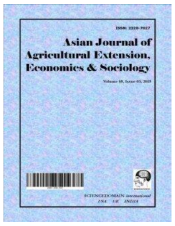

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Agricultural Production and Role of Policies for Sustainable Economic Growth in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author USM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author KS managed the analyses and literature of the study. Both authors read and approved the final manuscript.

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ABSTRACT

The study was conducted to examine the relationship between agricultural production and the role of policies in achieving sustainable food self sufficiency and overall economic growth in Nigeria using time series data and Johansen Vector Error Correction methodology. The results of the analysis from 1970 to 2015 revealed that there was long run association between Index of agricultural production and the explanatory variables included in the model. Agricultural production was found to increase with increased in agricultural capital expenditure and fertilizer consumption, whereas interest rate, inflation rate and exchange rate impacted negatively on production during the period of the study. In the short run, however, exchange rate and credit had slightly raised agricultural production. The study found out a unidirectional causality between index of agricultural production and agricultural capital expenditure and bidirectional causality between index of agricultural production and fertilizer consumption. It was recommended from the finding that, for sustainable agricultural production and economic growth, increase in budgetary allocation for agricultural capital expenditure is imperative, the inputs and distribution policy, exchange rate policy must be favourable to producers and entrepreneurs along the agricultural value chains.

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1. INTRODUCTION

The overall rate of economic growth depends to a larger extent on the growth of agricultural output and policymakers face challenge to formulate suitable agricultural policy by which the desired growth rate of agricultural output can be achieved [1,2,3]. The agricultural sector has the potential to be the industrial and economic springboard from which a country's growth and development can be realized, ostensibly through the sector's major roles which include; product contribution, factor contribution, market contribution and foreign exchange contribution. This is even more evident as agricultural activities are usually concentrated in the rural areas where there is a critical need for rural transformation, redistribution, poverty alleviation and socio-economic development [1,4].

The Nigeria agricultural policy provides a framework for implementation of programmes and guidelines for agricultural development. The objective is to attain self sustaining growth in all the sub-sectors of agriculture and realization of the structural transformation and overall economic growth. These policies involve not only activities in agricultural production but also include feeding the industries, entrepreneurship in form of food processing and manufacturing, distribution and marketing, trade and consumption. Over the years, successive governments of the country have designed and implemented myriads of agricultural policies and programmes in an attempt to stimulate and revamp the growth and development of the agricultural sector. These policies were modeled, changed or restructured while others still operate. [5,6,2,7]. Some of the policies under different institutions witnessed in the past three decades to achieve desired growth include among others; Agricultural commodity marketing and pricing with creation of commodity boards in 1977, inputs supply and distribution policy (1972), input price subsidy policy, between 1976 and 1979 seventy five percent was born by federal government. Land resource use policy in 1978 agricultural research policy (1971), agricultural cooperatives policy which became notable in 1979 and agricultural water resource & irrigation development policy, etc. However, these policies have their roots since colonial era. Similarly notable programmes and projects that played significant roles include; National Accelerated Food Production Programme (NAFPP) in 1972, Agricultural Development Projects (ADPs) 1974, River Basin Development Authorities (RBDAs) 1976, Nigerian Agricultural, cooperation and Rural Development Bank (NACRDB), Operation Feed the Nation (OFN) 1976, Green Revolution Programme 1980, Directorate of Foods, Roads and Rural Infrastructures (DFFRI) 1986, Agricultural Credit Guarantee Scheme Fund (ACGSF) 1977, National poverty eradication programme (NAPEP) 1990, National Special Programme for Food Security (NSPFS) 2002, Root And Tuber Expansion Programme (RTEP) 2003, Commercial Agricultural Development Programme (CADP) 2009, National Fadama Project 1999, National Economic Empowerment Development Strategy (NEEDS) 1999 etc. [8,9,10,11,12,13].

In spite of the afore mentioned, Nigeria's agricultural sector still underperformed looking at the declining GDP contribution and the heavy importation of some basic food crops like rice and wheat coupled with the looming food insecurity situation especially relative to unmatched increased in population growth. Various reasons have been advanced for the poor performance of agricultural sector which includes inconsistency in these policies, lack of proper implementation due to absence of political will, the negative influence of macroeconomic policies and inadequate agricultural capital expenditures and the role of institutions in discharging these policies among others [13,2].

