DETERMINANTS OF AGRICULTURAL OUTPUT IN NIGERIA from 2000-2022

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Abstract
The study examined the determinants of agricultural output in Nigeria from 2000-2022. It employed econometric techniques of co-integration test and Multiple regression approach to analyze the data obtained from the CBN statistical bulletin. The Augmented Dickey Fuller unit root test results showed that all the variables were stationary at first difference. The Johansen co-integration test results showed that co-integrating equations exist. Meanwhile, the regression results showed that; government funding in agriculture is positively and significantly related to agricultural output with parameter value of 0.272406 and probability value of 0.0012, agricultural credit has positive (0.150567) and significant (0.0309) impact on agricultural output. Also, exchange rate has a positive (0.063865) and insignificant (0.5446) effect on agricultural output. The findings from the study showed that agricultural funding; agricultural credits as well as exchange rate are key determinants of agricultural output in Nigeria explaining about 90.5 percent change in agricultural output within the period of our study. Based on these findings, the study recommends amongst others that there should be increase agricultural funding in the yearly budget in order to provide infrastructural facilities to the rural areas where bulk of farm products are produced. Also, credit to the agricultural sector via the rural farmers should be encouraged.

KEY WORDS: Determinants, Agricultural Output, Credit, Government Funding, Exchange rate.

INTRODUCTION

The agricultural sector in less developed countries is pivotal to their national development because of its huge role in creating employment especially in rural areas, food and income security, and provision of raw materials for industry. The sector account for about 50% of gross domestic product (GDP), 90% of the total export revenue, 85% of employment of the country's labour force and accounts 70% of raw materials requirement of the country's industries, which is very important for the countries sustainable development (Nwajiuba, 2020).

In Nigeria, according to National Monetary Policy line (NMPL) (2022), 40.1% of people are poor, and 63% are multidimensionally poor according to the National MPL (2022). Multidimensional poverty is higher in rural areas, where 72% of people are poor compare to 42% of people in urban areas (NMPL) (2022). Most of these people are small scale farmers. The small- scale farmers particularly in a less developed country like Nigeria face a number of production and marketing constraints, such as limited access to services, including effective extension and rural credit, which are crucial pre-conditions for upgrading commodity value chains (Wiggins, Johann, & Luis, 2010). Low fertilizer use intensity has been cited as one of

the main factors limiting agricultural production in Sub-Sahara Africa (SSA) (Fuglie & Bosch 2012). Smallholder farmer's poor access to credit is due to lack of collateral or due to the high interest rates demanded by financial institutions (Oya, 2012). Also, in SSA, there is preponderance of agrarian population for the onset of decreasing returns comes swiftly than with other sectors (Nwajiuba, 2020). Much of the poverty in many developing lands is attributable to this: pressure of population with no alternative employment forcing far too many into agriculture. Labour is applied beyond the point of decreasing returns with consequent inefficiency and low productivity per head (Nwajiuba, 2020).

In spite of the current dominance of the petroleum sector in Nigeria's economy, agriculture remains a major source of economic survival and sustenance. Agriculture's contribution to the nation's food supply, raw materials export, savings and investment and general price stability have been critical for economic growth since independence. It is in realization of this that successive governments in Nigeria have made huge investments and adopted various strategies of intervention in the agricultural sector with a view to increasing output. However, the agricultural production output is far below expectation and Nigeria has to rely on importation of food to compliment the local production raising a number of still largely open questions, ranging from the potential lagged seffects of the basic determinants of agricultural production such as climate change, government funding, favourable government monetary policy vis-à-vis low interest rate on agricultural loan have not been given adequate attention in order to boost agricultural production (Obi &Obayori, 2016). Similarly, the utter neglect of agriculture and overdependence on oil had created disincentives to millions of farmers who had abandoned their farming implements and migrated into cities in search of jobs outside the farms. As a result, agricultural production has been low in Nigeria. Another fundamental problem facing agricultural sector across the globe is the issue of climate change. The Nigerian meteorological agency has affirmed an appreciable fluctuation in the country's weather pattern in recent years (Enete, 2017). Most regions of the country, especially, the northern region have been experiencing low rainfall when compared to the southern region. Records show that while rainfall in the northern part has been on the decline, temperature has increased from about 1.4 to 1.9 degree Celsius on average and scientist have stated that it could increase from 2 to 5 degree Celsius in the future (Nwajiuba, 2020). The repercussions associated with such persistent increase in temperature are decrease in agricultural output and surge in evaporation rate which results in depleting soil moisture, thereby drying up the surface water and reduction of available ground water (Ufiobor, 2017). Also, with an unbearable temperature level, labourers easily get tired and they become less productive compared to a period of mild temperature (Enete, 2017). Some non-climatic constraints to agricultural productivity borders on insufficient supply of inputs (such as, labour and capital) as well as macroeconomic swings and inefficiencies in supply and distribution of these inputs. For instance, given the frequent fluctuations of the Naira-Dollar exchange rate, acquisition of modern farm inputs from technologically advanced countries have limited productivity of the farmers (Omekwe, Bosco & Obayori, 2018; Anyanwu, 2013).

