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## Investigating the Effect of Macroeconomic Variables on Agricultural Output in Nigeria

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### Authors' contributions

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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### ABSTRACT

The research work investigated the effect of macroeconomic variables on agricultural output in Nigeria. The study used annual data spanning from the period 1995 to 2020. The agricultural output growth represented the explained variable while money supply, commercial bank loan on agriculture, exchange rate, interest rate, recurrent government expenditure on agriculture and inflation rate represented the explanatory variables which served as the selected macroeconomic variables under study. The stationarity of the variables were checked using the Augmented Dickey-Fuller test. The long run relationship was tested using the Johansen Co-integration technique. The OLS analysis was computed which shows that the model is statistically significance, judging with the p-value of the F-statistic. The analysis also presented that money supply, exchange rate and inflation have a positive relationship with agricultural output within the given period of study while commercial bank loan on agriculture, interest rate and recurrent government expenditure on agriculture have a negative link with the explained variable. Based on the findings, the researchers recommended among others things, that a favorable interest rate should be placed for farmers to easily access the loans of the financial institutions, which will ensure increase in the productivity of the sector.

*Keywords: Agriculture; output; macroeconomics; Nigeria.*

## 1. INTRODUCTION

The agricultural sector is vital to economic growth and development, particularly in emerging nations such as Nigeria. It is frequently referred to as a country's economic basis. Agriculture was viewed as the foundation for industrial expansion and development in Lewis's 1954 economic development theory. Agriculture reform has been regarded as a key to the economic freedom of developing nations in recent studies on the origins of development and underdevelopment. The roles of agriculture are mostly derived from its interactions with other sectors of the economy in the development and expansion of most emerging countries. According to this viewpoint, agriculture is the most important predictor of economic development and whether the war on poverty can be won or lost in the long run, [1,2].

Nigeria is a large agrarian economy with vast natural resources, including 68 million - acre land, 12.6 million hectares of fresh water resources, 960 kilometers of shoreline, and a rich biodiversity that allows the country to produce a wide range of crops, farm animals, forest management, and fishing industry product lines [3]. Led to the advent of oil in 1956, the agriculture industry was unquestionably the nation's economic backbone and primary means of income. Due to substantial exports of latex, peanuts, cowhide and leather, vanilla, cocoa, oil palm, and kernel oil, it was the backbone of the Nigerian economy [4]. Agriculture produced around 65 percent of total GDP production, more than 80 percent of Nigerian export profits, and almost half of government income in the 1960s [5].

The agricultural sector's contribution to GDP increased to 22.35 percent in Q1'21, up from 19.79 percent in 2021, according to statistics from the Nigeria Bureau of Statistics. The most striking example is the agricultural sector's 2.2 percent real growth in 2020, despite the economy as a whole contracting by 1.92 percent. The sector's 3.4% real growth in Q4'2020, the highest since 2017, is particularly noteworthy in this regard. According to economists, the agricultural sector's solid expansion in Q4'2020 aided the economy's first increase in three quarters, as well as its exit from recession, following contractions in Q2'2020 and Q3'2020, which pushed Nigeria into its second recession in five years [6]. The expansion of the oil industry in the 1970s, followed by a surge in crude oil revenue in the early 1970s, hastened the

government's abandonment of the agricultural sector. In the 1960s, the sector accounted for 65-70 percent of overall output; by the 1970s, it had dropped to around 40%, and by the late 1990s, it had dropped to less than 2%. [5]. Shocks to macroeconomic indicators anticipate economic imbalance due to overdependence on oil and externally dictated price and output quotas. Other industries, such as agriculture, industry, and services, may now have a brighter future. Oil price volatility is a crucial element influencing the behavior of macroeconomic variables resulting from emerging nations' frequently contradictory fiscal, monetary, and trade policies [7,8,9].

Climate change, a lack of funding for the agricultural industry, and low productivity owing to poor planting material are only a few of the major concerns threatening agricultural production [10]. Furthermore, the reduction in food output in Nigeria, which has resulted in increased food imports, might be attributed to farmers' inability to get fertilizers and limited access to soft loans. As a result, Nigeria's food production profile has dipped, resulting in an increase in annual stable food imports [11]. Various policies, such as monetary, fiscal, and trade policies, are used by the federal government to try to impact the performance of the national economy. Changing macroeconomic policies have an impact on national income, interest rates, pricing, inflation rates, and currency rates, among other things, all of which have an impact on agriculture. They function as economic indicators, indicating current economic trends. These economic policies have an impact on all aspects of the country's operations. As a result, better understanding the relationship between agricultural production and macroeconomic factors in the economy can pave the way for excellent economic growth and development strategies in Nigeria.