The link between macroeconomic policies and the success of agricultural growth has been reported with empirical evidences [14,15,4,12,16]. In Nigeria major macroeconomic policies that affect the agricultural sector includes budgetary and tax policies, credit, rate of interest, inflation, exchange rate system and import and export regulation to mention a few under fiscal, monetary and trade policies. In view of the above, this study seeks to determine and add to available knowledge the relationship between agricultural production and some policy variables with a view to draw a valid conclusion to achieving sustainable food self sufficiency and overall economic growth.

2. METHODOLOGY

The study area for this research in Nigeria. Data for the study were drawn from Food and

Agricultural Organization Database (FAOSTAT) and National Bureau of Statistics (NBS) and International Monetary Fund (IMF) Data file. The duration of the study **(**range of data**)** spanned a period of 45 years, from 1970 to 2015 and variables included to achieve the objective of the study comprise; index of agricultural production, agricultural capital expenditures, inflation rate, exchange rate, interest rate and fertilizer consumption.

2.1 Analytical Framework

2.1.1 Augmented dickey fuller (ADF) unit root test

If two variables are trending over time, a regression of one on the other could have a high R^2 even if the two are totally unrelated, this is spurious regression. Therefore applying ordinary least squares regression on non stationary variables can give misleading parameter estimate about the relationship between variables. If the variables in the regression model are not stationary (mean and variance are variant with time), then it can be proved that the standard assumptions for asymptotic analysis will not be valid. In other words, the usual t-ratios will not follow a t-distribution, so we cannot validly undertake hypothesis tests about the regression parameters [17]. A time series Y_t is considered as stationary on the existence of invariant mean and variance over time. To test for stationarity, ADF was used. The test is based on the following model;

$$\Delta Y_t = \alpha + \varphi t + \theta Y_{t-1} + \sum_{i=1}^{n} \omega_i \, \Delta Y_{t-i} + v_t \quad (1)$$

T statistics are compared with critical values, the null hypothesis of unit root is rejected when t statistics is greater than critical values or probability is found to be < 0.05%.

2.1.2 Johansen cointegration framework

Johansen's vector error correction model (VECM) methodology was employed to examine the response of output on policy variables affecting agricultural production. Cointegration techniques verify the existence of long-run relationships between variables. The Johansen full information maximum likelihood test estimation technique is chosen over Engle-Granger two-step estimation technique because, unlike the Granger cointegration procedure which assumes a single co-integrating vector, the Johansen method allows for all possible co-integrating relationships and permits empirical determination of the number of co-integrating vectors and also the short-run coefficients are estimated in such a way that they are guided by and consistent with long-run relationships [18,19]. The method, however, assumed variable must be integrated of the same order. According to Johansen 1988, the definition of a vector autoregressive (VAR) model is given by;

$$X_t = \Pi_1 X_{t-1} + \sum \Pi_2 X_{t-2} + \cdots + \Pi_k X_{t-k} + U_t \quad (2)$$

Where, X_t is an (*n×1*) vector of *I*(1) variables, $\Pi_1 \ldots \Pi_k$ represents (*m×m*) matrix of coefficients, and U_t is (*n×1*) vector of white noise errors. With the assumption that X_t is non-stationary, equation the can be written in an error correction representation as;

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \cdots + \Gamma_k \Delta X_{t-k+1} + \Pi_1 X_{t-k} + U_t \quad (3)$$

Where, $\Gamma_1 = \Pi_1 - 1$, $\Gamma_2 = \Pi_2 - \Gamma_1$, $\Gamma_3 = \Pi_3 - \Gamma_2$ and $\Pi = -\Pi_1 - \Pi_2 - \cdots \Pi_k$ respectively.

Γ's are (n×n) coefficient matrix for X_{t-1} i=1,2,3….

