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NIGERIAN AGRICULTURAL OUTPUT DYNAMICS: A DOLS PERSPECTIVE

SHUAIBU, YUSUF UMAR; & ZAKARI, YUSUF HALILU

Department of Economics, Federal College of Education, Zaria, Kaduna State, Nigeria
Corresponding Author: *shuaibuyusuf125@gmail.com*

Abstract

Agriculture and education have been utilized as veritable tools for tackling the menace of poverty particularly in the Global South. However, in Nigeria, the low literacy level along with rising poverty rates have continued to undermine agricultural productivity. Therefore, this study attempted to investigate the impact of poverty and literacy level on agricultural output in Nigeria. The dynamic ordinary least squares (DOLS) technique was relied upon by the study to analyse the obtained second-hand time series data covering 37 years from 1985 to 2021. The research finding expressed a significant positive relationship between agricultural output and poverty rate. Likewise, it reported a direct relation among agricultural output and literacy rate. The paper advocated that the government should be aggressive in addressing the issues of insecurity in the country as well as expend more resources in the delivery of basic education amongst others.

Key Words: Agriculture, Poverty, Literacy, Nigeria, DOLS

Introduction

In Nigeria, agriculture is one of the main economic sectors (Okolo, 2004). It is crucial for poverty alleviation, food security, employment generation, foreign exchange and the provision of linkages with other economic sectors (Udah & Nwanchukwu, 2014), The sector employs over 65% of the Nigerian labour force (Emeka 2007) and contributes an average of 24% to GDP between 2013 and 2019 (NBS, 2020). The nation is endowed with rich arable land necessary for agricultural development (Oluwatoyese & Applanaidu, 2021). However, less than half of the country's arable land is actually utilized contributing to low output. (Manyong et al., 2005). The government in an attempt to improve productivity and output initiated several intervention programs. But Yusuf (2014) observed these efforts have not yielded the desired outcome due to several challenges. This challenge according to Food and Agricultural Organization (2022) includes climate change, inadequate irrigation farming, problematic land tenure system, high cost of production. Others are insufficient funding, limited access to markets, inadequate input distribution mechanisms and significant post-harvest losses.

Government expenditure is one of the tools it can use to develop the agricultural sector and alleviate poverty (Igweze et al., 2022). Capital expenditure in Nigeria is used to build feeder roads to connect rural areas, build silos, and provide more tractors and other farming equipment so as to improve the productivity and well-being of the local population. Nonetheless, the pattern of government capital expenditures on economic services in Nigeria indicates that the sector received the least amount of funding out of all the economic sectors (Central Bank of Nigeria [CBN], 2019). Essentially, from 1.25 percent in 2015 to 1.82 percent in 2016, it rose by 2.23 percent in 2018, but fell by 1.56 percent in 2019 and 1.3 percent in 2020. Government's expenditure in agriculture consistently falls below the 10% government spending as contained in the Malabu 2014 recommendations. The low-level investment in the agricultural sector by government has resulted to the decline in productivity (Salisu & Haladu, 2021).

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Prof. R. Rena [South Africa]

Poverty in Nigeria is more pronounced in rural areas where agricultural is the predominant activity (National Bureau of Statistics [NBS], 2006). Poor farmers lack the ability to obtain the necessary inputs such as fertilizers, improved seeds, irrigations systems and modern inputs which can limit their productivity and output. Poverty could also trap farmers in subsistence farming preventing them from engaging in profitable and sustainable farming practices. Farmer's educational attainment is also an important factor towards enhancing their productivity. In Nigeria, the literacy stood at 48.9% in rural area the literacy rate is 33.7% (NBS, 2022). Studies have indicated that the most practical way to increase agricultural productivity is through education. For instance, a study by Das and Sahoo (2012) discovered that agricultural output increased with an extra year of education. Similar findings were reported in another study conducted by Bandiera and Rasul (2006), which showed that literate farmers with a high school education were 26% more likely to produce cash crops than farmers with only a primary school education.

Despite the significance of the agricultural sector to the Nigerian economy, there are indications of erratic or varying trends in the sector's performance even with decades of public sector spending. In addition, studies conducted to examine the impact of government spending on agriculture have remained inconclusive. For example, studies by Udoh (2015) and Chinedu et al. (2018) found that government expenditure has a positive impact on the agricultural sector while Ebiringa and Charles-Anyaogu (2012) found a negative impact. To help guide policy decisions about resource allocation towards agricultural production, growth, and development in Nigeria, a study on the effect of agricultural expenditure on agricultural output is therefore crucial. The paper is divided into five sections: beginning with this section, then section two which gives an overview of the theoretical and empirical literatures, section three presents the methodology, the empirical findings are discussed in section four, and section concludes the study with recommendations.

