An Econometric Analysis of the Effect of Agricultural Funding on Maize Output in Nigeria (1999 -2020)

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Abstract
This study determined the influence of agricultural funding on Maize output in Nigeria within the period 1999-2020. The study adopted ex-post factor research design and relied on time series data. Pre and post -estimation diagnostics tests were adopted to check for reliability of the data used. The regression results showed that Public capital expenditure to agriculture (PCEXPA) (21.93377) has a positive and significant influence on maize production (MAZPD) for the period under study. The study concluded that the agricultural funding schemes have not been properly maximized to boost maize production and sustainability, and recommended that all the funding's to agriculture selected in this study, with respect to maize production should be reviewed and properly channeled so as to increase the output of maize in the country.

Keywords: *Agric. Funding, Cereal Crops, Maize*

INTRODUCTION

Agriculture has been identified as a critical sector with huge potential for promoting inclusive growth by stimulating economic growth, reducing poverty, and creating employment for a large number of people in developing countries. Rapid agricultural growth based on sustained productivity increase has been widely accepted as an essential requirement for achieving inclusive growth (Briones, 2013). Nigeria has also consistently failed to reach the 10 per cent agriculture budget standard of the Maputo declaration, which has led to negative implications for food security (Ochigbo, 2012).

The Food and Agricultural Organization (FAO) recommends that 25 per cent of government capital budget be allocated to agricultural development. This has not been achieved by the various administrations of Nigeria, thereby affecting government programmes and policies for the sector. While agricultural spending expressed as a share of total spending is generally low in African countries compared to other developing countries, Nigeria fares unfavorably even within the African context. When public spending in agriculture in Nigeria is benchmarked relative to public spending in other sectors, the value of the indicator for agriculture is lower than the values of all other sectors, such as industry, construction, trade, and services (Mogues *et al*., 2008).

The aim of this study is to determine the effect of agricultural funding (ACGSF, BOA, BOI, IFAD, PCEXA & PREXA) on maize production in Nigeria.

Methodology

Research Design

This study adopted the quasi-experimental research design. The choice of this approach emanated from its suitability in assessing the impact of multivariate explanatory variables on a single dependent variable.

Data Collection

Secondary data was used for this study. Specifically, Bank of Agriculture (BOA), Bank of Industry (BOI), Public Capital Expenditure to Agriculture (PCEXPA), Public Recurrent Expenditure to Agriculture (PREXPA), International Funding for Agricultural Development and Maize was gotten mainly from the publications of Central Bank of Nigeria (CBN) namely; Statistical Bulletin and World Bank that covers from 1999 – 2021.

Data Analysis

The estimation method adopted for the models is the Auto Regressive Distributed Lag and Error Correction Model (ARDL-ECM).

Model Specification

The model is expressed explicitly as

$$MAZPD = f(ACGSF, BOA, BOI, IFAD, PCEXPA, PREXPA) \quad (1)$$

Where:

MAZPD = Maize output
ACGSF = Agricultural Credit Guarantee Scheme Fund
BOA = Bank of Agriculture
BOI = Bank of Industry
IFAD = International Fund for Agriculture Development
PCEXPA= Public Capital Expenditure on Agriculture
PREXPA= Public Recurrent Expenditure on Agriculture

Equation (1) is an implicitly expressed econometric model

The model for the regression is specified explicitly as follows

$$InMAZPD = a_0 + a_1 InACGSF_t + a_2 InBOA + a_3 InBOI + a_4 InIFAD + a_5 InPCEXPA + a_6 InPREXPA + u_t \quad (2)$$

Where:

a_0 = Constant
$a_{1} - a_{6}$ = Coefficients
u_t = stochastic error terms
In = natural log notation

Specifying equation (2) in ARDL Cointegration model by incorporating the lag and lead of each of the explanatory variables into the model as part of the explanatory variables.

In the short run:

$$\Delta Y_t = \alpha + \sum_{i=1}^{p} \Delta Y_t + \sum_{i=1}^{q} \Delta\beta_1 B_{t-1} + \sum_{i=1}^{q} \Delta\beta_2 C_{t-1} + \sum_{i=1}^{q} \Delta\beta_3 C_{t-1} + \sum_{i=1}^{q} \Delta\beta_4 C_{t-1} + \sum_{i=1}^{q} \Delta\beta_5 C_{t-1} + \sum_{i=1}^{q} \Delta\beta_6 C_{t-1} \mu_t \quad (3)$$