Improving Nigeria's agricultural output to an acceptable and sustainable level is therefore the challenge to policy makers in government and operators in the private sector. Though, previous studies have focused mainly on agricultural productivity, however, paucity of information exists in the area of determinants of agricultural output over the years. This paper filled the gap by examining the determinants of agricultural output in Nigeria between 2000 and 2022.

The following null hypotheses were formulated and were tested at the $P \leq 0.05$ level of

significance.

Ho_1: Government expenditure on agriculture has no significant relationship with agricultural output growth in Nigeria.

$H0_2$: Agricultural credit has no impact on agricultural production output in Nigeria

H03: There is no significant relationship between exchange rate and agricultural production output in Nigeria.

Review of Related Literature

Research studies have been conducted to investigate the determinants of agricultural output in Nigeria and the world at large. For instance, Desta and Murad (2021) examined the determinants of crop productivity among smallholder farmers in Haramaya district, Eastern Ethiopia. A two-stage random sampling procedure was employed to detect a sample containing 260 smallholder households in the study area. Data was collected through semi-structured questionnaire schedules administered to the selected household farmers. The features of smallholder farmers were analyzed through descriptive statistics and multiple linear regression models. The results indicated that the length of farming experience of the household head, number of economically active members in family, amount of organic fertilizer applied, irrigated land area, and soil fertility status of farmland were the significant determinants of agricultural crop productivity. To increase the production and productivity of smallholder farms, the farmers were provided with land irrigation. Based on these findings, the study recommends the provision of organic fertilizer to farmers. Policies should also target supplying improved technology and improved seed to enhance agricultural crop production in Ethiopia

Mouayadi, Jiong and Kokou (2020) employs a panel data spanning 26 year (1990-2015) and including 13 ECOWAS countries to analyze the impact of production factors on agricultural productivity and examine the question of whether and how agriculture can serve as a tool for growth and poverty alleviation in the region. By linearizing the Cobb-Douglas production function and using fixed effects (FE) with country dummies, we find positive and significant relationship between lands cultivated, physical and financial capitals, as opposed to labor employed on agricultural productivity. Next, by using 2SLS/IV and GMM/IV methods, we show that agricultural productivity can be a pro-growth and counter-poverty tool. Furthermore, we find that non-agricultural productivity interacts significantly with agricultural productivity and that agricultural productivity gap (APG) decreases both growth and poverty index. Following these results, we chart the transmission mechanisms for policy makers that will allow them to understand the linkages and pathways through which agricultural productivity affects the entire economy

Samuel, Samuel, Hezron and Lucy (2020) examined the effect of some selected socioeconomic factors on sorghum productivity using a case of small-scale farmers in Siaya County. The four sub-counties considered for this study were selected on the basis of sorghum production. Stratified and random sampling techniques were applied to identify a sample comprising of 300 smallholder households in the study area. Data was collected using semi-structured interview schedules administered to the selected farm households. The characteristics of the smallholder farmers sampled were analyzed using descriptive statistics and Ordinary Least Square multiple regression model. The results showed that farm size under sorghum, labour, farm gate price, serena and seredo seed varieties were significant determinants of sorghum productivity in the study area. Based on these findings, the study recommends provision of improved seed varieties to the farmers. Policies targeted at promoting industrial use of sorghum will increase sorghum demand and promote its uptake. In addition, agricultural development policies should target provision of such services

like training and extension support to enhance sorghum production in Kenya.