Despite Nigeria's abundant agricultural resources, literature suggests that agriculture's contributions to the country's economy have been steadily declining [12]. Only around half of Nigeria's agricultural area is under cultivation [5]. The majority of this land is still cultivated by smallholder and traditional farmers who utilize crude production practices and produce low yields as a consequence. Many issues afflict smallholder farmers, including lack of access to modern inputs, soft loans and credit, insufficient market access, poor infrastructure, land and environmental degradation, and insufficient research and extension services. In light of the

foregoing information, the issue of what influence macroeconomic factors have on agricultural output in Nigeria arises. To that aim, the purpose of this paper is to examine the influence of macroeconomic factors on agricultural output in Nigeria from 1995 to 2020.

## 2. LITERATURE REVIEW

There has been a lot of research done in Nigeria on the link between macroeconomic variables and agricultural production. The following is a list of some of them. According to Odior [13], the real monetary aggregate, technical development brought through time, and the pass level of agriculture sector performance all have a significant impact on Nigeria's agricultural gross domestic product. Imoughele and Ismaila [14] also observed that the exchange rate, money supply, lending to the private sector, and real GDP all have substantial effects on non-oil export growth, with the exception of the exchange rate appreciation, which has a negative influence on Nigeria's non-oil exports. Brownson, Vincent, Emmanuel, and Etim [15] found that real exports, real external reserves, inflation rate, and external debt had substantial negative effects on agricultural production in both the long and short term. Industrial capacity utilization and the nominal exchange rate, on the other hand, boost agricultural production in Nigeria. Long-term positive drivers of agricultural diversification, according to Akpan, Udoka, and Patrick [16], include inflation, viable manufacturing, loans to the agricultural sector, foreign reserves, per capita income, unemployment, and energy consumption. Crude oil prices, commercial bank lending capacity, foreign direct investment in agriculture, and non-oil imports, on the other hand, are all negative long-run drivers of the Nigerian economy. Commercial bank loans to agriculture, interest rates, and food imports are significant factors affecting agricultural output, according to Oluwatoyose, Applanaidu, and Abdul-Rasak [17], whereas exchange rate, inflation rate, and unemployment rate are insignificant factors driving Nigeria's agricultural output.

According to the Cobb Douglas production function, which may be used to analyze agricultural productivity drivers. The Cobb-Douglas production function simulates the connection between output and inputs in manufacturing (factors). Therefore, output is a function of inputs of labor (L), capital (K) and advancement in technology (T). It starts with the

idea of production functions, namely, that the quality of output (Q) in any sector is a function of the amounts and quantities of factors of production (inputs). There are many other factors affecting economic performance, their model proved to be remarkably accurate [11]. The function they used to model production was of the form;  $P(L, K) = BL^\alpha K^\beta$ ; Where: P = total production (the monetary value of all goods produced in a year), L = labor input (the total number of person-hours worked in a year), K = capital input (the monetary worth of all machinery, equipment, and buildings), B = total factor productivity (efficiency coefficient),  $\alpha$  and  $\beta$  are the output elasticity of labor and capital, respectively. These are constants dictated by the technology available at the time. The production function's main goal is to address the efficiency of the utilization of factor inputs in production and the subsequent distribution of revenue to those components, while abstracting away from the technical issues that come with achieving technical efficiency. In agricultural production, effective agricultural input allocation aids farmers in achieving their targeted outcomes. It gives farmers the chance to increase their production and income. At the microeconomic level, effective agricultural resource allocation (land, credit, fertilizers, seedlings, and labor, to name a few) assists farmers in contributing to food production, job creation, industrial raw material, and export product for foreign exchange earnings.