In the long run the error correction term is introduced:

$$Y_t = \alpha + \sum_{i=1}^{p} Y_t + \sum_{i=1}^{q} \beta_1 B_{t-1} + \sum_{i=1}^{q} \beta_2 C_{t-1} \sum_{i=1}^{q} \Delta\beta_3 C_{t-1} + \sum_{i=1}^{q} \Delta\beta_4 C_{t-1} + \sum_{i=1}^{q} \Delta\beta_5 C_{t-1} + \sum_{i=1}^{q} \Delta\beta_6 C_{t-1} + \lambda ECT_{t-1} + \mu t \quad (4)$$

Now adopting the model to the study, with indication of co-integration in the long run of the variables we have:

$$MAZPD_t = \psi + \sum_{i=1}^{p} MAZPD_{t-1} + \sum_{i=1}^{q} \alpha_1 ACGSF_{t-1} + \sum_{i=1}^{q} \alpha_2 BOA_{t-1} + \sum_{i=1}^{p} BOI_{t-1} + \sum_{i=1}^{p} IFAD_{t-1} + \sum_{i=1}^{p} PCEXPA_{t-1} + \sum_{i=1}^{p} PREXPA_{t-1} + \sum_{i=1}^{q} \Delta MAZPD_{t-1} + \sum_{i=1}^{q} \beta_1 \Delta ACGSF_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta BOA_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta BOI_{t-1} + \sum_{i=1}^{p} \beta_4 \Delta IFAD_{t-1} + \sum_{i=1}^{p} \beta_5 \Delta PCEXPA_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta PREXPA_{t-1} + \lambda ECT_{t-1} + \mu_t \quad (5)$$

Where: ψ = intercept

$\alpha_{1,2,3,4,5,6}$= parameter estimates of the regressors in the long run

$\beta_{1,2,3,4,5,6}$= parameter estimates of the regressors in the short run

u_t= stochastic error terms.

ECT = Error Correction Term (ECM)

λ= Speed of Adjustment with a negative sign (-)

μ= stochastic term (Y_{t-1} - ΘX_t)

RESULTS

DATA PRESENTATION

Table 1 Time Series Data on the Variables Used for The Study from 1995-2021

YEAR	ACGSF	BOA	BOI	IFAD	PCEXPA	PREXPA	MAZPD
1999	241839	25515006.00	808111334.00	960000	6912.6	31,347.20	5476000
2000	361449	30315222.00	902,212,33	1110000	5761.7	4,834.70	4107000
2001	728545.4	331222110.00	606322033.00	1200000	57879	7,064.90	4596000
2002	1050982	402111203.00	332621000.00	1650000	32,364	12,439.40	4890000
2003	1151051	205513331.00	362402059.00	3410000	8510.9	7,534.30	5203000
2004	2083745	208111203.00	600311511.00	270000	48047.8	11,725.60	5567000
2005	9493855	310111233.00	616712552.00	5010000	79393.4	10,858.80	5957000
2006	4262430	316313457.66	629046803.04	4410000	15176.8	18,739.80	7100000
2007	4425462	523610210.00	715311334.00	6660000	22518.5	15,781.40	6724000
2008	6497959	626924659.79	506600234.00	6490000	58453.1	65,415.20	7525000
2009	8328566	93492313.15	709316805.00	5530000	35879.3	22,440.10	7358260
2010	6567357	241407.526.35	737689477.20	2800000	47098.1	28,221.50	7676850
2011	7312700	159874046.35	608331322.00	8350000	63056.3	41,201.30	8878456

2012	8150030	502667553.75	810661555.00	14030000	74215.6	33,304.10	8694900
2013	10005594	175,005,00.00	805331222.00	8880000	69871.7	39,436.40	8422670
2014	10234166	412,480,552,00	702315470.00	3440000	86025.8	36,700.40	10058968
2015	12432130	420764825.00	612327479.00	10980000	72367.9	41,271.20	10562050
2016	10890630	54010877.00	683198982.00	19600000	76088.5	39,136.00	11547980
2017	11326255	841764825.00	713143335.00	30840000	79132.04	40701.44	10420000
2018	11779305	336078843.16	1006160794.00	32073600	82297.32	42329.49	11000000
2019	12250478	349521996.89	1046407225.76	33356544	85589.22	44022.96	12700000
2020	12740497	363502876.76	1088263514.79	34690806	89012.78	45783.87	12000000

Source: Central Bank Statistical Bulletin (2020)
National Bureau of Statistics (2020)
Development Finance Department Central (2020)
Bank of Nigeria (2020)
Bank of Agriculture (2020)
Bank of Industry (2020)
Food and Agriculture Organization (FAO) (2020)

Table 1 presents the time series data of the dependent and independent variables, the dependent variable being Maize output (MAZPD) measured in tons, while the independent variables which are Agricultural Credit Guarantee Scheme Fund (ACGSF), Bank of Agriculture (BOA), Bank of Industry (BOI), International Fund for Agriculture Development (IFAD), Public Capital Expenditure on Agriculture (PCEXPA) and Public Recurrent Expenditure on Agriculture (PREXPA) measured in dollars covering the time period from 1999 to 2020.