Similarly, Gero and Egbendewe (2020) studied the macroeconomic effects of agricultural productivity in Benin Republic. They applied a dynamic computable general equilibrium (CGE) model. The results suggested that public policies that promoted growth in food crop productivity might become more effective in enhancing greater economic performance.

Seven & Pumen (2020) presented cross-country evidence showing that agricultural credit positively affects agricultural productivity. Particularly, it was found that increasing agricultural credits generated about 4-5 percent increase in agricultural productivity. This suggested that the nature of the relationship between agricultural finance and agricultural output varied along the development path.

Ochalibe, et al. (2019) examined the impact of exchange rate and interest rate policy instruments dynamics on agricultural growth in Nigeria using time series data covering from 1980-2018, they concluded that inflation rate in Nigeria is volatile over the period of study and inflation volatility has a negative but significant impact on agricultural growth. The study recommended that exchange rate be stabilized and interest rate reduced to encourage investment in agriculture, hence stimulating growth.

Enilolobo, Mustapha and Ikechukwu (2019) investigated the effect of macroeconomic indicators on agricultural output in Nigeria using quarterly time series data for the period 1981-2018 from various publications of the Central Bank of Nigeria statistical Bulletin and National Bureau of Statistics. The results of the study revealed that the inflation rate in Nigeria is volatile over the period of study and inflation volatility has a negative but significant impact on agricultural growth. Exchange rate and cost of funds also possess varying impacts on agricultural output.

Oyetade, Shri and Nor (2019) examined the impact of macroeconomic factors and Structural Adjustment Program (SAP) on agricultural output in Nigeria adopting the time series data ranging from 1981-2017. The results showed relationship that exists between the agricultural output which is the dependent variable and the independent variables. It also revealed the variations between the dependent and independent variables which are Gross Domestic Product (GDP) growth rate, interest rate, foreign direct investment (FDI), commercial bank loan on agriculture, SAP and inflation rate.

Again, Emenuga (2019) investigated the effect of credit supply to the Nigerian agricultural sector over a period of 37 years (1981-2017). The results of the Johansen cointegration test showed a long-run relationship between bank credit and agricultural sector development in Nigeria. The study also indicated that commercial banks' credit and Agricultural credit guarantee scheme were positively related to Agricultural sector development while interest rate showed a negative relationship with agricultural development in Nigeria. Also, Omekwe, Bosco and Obayori (2018) examined the determinants of agricultural output in Nigeria from 1985-2016. The study utilized the econometric cointegration test and error correction mechanism (ECM) approach for the analysis of data. The Johansen cointegration test results showed that the variables were cointegrated which fit the model for the ECM. The findings from the study showed that agricultural funding; agricultural credits as well as climate change were key drivers of agricultural output in Nigeria. Again, this time in Uganda, Epule, Ford, Lwasa, Nabaasa & Buyinza (2018) analyzed the determinants of crop yields. The study considered climatic and non-climatic variables affecting crop yields using a systematic approach which involved a multiple linear regression. The findings revealed that non-climatic determinants of crop yields such as dynamics in forest area, wood fuel and usage of tractors were significant determinants of crop production than climatic

fundamentals like temperature, CO2 emissions as well as precipitation.

Theoretical Framework

The theoretical framework of this study is built on the Cobb-Douglas production function and endogenous growth theory. These theoretical models were applied in e*xt*ant literature including Ekwere (2021).

The Cobb Douglas production is express as:

$P(L, K) = A L^{\alpha} K^{\beta}$ 1

Where: P = productivity, L = labour, K = capital input, A = total factor productivity (efficiency coefficient), α and β are the output elasticity of labour and capital, respectively. These values are constants determined by available technology.