Statement of the problem

Before the discovery of oil, Nigeria produced enough food on its own and was a net exporter of agricultural products. Following the oil boom, agricultural output started to fall and eventually was unable to keep up with the rapidly increasing population of Nigeria. The nation currently relies on food imports to survive. Nigeria imported agricultural goods of US$231,550,000 between 2010 and 2018 (CBN, 2018). This is as a result of the government paying less attention to agriculture, the reliance on oil exports combined with population growth. Hunger, malnutrition, widespread poverty, unemployment, inflation, and slow economic growth have all continued to plague Nigeria's economy despite the country's enormous oil wealth (Agbana & Lubu, 2022).

Literature Review

Theoretical Foundation

Endogenous growth theory holds that, internal variables like the accumulation of human capital, technical advancement, and innovation—rather than external ones like governmental regulations or the availability of natural resources—are the main drivers of long-term economic growth. The fundamental tenet of endogenous growth theory is that sustained economic growth can be promoted by expenditures in infrastructure, education, and research and development. The theory contends that there are processes within economies that can continue to expand output indefinitely, in contrast to classical growth theories, which predict that economies would eventually achieve a stable state with no further development.

Endogenous growth theory emphasizes the role of human activity and creativity in propelling economic advancement by highlighting the significance of innovation, knowledge production, and entrepreneurship. The idea contends that by creating the environment for ongoing innovation and productivity improvements, policies supporting education, research, and development can have a long-lasting effect on a nation's potential for growth.

Overall, by emphasizing the ways in which internal forces can influence an economy's trajectory over time, endogenous growth theory provides a more dynamic and upbeat picture of economic growth. It offers a framework for comprehending how expenditures on human capital and technology development might result in long-term raises in living standards and general prosperity.

Empirical Review

Okpara (2017) examined relationship between government expenditure and agricultural output in Nigeria. The study utilized co-integration technique to analyse data from 1980-2014. The result indicates that government expenditure has a positive and significant effect on agricultural output. In Addition, there is a long run relationship between government expenditure and agricultural output.

EDITOR-IN-CHIEF
Prof. R. Rena [South Africa]

Similarly, Aina and Omojola (2017) using an error correction technique studied the relationship between government spending and the agriculture sector in Nigeria between 1980 and 2013 employing error correction technique strong and positive correlation was found between the expansion of the agricultural sector and government spending on agriculture.

Atayi et al. (2020) examined the relationship between governments capital expenditure, recurrent spending, GDP and agricultural output in Nigeria between 19 81- 2018. Findings show that capital expenditure and recurrent expenditure have positive impact on agricultural output.

In another study, Bafadal et al. (2020) studied the relationship between government expenditure on agricultural output and electricity consumption in Nigeria from 1981- 2017. ARDL results reveal that inadequate power supply has adverse effect on agricultural output while government spending has a weak positive lag on agricultural sectors performance.

Oriakhi (2021) examined the connection between government spending, economic growth, and poverty reduction in Nigeria by analysing data from 1981 to 2021 using a vector error correction technique. The results show that effective use of public funds will support economic growth.

The impact of government expenditures on the output of Nigeria's various agricultural subsectors was examined by Abdullahi (2021). The subsectors include livestock, fisheries, forestry, and crop production. The data from 1980 to 2021 were studied using the Johansen co-integration and error correction technique. Findings show that, with the exception of the forestry subsector, government expenditure has a favourable and considerable impact on agricultural output both over the long and short terms. Additionally, it was found that there was no causal relationship between government spending and agricultural output—with the exception of the subsector of crops and livestock.

The ARDL technique was used by James and Uduak (2022) to investigate the impact of government spending on agricultural productivity in Nigeria between 1980 and 2018. The results show a strong and positive correlation between government spending and the agriculture sector.

In their 2016 study, Mathew and Modeci combined the Granger causality test, ECM method, and Johansen co-integration to examine the effects of government investment on agricultural output in Nigeria between 1981 and 2014. According to the findings, government expenditure significantly and negatively affects agricultural productivity.

Ukpong et al. (2022) studied the relationship between governments spending on administration, community services, economic services and agricultural output in Nigeria. OLS technique was employed to analyse data covering the period from 1990-2020. Findings indicate that all the variables have positive and significant impact on agricultural output.