Trends in the Dependent and Independent Variables

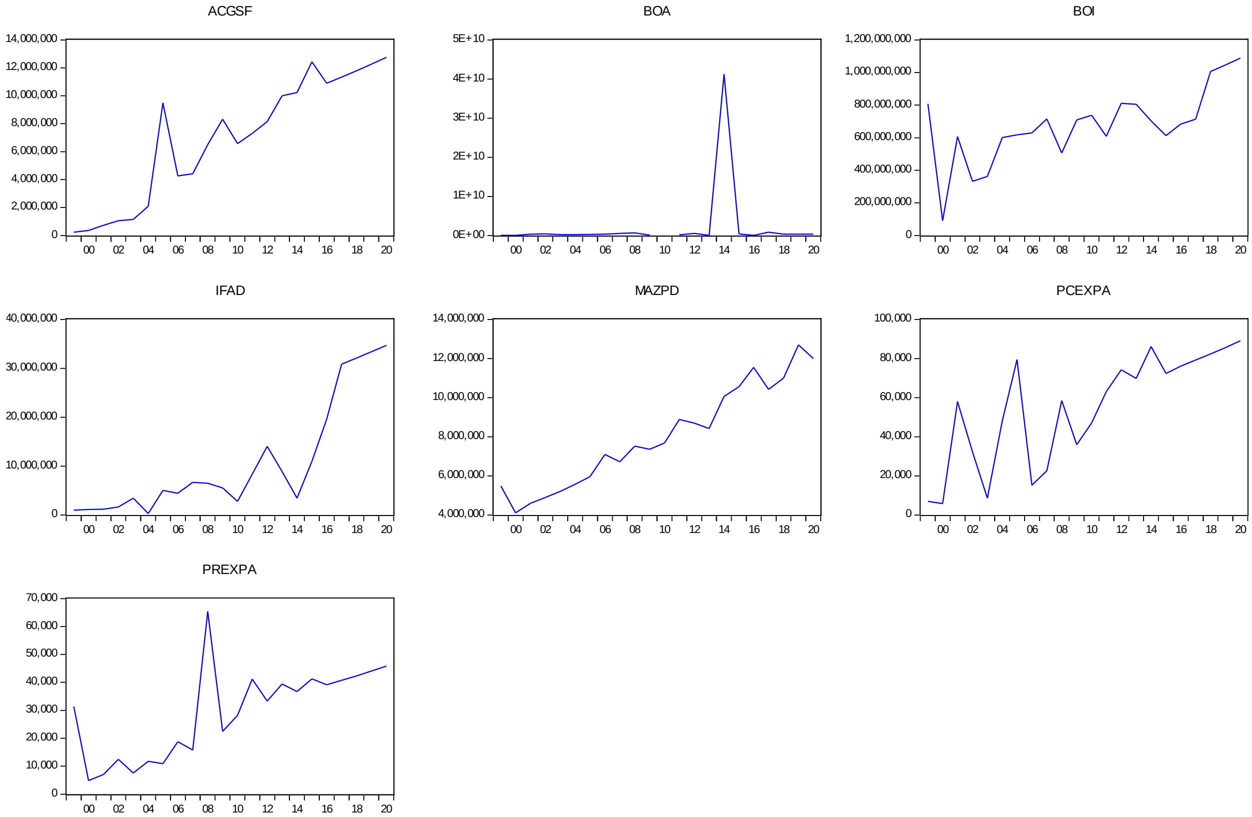

Figure 1: Trends in selected Dependent and Independent Variables over the period 1999-2020.

The trend shows that funding of agriculture through the ACGSF had been on the increase over the period of study, with slight fluctuations. This shows consistency on the part of government to finance agriculture for improved performance of the agricultural sector in the country. This agrees with Okidim and Eze (2018), who attributed increase in ACGSF to national economic empowerment and development strategy instituted in 2002.

The funding of agricultural development in Nigeria through the bank of agriculture as shown from the trend analysis in figure 1 has been fluctuating. Based on the trend it can equally be stated that the bank of agriculture can be said to be consistent to a large extent on their funding of the agriculture sector in Nigeria.

The Bank of Industry was setup to provide funding to the industrial sector, and it also provides funding to agro-allied industries. The funding from the bank of industry based on the trend have relatively been on the same level for the most part of the time period under study but picked up from 2017, and have been on the increase significantly since then.