Enilolobo et al. [18] used quarterly time series data from several publications of the CBN statistics Bulletin and the National Bureau of Statistics to explore the influence of macroeconomic factors on agricultural output in Nigeria. The study's findings demonstrated that Nigeria's inflation rate fluctuates over time, and that this volatility has a negative yet considerable influence on agricultural growth. The influence of the exchange rate and the cost of finance on agricultural output varies. According to Eyo [1], macroeconomic policies in Nigeria may dramatically lower inflation, enhance foreign private investment in agriculture, establish advantageous exchange rates, and improve agricultural credit, all of which have a considerable impact on agricultural production growth. Nwanji, et al. [19] used time series data from 1981 to 2018 to investigate the impacts of international trade on agricultural output in Nigeria. Foreign trade, according to the report, has a detrimental impact on agricultural output in Nigeria. From 1981 through 2013, Oyetade,

Sheri, and Azam (2016) investigated the influence of macroeconomic factors on agriculture in Nigeria. The researchers used a multivariate co-integration technique to look at their link. They discovered that the agricultural production and the explanatory factors had a long-term connection (commercial bank loan on agriculture, interest rate, inflation rate, exchange rate, food import value, unemployment rate). Commercial bank loan, interest rate, and food import value are major factors that impact agricultural output in Nigeria, according to the study, although exchange rate, inflation rate, and unemployment rate are not.

Appropriate funding of agriculture, according to the report, will benefit the sector. Government capital spending was shown to be favorably associated to agricultural production by Iganiga and Unemhilin [20], whilst total credit to agriculture and population growth rate were found to be negatively related. According to Gil et al. [21], changes in monetary policy and the currency rate have an impact on the agricultural sector, but not the other way around. This study also discovered that changes in monetary policy, namely in the money supply, had an impact on agricultural output and exports. Olarinde and Abdullahi [22] looked at the influence of macroeconomic policies on agricultural output, especially crop production in Nigeria, with a focus on food security consequences. The time series data included in the study spanned the years 1978 to 2011. The study's findings revealed that agricultural output is susceptible to changes in government expenditure, agricultural loans, inflation, interest, and currency rates in the long term. While the findings of the variance decomposition show that fluctuations in the currency rate and government spending movements account for a large variation in Nigeria's agricultural food output.

### 3. METHODOLOGY

#### 3.1 Data Sources

The research study uses time series data from secondary sources for the period of 26 years, 1995-2020, sourced from Central Bank of Nigeria Statistical Bulletin and World Development Indicators (WDI). The data was processed and analyzed by applying econometrics tools & techniques using E-View 9.0 statistical package. This annual data was analyzed through the unit root test for stationary test, a co-integration test

for long run relationship test and the regression analysis using Ordinary Least Squares (OLS).

The Cobb-Douglas production function serves as a platform on which the empirical model used is formulated. This is given below:

$$AOG_t = \beta_0 + \beta_1 MS_t + \beta_2 CBLA_t + \beta_3 EXR_t + \beta_4 INT_t + \beta_5 RGEA_t + \beta_6 INF_t + \varepsilon_t \dots \quad (1)$$

Where; AOG is Agricultural Output Growth; MS is Money Supply; CBLA is Commercial Bank Loan on Agriculture; EXR is Exchange Rate; INT is Interest Rate; RGEA is Recurrent Government Expenditure on Agriculture; INF is Inflation Rate;  $\varepsilon$  is the Error Term; L is Log. Two variables which are in high values were logged (AOG & MS). The equation becomes;

$$LAOG_t = \beta_0 + \beta_1 LMS_t + \beta_2 CBLA_t + \beta_3 EXR_t + \beta_4 INT_t + \beta_5 RGEA_t + \beta_6 INF_t + \varepsilon_t \dots \quad (2)$$

The principles of economic theory examine the apriori expectation and make reference to the sign and size of the parameters of economic relationship. It is expected that;

$$\beta_1 > 0; \beta_2 > 0; \beta_3 < 0; \beta_4 < 0; \beta_5 > 0; \beta_6 < 0.$$

Where  $\beta > 0$  denotes a positive relationship between AOG and the coefficients of the explanatory variables,  $\beta < 0$  denotes the negative relationship, while  $\beta < > 0$  implies that the coefficient could be a positive or negative one.