Ikubor et al. (2022) studied the relationship between governments capital spending and economic services sector in Nigeria from 1981-2020 utilizing ARDL technique. Findings show that governments capital spending on agriculture, mining and quarrying and manufacturing sectors have positive and significant relationship with economic growth.

Methodology

Model and Data

This section of the research paper detailed the approach adopted to investigate the effect of poverty and literacy on agricultural output in Nigeria. Therefore, relying on Fagbemi et al. (2022) and Okijie (2024), the functional specification for our model is stated as:

$$AGQ = f(PVR, LTR, GXES) \quad (1)$$

Basically, equation 1 is then remodelled as:

$$AGQ_t = \beta_0 + \beta_1 PVR_t + \beta_2 LTR_t + \beta_3 GXES_t + \mu_t \quad (2)$$

Where: AGQ is agricultural output measured as a percentage of GDP, PVR is poverty rate as a percentage of population, LTR is literacy rate proxied by primary school enrolment as percentage of gross enrolment ratio, GXES represents total government expenditure on economic services, and μ stands for the error term all at time 't' time period. Only the variable GXES was normalised via log transformation. Where β_1, β_2, and β_3 are the estimated slope coefficients of the regressors, β_0 is the intercept. The a priori expectations for these parameters are: $\beta_0 \neq 0$, $\beta_1 < 0$, $\beta_2 > 0$, and $\beta_3 > 0$.

Further, the data for the variables used in our study ranged from 1985 to 2021; and were sourced from the databases of the World Development Indicator (WDI) which is a data catalogue of the World Bank and the Central Bank of Nigeria (CBN) statistical bulletin of 2022 respectively.

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Estimation Procedure

We began our analysis with a pre-estimation test that involved testing the univariate stationarity properties of the annualise time series data using the Augmented Dickey Fuller (ADF) test for unit root. This is crucial in order to avoid estimating spurious regression – which could invalid our results especially from a policy direction standpoint. The result of our stationarity test as depicted on [Table 3] indicated that our variables are integrated of different orders. The study then proceeded with estimating the data utilising the dynamic ordinary least squares (DOLS) technique.

DOLS is a cointegrating estimator which implies that it could be used to estimate non-stationary variables if peradventure they are cointegrated. It can also be applied to variables integrated of different orders (combination of I(0) and I(1) series). Besides, its suitability for small sample sizes; it is robust to the issues of autocorrelation and endogeneity.

The DOLS technique was introduced by Stock and Watson (1993) and it is specified as:

$$Y_t = \beta_0 + \beta Z + \sum_{j=-n}^{m} \delta \Delta Z_{t-j} + \mu_t \qquad (3)$$

From eq. 3 Y_t is the dependent variable, and Z is the vector of independent variables. While β represents the cointegrating vector (the effects of a change in X on Y in the long-run), j and m individually signify the lag and lead lengths. The inputted lag and lead terms enable the stochastic disturbance term in DOLS to be immune to any prior shocks emanating from the stochastic explanatory variables (Camacho-Gutierrez, 2010; Fagbemi et al., 2022).

The analysis concluded with conducting post-estimation tests such as the test for normality, heteroskedasticity, and stability to maintain the validity of our findings.

Empirical Findings

Table 1: Summary Statistics

Variables	AGQ	PVR	LTR	GXES
	%	%	%	₦' Bn
Mean	23.75930	45.19854	84.75387	440.33
Standard Deviation	3.836077	8.607262	21.61081	445.96
Minimum	18.02043	30.86000	0.000000	1.1673
Maximum	36.96508	58.42000	105.5981	1,597.79
Skewness	1.435954	-0.346734	-3.309746	0.938450
Kurtosis	5.868325	1.795440	13.57279	2.999272

Source: Authors'

Table 1 provides summary statistics of the variables under consideration. It is apparent from our data that the government spent on average ₦440.33 billion to support economic services in the country, while the average values of AGQ, PVR, and LTR stood at 23.76%, 45.20%, and 84.75% respectively within the period considered by the study. Unlike the other variables, the high variation observed in the literacy rate as demonstrated by the minimum and maximum values suggest a wide gap between those who are literate and otherwise. While AGQ and LTR were leptokurtic, PVR and GXES were platykurtic. However, only the series GXES mirrored normal skewness.