The Cobb-Douglas production function is of degree one if $\alpha + \beta = 1$. A production function of degree one has constant returns to scale. If $\alpha + \beta < 1$ then the production function exhibits decreasing returns to scale. If $\alpha + \beta > 1$ the production function exhibits increasing returns to scale.

The value of α and β determine what degree of returns to scale a Cobb-Douglas production function can exhibit. Since the values of α and β are not limited, Cobb-Douglas production function can exhibit any degree of returns to scale (Koutsoyiannis, 2006).

To eliminate the bias in Cobb-Douglas production function, the equation can be transformed by taking the logarithms of both sides. Comparing the transcendental logarithmic function (trans-log) and Cobb-Douglas production function, the former is relatively more flexible, thus it is more appropriate especially when estimating a production relationship which is not well understood. This transformed function can be estimated through ordinary least square technique (OLS).

Thus, the Cobb-Douglas production function can be written as $\ln Y = \ln A + \alpha \ln K + \beta \ln L$. Ordinary least square (OLS) can be used to estimate the model as it is now linear in parameters. With all the variables in logs, this is now a log-linear model.

In Agricultural production, efficient allocation of agricultural inputs helps farmers to attain their desired objectives. It avails the farmers the opportunity of improving their productivity and income. At the micro-economic level, efficient allocation of agricultural resources such as credit, facilities, seedlings, labour among others) help farmers to contribute to food production, employment generation and export product for foreign exchange earnings.

Estimation Techniques

A descriptive statistic for all the variables was first carried out. The study also conducts a stationarity test of each variable by employing the augmented Dickey-Fuller (Dickey and Fuller, 1979) unit root test in order to avoid any spurious regression. Next, a system-wise Johansen co-integration test (Johansen, 1988; Johansen and Juselius, 1990) was used to analyze the presence of the long-run equilibrium relationship among the variables under study.

Model Specification

The determinant of agricultural output is expressed as;

$$AGO = f(GFA, AGC, EXR) \quad (1)$$

$$AGO = a_o + a_1 GFA_t + a_2 AGC_t + a_3 EXR_t + \mu \quad (2)$$

The model in equation (2) is further restated in the log-linear form. This is aimed at reducing the problem of multicollinearity among the variables in the model and as well estimates the variables in the same unit of measurement.

Thus, the log-linear model is specified as shown below;

$$InAGO = In\alpha_o + \alpha_1 InGFAt + \alpha_2 InAGCt + \alpha_3 InEXR_t + \mu \quad (3)$$

Where: AGO= Agricultural Output measured in monetary term , GFA= Government Funding in Agricultural Sector, AGC = Agricultural Credit, EXR = exchange rate, μ = stochastic random variable, Ln = the logarithmic transformation to the natural base, αo = intercept, parameter, α1-α3= slope parameter, t = Time/Period

Apriori Expectation; $\alpha_1 > 0$, $\alpha_2 > 0$ and $\alpha_3 < 0$

RESULT AND DISCUSSION OF FINDINGS

Descriptive Statistics

Descriptive statistics are useful for describing the basic features of data. In a research study with large data, these statistics may help us to manage the data and present it in a summary table as presented and interpreted in table 1

Table 1: Summary of Statistics of the Variables

	LAGO	LGFA	LAGC	LEXR
Mean	16.32522	3.340000	5.273913	5.182609
Median	16.41000	3.590000	5.540000	5.020000
Maximum	16.77000	4.280000	6.520000	6.260000
Minimum	15.39000	1.850000	3.710000	4.610000
Std. Dev.	0.395886	0.777666	1.015962	0.470041
Skewness	-0.985406	-0.660480	-0.228371	1.020073
Kurtosis	3.194754	2.170037	1.424143	2.899653
Jarque-Bera	3.758612	2.332364	2.579772	3.998420
Probability	0.152696	0.311554	0.275302	0.135442
Sum	375.4800	76.82000	121.3000	119.2000
Sum Sq. Dev.	3.447974	13.30480	22.70795	4.860643
Observations	23	23	23	23

Source: Computed by the Researcher Using E-view version 12, 2023

The summary of descriptive statistics of relevant variables of study is as reported in table1. As may be observed from the table, the mean, median, standard deviation as well as the skewness and Kurtosis measures of the variables is given. The mean for LAGO, LGFA, LAGC and LEXR was 16.32522, 3.340000, 5.273913, and 5.182609 respectively. The low standard deviation exhibited by the variables indicate that they oscillate around their mean. The probability of Jacque- Bera for the variables are not significant, hence we accept the null hypothesis that the series are normally distributed.