## 4. RESULTS AND DISCUSSION

### 4.1 Unit Root Test

The results presented in Table 1 below shows the stationary (unit root) test conducted for all the variables. The properties of each macroeconomic variable were analyzed first in order to determine the stationary of the selected variables. Augmented Dickey Fuller (ADF) was used to ensure that the data is stationary, before proceeding to the co-integration form.

The result indicates stationary of all variables in different orders; Agricultural Output Growth, Money Supply, Interest Rate, Exchange Rate and Recurrent Government Expenditure on Agriculture were stationary at first differencing; Commercial Bank Loan on Agriculture was stationary at second differencing, whereas, Inflation Rate was stationary at level.

**Table 1.The ADF Unit Root Test Result**

Variable	ADF Statistic	Level of Significance	Lagged difference	Critical Values	Order Of Integration	Probability value
LAOG	-4.612885	5%	2	-2.991878	I(1)	0.0013
LMS	-3.168443	5%	2	-2.991878	I(1)	0.0347
CBLA	-10.82323	5%	2	-2.943427	I(2)	0.0000
EXR	-4.277755	5%	2	-2.941145	I(1)	0.0017
INT	-6.857084	5%	2	-2.941145	I(1)	0.0000
RGEA	-6.994961	5%	2	-2.943427	I(1)	0.0000
INF	-13.78712	5%	2	-2.938987	I(0)	0.0000

Source: Author's Computation using E-view 9.0

**Table 2. The Unrestricted Co-integration Rank Test (Trace) Result**

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.983682	254.9888	125.6154	0.0000
At most 1 *	0.935848	156.2167	95.75366	0.0000
At most 2 *	0.748030	90.30071	69.81889	0.0005
At most 3 *	0.655439	57.21802	47.85613	0.0052
At most 4 *	0.515920	31.64639	29.79707	0.0303
At most 5	0.318278	14.23427	15.49471	0.0767
At most 6 *	0.189384	5.039058	3.841466	0.0248

Source: Author's Computation using E-view 9.0

**Table 3. Regression Results**

Dependent Variable: LAOG				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.638363	0.295745	22.44626	0.0000
LMS	0.330969	0.024130	13.71578	0.0000
CBLA	-0.000270	0.000120	-2.255907	0.0361
EXR	0.001909	0.000814	2.345628	0.0300
INT	-0.018485	0.010299	-1.794778	0.0886
RGEA	-0.001993	0.001282	-1.554736	0.1365
INF	0.002086	0.001371	1.521297	0.1447
R-squared	0.981784	Mean dependent var		9.182380
Adjusted R-squared	0.976032	S.D. dependent var		0.534393
S.E. of regression	0.082733	Akaike info criterion		-1.921591
Sum squared resid	0.130050	Schwarz criterion		-1.582873
Log likelihood	31.98069	Hannan-Quinn criter.		-1.824053
F-statistic	170.6740	Durbin-Watson stat		1.661708
Prob(F-statistic)	0.000000			

Source: Author's Computation using E-view 9.0

## 4.2 Co-integration Test

Having ascertained the stationary of all variables, the co-integration test was computed to check for the long run relationship existing among variables. The Johansen Co-integration was applied to attain this.

The test result in Table 2 indicates six co-integrating equations at the 0.05 level of significance. The \* denote rejection of the hypothesis at the 0.05 level of significance.

Hence, we conclude that there exists a long run relationship among the examined variables.

## 4.3 Estimate of Equation

The estimate of the equation for achieving the objective is computed and presented using Ordinary Least Squares (OLS) in Table 3:

$$LAOG_t = \beta_0 + \beta_1 LMS_t + \beta_2 CBLA_t + \beta_3 EXR_t + \beta_4 INT_t + \beta_5 RGEA_t + \beta_6 INF_t + \varepsilon_t \dots \quad (2)$$

The result of Table 3 shows the OLS analysis. From the table, money supply has a positive and significant impact on Agricultural Output Growth, based on the coefficient of 0.33 and p-value of 0.0000, which is less than the 0.05 level of significance. The positive coefficient conforms to the priori expectation between LMS & AOG. A unit increase in LMS will bring about 0.33 unit increase in AOG, holding other variables constant. This implies that those monies meant for agricultural sector, duly utilized, increases its output [23].