The above specification conveys information about both the short and long-run adjustments to changes in X_t through the estimates of Γ and Π respectively. Γ gives the short-run estimates while Π gives the long-run estimates. The impact matrix Π gives information on X_t and determines the extent to which a given system is co-integrated. If the rank of Π matrix represented by r, is 0 < r > n, there are r linear combinations of the variables in X_t that are stationary [20,21]. Thus Π can be decomposed into two matrices α and β, where α represents the error correction term and measures the speed of adjustment in ΔX_t and β contain r co-integrating vectors. Johansen and Juselius [19] derived two likelihood ratio test statistics to test for the number of cointegrating vectors. The null hypothesis of r cointegrating vectors against the alternative of more than r cointegrating vectors is tested by using Trace statistics given by;

$$Trace\ test(\lambda_{trace}) = -T * \sum_{i=r+1}^{n} ln\,(1-\lambda) \quad (4)$$

Null hypothesis (Ho): the number of co-integrating vectors is less than or equal to r Alternate hypothesis (H_1): the number of co-integrating vectors is more than r.

The maximum Eigen value test, on the other hand, conducts separate tests on the individual Eigen values for a null hypothesis (Ho) that the number of co-integrating vectors is r, against an alternative hypothesis (H_1) of r+1.

$$Max\ Eigen\ value\ test(\lambda_{max}) = -Tln(1-\lambda) \quad (5)$$

Where, λ (trace and max) are the estimated Eigen values (characteristic roots) obtained from the Π matrix, and T is the number of usable information observation after lag adjustment. The presence of significant cointegrating vector(s) in the multivariate formulation of the model can provide some important indications as to the long-run relationship(s) among concerned variables.

2.1.3 Model specification

The vector error correction model to achieve the stated objective is specified as follows;

$$Indexagr_t = \beta_0 + \sum\beta_1 \Delta lnAcapexp_{t-i} + \sum\beta_2 \Delta \ln \mathrm{Cred}_{t-i} + \sum \beta_3 \Delta \ln \mathrm{Fert}_{t-i} + \sum\beta_4 \Delta \ln Int.rate_{t-i} + \sum\beta_5 \Delta \ln \mathrm{Ex.rate}_{t-i} + \sum\beta_6 \Delta \ln \mathrm{Inf.rate}_{t-i} + \phi \mathrm{ECT}_{t-1} \quad (6)$$

Where, $Indexagr$ = Index of agricultural production; $Acapexp$ = Agricultural capital expenditure in Naira. $Ex.rate$ = Exchange rate (Dollar to Naira); $Cred$ = Credit to food crops in Naira.

$Fert$ = fertilizer consumption (Nitrogenous) (kg ha^{-1}) as proxy for inputs distribution and subsidy policies; $Inf.rate$ = Inflation rate (%); $Int.rate$ = Interest rate (%); Δ = lag operator; ln = natural logarithm; t-i = no. of lags.

2.1.3 Granger causality test

According to [22] if a series Y_t "granger causes" a series X_t , then the past values of Y_t should contain information that helps to predict X_t , above and beyond the information contained in the past values of X_t, alone. Granger causality test is an essential analysis given that it highlights the existence of causation and it can be unidirectional or bidirectional. Granger causality measures the ability of past values of one variable to cause the current values of another variable. The test involves estimating the following equations,

$$Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha Y_{t-i} + \sum_{j=1}^{p} \beta i\, X_{t-j} + \varepsilon_{1t} \quad (7)$$

$$X_t = \varphi_0 + \sum_{i=1}^{p} \varphi X_{t-i} + \sum_{j=1}^{p} \vartheta i\, Y_{t-j} + \varepsilon_{2t} \quad (8)$$

From above two equations, the disturbances $\varepsilon_{1t}\ and\ \varepsilon_{2t}$ are assumed uncorrelated and unidirectional causality existed from Y to X if $\beta i = 0$ and $\vartheta i \neq 0$. Similarly, there is unidirectional causality from X to Y if $\vartheta i = 0$ and $\beta i \neq 0$. There is mutual causality if $\vartheta i \neq 0$ and $\beta i \neq 0$ and variables are independent (no link between them) if $\beta i = 0$ and $\vartheta i = 0$. The null hypothesis is rejected when probability is < 0.05 percent.