Table 2: Correlation Matrix

Variables	AGQ	PVR	LTR	GXES
AGQ	1.000000	0.297133	-0.149122	-0.065748
PVR	0.297133	1.000000	-0.192748	-0.618509
LTR	-0.149122	-0.192748	1.000000	-0.005457
GXES	-0.065748	-0.618509	0.005457	1.000000

Source: Authors'

Table 2 depicts the common association among our series. From the matrix AGQ had a low positive relationship with PVR, while its relationship with LTR and GXES are individually negative which is unexpected particularly from the theoretical standpoint. Besides, the AGQ-PVR association suggests an undesirable

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Prof. R. Rena [South Africa]

situation of rising poverty amidst increases in agricultural production in the country within the scope of the study. However, the relationship between LTR and PVR is negative which indicates that poverty rate is likely to decline with improved literacy.

Table 3: Augmented Dickey Fuller (ADF) Unit Root Test

Variables	Level Test Statistics	First Difference Test Statistics	Order of Integration
AGQ		-6.8630 (0.0000) ***	I(1)
PVR		-4.8985 (0.0019) ***	I(1)
LTR	-4.3827 (0.0071) ***		I(0)
GXES	-4.7284 (0.0008) ***		I(0)

Source: Authors'

It is evident from the result of the ADF test on Table 3 that LTR and GXES are I(0) series which implies that they are stationary at level, whereas the variables AGQ and PVR are I(1) series as they became stationary after first differencing at the predetermined significance levels. Therefore, the outcome of our stationarity test using the ADF test approach produced series that are integrated of different order - that is I(0) and I(1) series.

Table 4: DOLS Regression Estimates

Dependent variable: AGQ_t	
Variable	**Coefficient**
PVR_t	**0.736924***[0.095449]**
LTR_t	**0.257898***[0.087840]**
$GXES_t$	**2.108665***[0.549652]**
C	**-83.22745***[22.24593]**
Adjusted R-squared	**0.760303**
F-statistic	**6.462782(0.000703)**
Jarque-Bera normality test	**0.143634(0.930701)**
Breusch-Godfrey serial correlation test	**1.647238(0.1993)**
Breusch-Pagan-Godfrey heteroskedasticity test	**21.96253(0.2337)**

*Note: *** connotes statistical significance of the regression parameters at 1%. The values in the block brackets stand for the standard errors, while the probabilities are in the round brackets.*
Source: Authors'

The regression result in Table 4 depicted the influence of the regressors on the regressand (AGQ) within the period under consideration. These outcomes being expressed are based on the dynamic ordinary least square (DOLS) approach.
The result from the table demonstrated that the DOLS estimates are significant predictors of agricultural output in Nigeria. That is, a percentage point increase in the poverty rate is associated with a 0.7369 percent rise in agricultural output. A similar influence was observed for the literacy rate such that, agricultural output surged by 0.2579 percent as the country's literacy rate accelerated by one percent point. Equally, a one percentage point boost in government expenditure will cause a 2.1087 percent expansion in agricultural production. While PVR, LTR, and GXES jointly account for 76.03 percent variations in AGQ, agricultural output will be -83.23 if the trio of PVR, LTR, and GXES are invariable. The adequacy of our model is supported by the significant F-stat. value of 6.4628.
Further, the outcome of our post-estimation test indicated that our model in addition to being unencumbered by the issues of serial correlation and heteroskedasticity, passed both the normality and stability tests.

Discussion of Findings
From the foregoing analysis, all our regressors were found to have a direct relationship with the regressand. More importantly, that poverty exerts a significant and direct effect on agricultural production. This result conversely demonstrates that poverty levels will worsen even when agricultural output increases. This

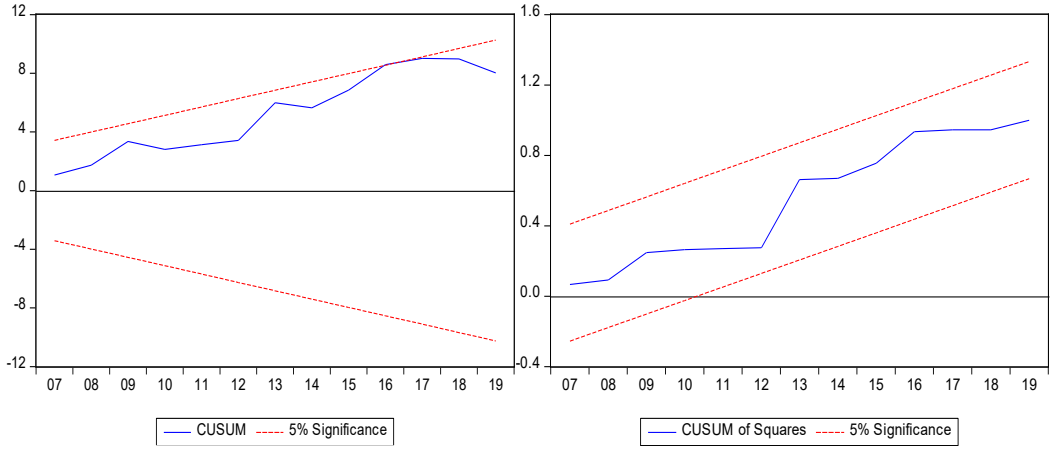
EDITOR-IN-CHIEF
Prof. R. Rena [South Africa]