Table 2. Stationary Test Results

	ADF at Level				ADF at 1st Difference				
ɔl	Test Stat	Test Critical Value at 5%	Prob.	Remark	Test Stat.	Test Critical Value at 5%	Prob.	Remark	Decision
ı	-5.937508	-3.012363	0.0001	S	-	-	-	-	I (0)
	-1.692376	-3.004861	0.4211	NS	-6.027721	-3.012363	0.0001	S	I (1)
	-1.029891	-3.004861	0.7237	NS	-6.187658	-3.012363	0.0001	S	I (1)
	-2.415379	-3.004861	0.9999	NS	-3.921439	-3.012368	0.0497	S	I (0)

Source: Author's Computation, underlying data from Central bank of Nigeria Statistical Bulletin and World Development Indicator (WDI) Database, 2022.

The time series behaviour of each of the series is presented in Tables 2, using the ADF tests at both level and first difference of the series. The result depicts that all the variables except LAGO which is stationary at level, are integrated of order one (i.e. I(1)). Therefore, they are made stationary by first difference prior to subsequent estimations to forestall spurious regressions.

Cointegration Test for Long run Relationship

Starting with the null hypothesis that there are no cointegrating vector (r = 0), the result show that at 0.05 per cent significance level, the trace and maximum tests suggest that the variables are cointegrated with r = 2 and r = 2 respectively. Since the variables are cointegrated, there is, therefore, a long run relationship among the variables

Table 3: Cointegration Test Results

Ɲo. ıf ƆE(s)	Eigen Value	Trace Statistic	Critical Value at 5%	Prob**	Eigen value	Max_ Eigen Statistic	Critical Value	Prob.**
= 0	0.965101	104.2473*	47.85613	0.0000	0.965101	70.46130*	27.58434	0.0000
= 1	0.732188	33.78598*	29.79707	0.0165	0.732188	27.66687*	21.13162	0.0052
= 2	0.225037	6.119111	15.49471	0.6814	0.225037	5.353742	14.26460	0.6967
= 3	0.035790	0.765368	3.841465	0.3817	0.035790	0.765368	3.841465	0.3817

Trace test indicates at least one cointegrating eqn(s) at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level **MacKinnonHaug-Michelis (1999) p-values.

Table 4: Pair Wise Granger Causality Test Result

Null Hypothesis:	Obs	F-Statistic	Prob.
LGFA does not Granger Cause LAGO	21	1.57034	0.2384
LAGO does not Granger Cause LGFA		4.12244	0.0360
LAGC does not Granger Cause LAGO	21	14.6340	0.0002
LAGO does not Granger Cause LAGC		1.22527	0.3198
LEXR does not Granger Cause LAGO	21	2.20264	0.1429
LAGO does not Granger Cause LEXR		0.15198	0.8602
LAGC does not Granger Cause LGFA	21	2.66229	0.1004
LGFA does not Granger Cause LAGC		0.93717	0.4122
LEXR does not Granger Cause LGFA	21	1.75903	0.2039
LGFA does not Granger Cause LEXR		1.37962	0.2801
LEXR does not Granger Cause LAGC	21	0.64625	0.5372
LAGC does not Granger Cause LEXR		2.89171	0.0847

Source: Computed by the researcher using E-view 2023
Alpha (a) = 0.05
Decision rule: reject Ho if P- value < 0.05

The result of Pairwise Granger's causality between the variable under study is provided in table 4. The rule of thumb states that the probability of the f-statistic must be less than 0.5 to show causal relationship at the 5% level. The granger causality test result in table 4 indicates unidirectional causality between LAGO and LGFA. The result indicates that LAGO Granger cause LGFA and not the other way. Similarly, the results indicate unidirectional causality running from LAGC to LAGO and not the other way.

