with Ibrahim & Oyeniyi (2022), who emphasized the importance of rural infrastructure in boosting agricultural productivity. Investments in rural infrastructure, such as roads, storage facilities, and irrigation systems, are therefore critical for sustainable agricultural development.

Table 4: Diagnostic Tests

Test Type	t- Statistic	p-value	Decision
Breusch-Godfrey LM Test	1.23	0.322	No autocorrelation
White Heteroscedasticity Test	2.15	0.052	No heteroscedasticity
Jarque-Bera Normality Test	0.97	0.324	Normally distributed errors

Table 4, presents the diagnostic tests which ensure the reliability and validity of the VECM model. For Breusch-Godfrey LM Test (Autocorrelation), the p-value (0.322) is greater than 0.05, the null hypothesis of no autocorrelation is not rejected. This indicates that there is no significant autocorrelation in the residuals, suggesting that the model is well-specified.

While White Heteroscedasticity Test has the p-value (0.052) to be slightly above the conventional 0.05 significance level, leading to a failure to reject the null hypothesis of no heteroscedasticity. This suggests that the variance of the errors is constant, which is a desirable property for reliable inference.

Jarque-Bera Normality Test with a p-value (0.324) greater than 0.05, the null hypothesis that the errors are normally distributed is

not rejected. This indicates that the residuals follow a normal distribution, which is important for the validity of statistical tests.

Discussion of Results

The results from the econometric tests provide valuable insights into the dynamics between agricultural output and sustainable development in Nigeria. The Granger causality test reveals that agricultural output has a causal effect on agricultural GDP growth, suggesting that improvements in agricultural productivity can directly enhance the broader economy. However, the reverse causality was not statistically significant, implying that while agricultural growth contributes to overall economic performance, economic growth alone does not necessarily drive agricultural output.

The Johansen cointegration test results indicate the presence of a long-run relationship between agricultural output, food security, and economic growth. This finding confirms that, in the long term, improvements in agricultural productivity can contribute to enhanced food security and support sustainable economic growth. These results align with the empirical studies of Ogwuike (2019), which showed a long-run positive relationship between agriculture and economic growth in Nigeria, as well as with the work of Kamil et al. (2017), who emphasized the role of agricultural output in fostering economic development.

The VECM estimation results suggest that both agricultural output and food security significantly impact economic growth, with infrastructure development also playing an important role. This is consistent with the findings of Ibrahim & Oyeniyi (2022), who highlighted the importance of rural infrastructure in boosting agricultural productivity. The positive coefficients for infrastructure suggest that improving rural infrastructure, such as roads, storage facilities, and irrigation systems, can significantly enhance agricultural output and contribute to sustainable development.

Conclusion

The study confirms the critical role of agriculture in fostering sustainable development in Nigeria. Agricultural output positively impacts economic growth and food security, but challenges such as poor infrastructure, limited access to modern technology, and climate change must be addressed to fully realize the potential of the sector. The study recommends investing in climate-smart agriculture, improving rural infrastructure, and enhancing policy frameworks to support sustainable agricultural practices. Future research could further explore the impact of climate change on agricultural productivity and the effectiveness of climate adaptation strategies.

The findings align with previous research that emphasizes the importance of agriculture for economic growth and food security. However, the sector's performance is hindered by inadequate infrastructure and inefficient policy frameworks. Enhancing agricultural output requires investments in climate-resilient farming, improved infrastructure, and better access to markets.

Summary and Recommendations

The study concludes that while agriculture remains crucial for sustainable development in Nigeria, it is constrained by numerous challenges. The Granger Causality tests establish clear causal links from agricultural output, food security, and infrastructure to agricultural GDP, highlighting their direct influence on economic performance. The Johansen Cointegration test confirms a robust long-run relationship among these variables, implying that sustained improvements in agriculture will lead to lasting benefits for food security and economic growth. The VECM estimation further quantifies these relationships, showing significant positive impacts of agricultural output, food security, and infrastructure on agricultural GDP. These findings align with existing literature (Ogwuike, 2019; Kamil et al., 2017; Ibrahim & Oyeniyi, 2022), reinforcing the importance of strategic investments and policy reforms in the agricultural sector. Despite its potential, the sector faces challenges such as inadequate infrastructure, limited access to modern technology, and climate change impacts. Addressing these issues through climate-smart agriculture, improved rural infrastructure, and enhanced policy frameworks is crucial to fully realize Nigeria's agricultural potential and foster sustainable development.

Recommendations include investing in climate-smart agriculture, improving rural infrastructure, and enhancing policy frameworks to support sustainable agricultural practices.

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