Trends for International Funding for Agriculture Development showed that funding through (IFAD) was low until 2012 when they began to pick up, dropped in 2014, and then increased at an increasing rate.

Figure 1 depicts the trend in governments capital expenditure on agriculture for the period under study being 1999 to 2020, and it could be seen from the trend that capital expenditure to the agricultural sector over the study period is marred with steep fluctuation, implying that the government have not been consistent with allocating resources to capital projects in agriculture, some years the values are on the increase and then followed by sharp decreases in funding.

For the trend in Public Recurrent Expenditure to the Agriculture sector from 1999 to 2020, it could be seen that 1999 and 2008 recorded higher allocation by the government to recurrent expenditure in the agriculture sector, there were fluctuations also in the allocations over the study period, but they were not as much as the fluctuations in the capital expenditure allocation on the average, it can be said based on the trend that governments allocation to recurrent expenditure in agriculture have been on the increase over the years.

Maize plays a key role in the food chain of the country. It is a staple crop that several affordable energy giving foods are derived from, and it can equally be eaten in its original state either by boiling or roasting. It is also the major carbohydrate used in the production of livestock feed in the country. The availability of livestock in the country is heavily dependent on the availability of maize for feed production. The trend shows that output for maize is on the increase, with very little fluctuations. Maize is produced all over the country, only PCEXPA had positive influence on maize as shown in the regressive result. This means that other funding sources did not increase maize output. This increase in maize output may be due to the personal efforts of the farmers to improve maize production or funding from sources that are not included in this study.

Random Walk Test (Unit Root Test for Stationarity)

The test for unit root preceded the estimation of the model due to its usefulness in exposing the time series properties of the variables. The test for stationarity is used to also determine if there are shocks in the series of the data and then adjust and correct these shocks to make suitable the data for regression analysis. The stationarity test result is presented in Table 2.

Table 2 Unit Root Test Result

Variable	ADF		ADF		Order of Integration
	Levels	Sig.	1st Diff.	Sig.	
ACGSF	-4.408493	0.0113			1(0)
BOA	-5.664398	0.0002			1(0)
BOI	-6.518993	0.0002			1(0)
IFAD	0.300054	0.9724	-3.454890	0.0210	1(1)
PCEXPA	-6.302897	0.0003			1(0)
PREXPA	-5.593436	0.0010			I(0)
MAZPD	-4.280030	0.0153			1(0)

Source: Author's Compilation, using E-views 10, 2023

The Augmented Dickey Fuller (ADF) unit root test was the stationarity test type used to carry out the random walk test. The order of integration shows that Agricultural credit guaranteed scheme fund (ACGSF), Bank of Agriculture (BOA), Bank of industry (BOI), public capital expenditure to agriculture (PCEXPA), public recurrent expenditure to agriculture (PREXPA) and maize Production (MAZPD) were stationary at levels I(O), while International funding for agricultural development (IFAD) became stationary at first difference I(1). For a time-series data to be certified stationary, the t-statistics value should be greater than the t-critical value at the either the 1%, 5% or 10% level of significance or at all the 3 levels. The statistical implication of this result is that the regression result will not be spurious and the data set is good for forecasting and examining future trends.

Co-integration Test

The mixture of I (0) and I (1) order of integration implies that the most suitable estimation technique is the ARDL method. However, it is necessary to test further for long-run cointegrating relationship amongst the variables, hence the test for Cointegration. The results for the various models are presented thus;

Table 3 ARDL Bounds Cointegration Test Results

Model	F-statistic	Signif.	I(0)	I(1)
MAIZEPD	5.670592	10%	1.99	2.94
		5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

Source: Author's Compilation, using E-views 10, 2023

From the result in Table 2, the bounds Cointegration tests showed that there is Cointegration (long-run relationship) among the variables, agricultural funding and maize output. This is so because the F-statistics values were greater than the lower I (0) and the higher I (1) bounds coefficients, thus, the null hypothesis of no level relationship is rejected. From the results, Maize had F-statistic value of (5.670592) which is greater than the lower I (0) and the higher I (1) bounds coefficients, at the 10%, 5%, 2.5% and 1% level of significance, thus, the null hypothesis of no level relationship is rejected. To that effect, the error correction model (ECM) is included to determine the speed of adjustment or the degree of convergence to equilibrium in the long-run from disequilibrium in the short-run.