Contrary to our priori expectation, CBLA has an inverse relationship with AOG. A unit change in CBLA brought about an inverse change in AOG indicating a possible wrong utilization of loans by farmers who borrow them. Its P-value of 0.0361 shows its statistical significance in affecting AOG. This is similar to the findings by Obilor [24] who noted that Agricultural Credit Guarantee Scheme Fund and Government fund allocation to agriculture produced a significant positive effect on agricultural productivity. EXR has a positive and significant impact on AOG, based on the coefficient of 0.001909 and p-value of 0.0300, which is less than the 0.05 level of significance. The positive coefficient conforms to the a priori expectation between EXR & AOG. According to the findings by Adekunle and Ndukwe [25] who reported that the significant drivers of agricultural output are real exchange rate (log-levels), real appreciation and depreciation (after some lags), industrial capacity utilization rate, and government expenditure on agriculture (after some lags). A rise in EXR (devaluation in currency) will bring about an increase in demand of agricultural products by 0.001909 units, holding other variables constant, which may imply that a fall in the currency value of the country makes export of agricultural goods cheaper, which attracts more foreign buyers, which encourages the farmers to produce more.

INT has a negative and insignificant impact on AOG. Based on the coefficient of -0.018485 and p-value of 0.0886, which is greater than the 0.05 level of significance. The negative coefficient conforms to the priori expectation between INT & AOG. A unit increase in INT will bring about -0.018485 unit decrease in AOG, holding other variables constant. It shows that as interest rate rises, farmers do minimize their request for loans; this reduces investment in the sector and a decrease in output.

Also, in an opposing direction with our priori expectation, RGEA has an inverse relationship

and insignificant effect towards AOG with its coefficient as -0.001993 and its p-value as 0.1365, which is greater than the 0.05 significance level. We may have to conclude that expenditure of government on agriculture has no significant impact in the sector. Is a similar study, Chiekezie, Nkamigbo and Ozor [26] found a negligible positive correlation between economic growth and agricultural guaranteed scheme loans and that government expenditure on agriculture and agricultural sector output have significant impact on economic growth. This may be that the high rate of corruption in the system makes them not to duly utilize that expenditure on agriculture, they pen down in papers for the sake of publicity. Small scale farmers, who take part more in agricultural activities, rarely benefit from government incentives, schemes and programs on agriculture [27].

INF, as expected, conforms to the priori expectation of a positive link with AOG, having its coefficient as 0.002086 but has statistical insignificant effect towards AOG as its p-value, 0.1447 is greater than the 0.05 level of significance. This shows that a unit increase in INF will bring about 0.002086 unit increase in AOG, having other variables constant [28].

R-squared value in regression was used to evaluate the scatter of the data points around the fitted regression line. It recognizes the percentage of variation of the dependent variable. From the table, the  $R^2$  of 0.981784 showed that that 98% of the variability observed in the target variable is explained by the regression model. Generally, a higher r-squared indicates more variability is explained by the model. The F-Statistic which shows the whole significance of the model has its p-value as 0.000000 which is less than the 5% significance level implies that our model is statistically significant. The Durbin-Watson statistic identifies that there is absence of autocorrelation in the model having its value as 1.661708, which is approximately equal to 2.

## 5. CONCLUSION AND RECOMMENDATIONS

The study looked at the influence of macroeconomic factors on agricultural output during a 10-year period, from 1995 to 2020. Money supply, currency rate, and inflation rate have a positive impact on agricultural production, but commercial bank loan on agriculture, interest rate, and government expenditure on agriculture

have an inverse impact. According to the conclusions of the study, enormous support of the agricultural sector is critical, and the government's budgeted spending for the sector should be kept up to date and monitored to guarantee proper usage of money for the industry's benefit. A favorable interest rate should be placed for farmers to easily access the loans of the financial institutions, which will ensure increase the productivity of the sector.

A sound monetary, trade and fiscal policies should be formulated and implemented to attain a sustainable growth in the sector which will also positively affect the Gross Domestic Product (GDP) of the country. The federal government should formulate a means to offer soft loans to rural farmers who may not be able to afford the cost of taking loans from the financial institutions. As much emphasis is given to the oil sector by the federal government, such should also be accredited more to the agricultural sector, diversification should set in, and the production capacity should be widen and also boost exportation from the sector.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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