Table 5: Results of Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGFA	0.272406	0.071344	3.818218	0.0012
LAGC	0.150567	0.064597	2.330859	0.0309
LEXR	0.063865	0.103514	0.616971	0.5446
C	14.29032	0.363061	39.36069	0.0000
R-sqared	0.904720			
Adjusted R^2	0.889676			
F-statistic	60.13766			
Prob(F-statistic)	0.000000			
Durbin-Watson stat	1.048253			

Source: Computed by the Researcher Using E-view version 12.1; 2023

The regression results presented in table 5 provides good and unbiased estimates of the determinants of agricultural output in Nigeria. The values in table 5 represent coefficient, standard errors, t-statistic values and probability values. From the regression results shown above, the coefficient of determination (R^2) value of 0.904720 implies that approximately 90.5 per cent of the total variation in LAGO is explained by changes in the explanatory variables while the remaining 9.5 per cent variation in LAGO is explained by other factors not included in the model. The adjusted coefficient of determination (R^2) Value of 0.889676 implies that approximately 89.0 per cent of the total variation in LAGO is explained by changes in the explanatory variables when the coefficient of determination is adjusted for degree of freedom. This implies that 11 percent variation in LAGO is unexplained due to other factors not included in the model.

F- Statistic of 60.13766 ($P<0.05$) shows that they are jointly significant and the Durbin Watson value of 1.048253 implies that the model suffers from autocorrelation problem. In terms of the significance of the individual variables, it is observed that LGFA and LAGC are the only significant determinants of LAGO in Nigeria for the period of analysis. Specifically, the result show that LGFA has a positive relationship with LAGO and this result conforms to the a priori expectation. The result implies that a unit increase in LGFA will on the average lead to 0.272406 increase in LAGO within the period under study.

Similarly, the log of agricultural credit (LAGC) has positive and significant impact on LAGO in Nigeria for the period of study. This result conforms to the theory. However, log of exchange rate (LEXR) which was included as a control variable has a positive and insignificant relationship with LAGO and this result does not

meet the a priori expectation. The result implies that a unit increase in LEXR will on the average lead to 0.063865 increase in LAGO within the period under study.

Conclusion and Recommendations

This paper focuses on examining the determinants of agricultural output in Nigeria between 2000 and 2022. The consistency and stability of the empirical results show that the model adequately explains the behaviour of the determinants of the agricultural output. The result points to the critical roles of government financing of agriculture, agricultural credit and exchange rate in influencing agricultural output in Nigeria. From the results obtained from this study, government financing of agriculture (LGFA) has a positive and significant impact on agricultural output in Nigeria within the period of our study. Also, there is direct and significant relationship between agricultural credit (LAGC) and agricultural output (LAGO within the period of our study.

The positive relationship between exchange rate and agricultural output though is not expected, and it was found to be statistically insignificant. Based on the results and the conclusion drawn from this study, the priorities of Nigeria government should be on increasing government expenditure in agriculture and ensuring that such funds get to the real farmers. Increasing government expenditure in agriculture will ensure that the sector produces sufficient research and enhances modern technologies for better production. The government can spend adequately by investing in climate-smart agriculture research to ensure that climate-friendly technologies are developed and adopted. The use of climate-friendly technologies will ultimately ensure that the country receives enough rainfall for agricultural purposes. There is a need to review the exchange rate policy.

Secondly, the Central Bank of Nigeria (CBN) should as a matter of necessity monitor the movement of the market determined exchange rate. This will ensure that exchange rate deregulation does not become counterproductive through price distortions on agricultural production, trade (agricultural input importation and agricultural produce exportation) and investment in the agricultural sector in line with the Agricultural Transformation Agenda.

Furthermore, concessional agricultural loans should be given to farmers so as to increase the productivity of the agricultural sector. With adequate financing which is easily accessible, maintenance and purchase of farm equipment used for production will be made much easier which will hasten the production process and thus significantly have a positive impact on the output levels of the agricultural sector

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