Regression Results for the Various Models

Table 5 Regression Result for Model Two

ARDL-ECM Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(MAZPD(-1))	-0.206734	0.093390	-2.213655	0.0777
D(MAZPD(-2))	-0.824339	0.131951	-6.247311	0.0015
D(MAZPD(-3))	-0.287178	0.111581	-2.573715	0.0498
D(ACGSF)	0.005064	0.039420	0.128451	0.9028
D(PCEXPA)	**21.93377**	**4.452272**	**4.926421**	**0.0044**
CointEq(-1)*	-0.653750	0.062654	-10.43434	0.0001
R-squared	0.886336			
Adjusted R-squared	0.838976			
S.E. of regression	311374.6			
Sum squared resid	1.16E+12			
Log likelihood	-249.5692			
Durbin-Watson stat	1.740996			
Long Run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ACGSF	**0.570169**	**0.214283**	**2.660825**	**0.0448**

BOA	-0.001877	0.001509	-1.244223	0.2686
BOI	-0.003756	0.002657	-1.413630	0.2166
IFAD	0.075174	0.031673	2.373433	0.0637
PCEXPA	-0.865829	26.70640	-0.032420	0.9754
PREXPA	19.28566	19.93879	0.967243	0.3778
C	6963407.	2042627.	3.409045	0.0191

Source: Author's computation using E-views 10, 2023.

Table 5 shows the ARDL-ECM Regression output and the long run coefficients. The result shows that the independent variables, Agricultural Credit Guaranteed Scheme Fund (ACGSF) and Public Capital Expenditure to Agriculture were automatically selected, out of the two selected variables, (ACGSF) had no significant influence on Maize production, this is so because the p-value (0.9028) was greater than 0.05. On the other hand, public capital expenditure to agriculture (PCEXPA) had a positive and significant influence on maize production (MAZPD) with a p-value of 0.0044 which is less than 0.05 at the 5 percent level of significance. PCEXPA had a coefficient value of (21.93377), meaning that a unit increase in Public capital expenditure to agriculture (PCEXPA) brought about a 21.93377-tons increase maize production (MAZPD). This finding is similar to Purokayo and Umaru (2012) who in their study on Global Food Crisis: Public Capital Expenditure and Agricultural Output in Nigeria, reported public capital expenditure to agriculture to have a positive impact on agricultural output in Nigeria. This means that Public capital expenditure to agriculture did brought about increase in maize production during the period under study. Maize is a major staple crop, that is consumed by humans and is also a very vital input in the production of feed for livestock, proper funding needs be directed to maize production, other financing towards agriculture should be made to impact on maize production. The R-squared of 0.88 shows the model is a good fit for estimation and that variations of Maize production (MAZPD)was explained by the independent variable (PCEXPA), implying that PCEXPA is 88% responsible for changes in maize production in the country, only 12% was accounted for by the error term. The cointegrating equation coefficient shows an average speed of adjustment of -0.653750 convergence to equilibrium. Implying that it will take a speed of adjustment of 65.37% for all variables to converge at equilibrium in the long run. The system is said to correct its previous period of disequilibrium at a speed of 65.37% annually. In the long run, none of the explanatory variables had significant influence on maize production for the period under study, except for Agricultural Credit Guaranteed Scheme Fund (ACGSF), which had a positive and significant relationship with maize production. In the long run (ACGSF) brought about a 0.570-unit increase in maize production.

Post Estimation Tests

The post estimation test was used to determine further the statistical characteristics of the residuals in the models.

Serial Correlation and Heteroskedasticity Test for Each Region

Serial correlation (Breusch-Godfrey LM Test F-Stat. p-value)	**Heteroskedasticity (Breusch- Pagan - Godfrey F-Stat. p-value)**
0.8423	0.2086

Source: Author's computation using E-VIEWS 10.0, 2022

The tests for serial correlation and Heteroskedasticity showed that the model was free from serial correlation, this is so because the F-probability values was greater than 0.05. The residual of the model was homoscedastic with no problem of Heteroskedasticity, since the F-probability value was greater than 0.05. Meaning the error term is constant throughout the series of the model.

Conclusion

From the findings of the study, the various agricultural lending schemes do have influence on cereal crop production in Nigeria both negatively and positively, it was concluded that the agricultural funding schemes have not been properly maximized to boost staple crop production and sustainability, evidenced by the negative coefficients of some of the funding scheme on the selected staple crops and the exclusion of several funding schemes in the ARDL-ECM models meaning they did not contribute either positively or negatively in such situations e.g., ACGSF (-0.105862) for Rice and BOA (-9.07) for Wheat respectively.

Recommendations

Based on the findings of the research work, it was recommended that all the funding's to agriculture selected in this study, with respect to maize production should be supervised and properly channeled so as to increase the output of maize in the country.

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