contradicts our a priori or theoretical expectations as well as previous empirical studies on this subject such that poverty has been found to lessen with growth in agricultural production largely due to the improved income that will be generated through such economic activity. For instance, studies by Enisan and Olalekan (2022), Baba et al. (2023), Mukaila et al. (2022), Onuche and Oladipo (2020), and Aderemi et al. (2021) argued that the level of poverty diminishes with increased agricultural production. This is because when farmers produce higher output, they earn higher income which translates into higher welfare (in terms of the quantity and quality of goods and services they can afford or have access to). However, the paradox in our findings suggests the presence of a web of compounding issues currently facing smallholder farmers - who produce a larger share of the agricultural output (Onuche & Oladipo, 2020) such as low technical know-how, the ransom tax paid for farming, the sharp practices of middlemen in the agricultural value chain, and the galloping inflation in the country which adversely affects their real income. Hence, these farmers are not able to escape poverty due to the low value they derive from their production.

Further, our findings established that the level of literacy has a positive and significant influence on agricultural output. That is, a higher literacy level among farmer will lead to a boost in agricultural productivity in the country. This is plausible as improved literacy exposes farmers to useful information about modern farming practices and ways on how to access and utilise available farm credits. Likewise, literate farmers are able to understand, cooperate and benefit from extension services which will make them economically efficient in their farming activities. As a result, output and income are more likely to rise due to the efficient use of these knowledge by such category of farmers. Our finding is in tandem with studies done by Achichi et al. (2023), Adeleke et al. (2021), Nwibo et al. (2022), Fidelugwuowo (2021), and Mukaila et al. (2022) who found that appreciation in literateness of farmers enhances the productiveness of agriculture.

Moreover, government expenditure just like in the other two scenarios had a favourable impact on agricultural output. It indicates that targeted government interventions in the agricultural sector – such as the provision of affordable farm inputs, accessible credit facilities/schemes to husbandmen, grange access roads and other support infrastructure or services is capable of spurring productivity in the sector as well as guarantee food security for the nation. Our result is corroborated by the works of Okuneye and Ajayi (2021), Apata (2021), and Mile (2021) who posited that government expenditure is positively associated with agricultural output. Thus, desirable and deliberate government expenditure in agriculture incentivises agricultural output especially in the long term.

Figures 1 and 2: Stability Tests



Conclusion and Recommendations

The study investigated the impact of poverty and literacy level on agricultural output in Nigeria spanning 1985 to 2021. It employed the dynamic ordinary least square (DOLS) technique to analyse the time series data obtained for the period. The findings though not in line with theory revealed a direct relationship between poverty and agricultural output. It suggests that a rise in poverty will elicit a rise in agricultural output by same magnitude. Thereby implying that farmers are not reaping commensurate benefits or rewards from producing higher output due to erosion of their real income by factors that could be linked to insecurity, activities of middlemen and inflation. Similarly, a positive association was found between the level of literacy, government expenditure and agricultural output respectively.

EDITOR-IN-CHIEF
Prof. R. Rena [South Africa]

Consequently, the study recommends that the government should tackle head-on the issue of insecurity (armed banditry, farmer-herders clash, terrorism) to guarantee free and unconditional access to farmlands particularly in the major food production belts of the nation. This will ensure proper utilisation of farmlands by farmers who will not have to pay illegal taxes to criminals and/or terrorists to cultivate and harvest their crops. Also, appropriate fiscal measures should be put in place by the fiscal authorities to complement the monetary side in tackling the pervasive incidence of inflation in the country in order to boost the purchasing power of citizens. Aside from making farm inputs cheaper, it will boost the real income of farmers. Lastly, the government investment more on basic education to improve the general level of literacy to ease access to useful agricultural information especially for farmers as well as expend freshen up old infrastructure and building new ones so as to stimulate and sustain agricultural output.

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