2.2 Specification of Variables

It is worthwhile to justify the inclusion of the variables in the model as follows;

2.2.1 Index of agricultural production

shows agricultural production for each year relative to the base period 2004-2006. It includes food crops that are considered edible and that contain nutrients.

2.2.2 Agricultural capital expenditure

This variable captures the extent of public spending on agriculture and reflects how well agricultural policies are well supported financially. It shows government commitment towards infrastructural development, research and training, agricultural extension technology transfer, water resource and irrigation and agricultural mechanization policies thus, augmenting the capital stock available for agricultural production and providing enabling environment to farmers. It is expected to have a positive relationship with agricultural production.

2.2.3 Credit to food crops

The variable was included to show how well the agricultural credit policy is firing during the period of study. It is expected that volume of credit to farmers has a direct link to agricultural production. Credit to food crops enters into the equation to assess the agricultural credit policy in the country. The ease with which farmers assess credit from financial institutions will affect the rate and cost of investment in the sector.

2.2.4 Exchange rate variable

The exchange rate policy is a macroeconomic policy which affects agricultural sector through cost of capital effect. The exchange rate between two currencies specifies how much one currency is worth in terms of the other. The Nigerian exchange rate i.e. the value of domestic currency in terms of foreign currencies impact the competitiveness of the agriculture sector by affecting prices of agriculture products and inputs and therefore farms' profits. The most significant foreign currency to Nigeria is the US dollar. This is due to the high level of trade between Nigeria and the US and also because it's the dominant world currency. A nominal exchange rate is used for the purpose of this study.

2.2.5 Fertilizer consumption

Fertilizer (Nitrogenous) consumed during the period of study is taken as a proxy for inputs distribution and subsidy policy. The direct relationship between inputs and agricultural production makes it imperative to factor the variable into the model. Various regimes have exerted different inputs supply policies in the bid to increase production in the country; it is expected to have a positive relationship with an index of agricultural production.

2.2.6 Inflation rate

Is another macroeconomic policy which affects almost all economic sectors. Persistent rise in prices grossly affects the living standard of the people by reducing their real income. Inflation impacted on agricultural policies and food production through its effect on the buying power of the consumers and the resultant demand for agricultural product [23]. When inflation reduces the real value of a producer's revenues and assets and devalues precautionary savings, they may be forced to reduce their supply. Inflation measured by the consumer price index (CPI) was used and it reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals.

3. RESULTS AND DISCUSSION

3.1 ADF Result

The result of the unit root tests performed on the level values of the data using ADF is presented in Table 1. The tests were carried out on each variable over the study period (1970–2015) with intercept only. The result confirmed that all the variables were non stationary at level as t statistics of the series were lower than the critical values at 5% probability level, thus accepting the null hypothesis of unit root. After taking the first difference all the variables became stationary, meaning that they have no unit root. The t statistics are now greater than the Mackinnon (1991) critical values at 5 percent, likewise the probability values are all less than 5% thus the null hypothesis of the existence of unit root is rejected. It is therefore concluded that, the series is first difference stationary or integrated of the same order which is a pre-condition for Johansen cointegration test.

3.2 Results of Johansen Cointegration Test

Summary of Johansen's maximum likelihood cointegration test using the maximum Eigen statistics is presented in Table 2. The test was carried out with intercept only in VAR model with three lags length. The null hypothesis of no cointegration against the alternative hypothesis of cointegration was examined by comparing Max Eigen and critical values. The maximum Eigen statistics revealed that there was one cointegrating equation at 5% level of significance thus rejecting the null hypothesis of $r = 0$. Max Eigen value (49.39) was greater than critical value 46.23 at 0.05% level. It was concluded that there was a long run relationship between index of agricultural production and the explanatory variables. When variables are cointegrated the data are never expected to drift too far away from each other thus, maintaining an equilibrium relationship.

3.2.1 Vector error correction (long run elasticities)

Although the cointegration technique showed the existence of long run relationship among the variables, it does not provide a mechanism to correct deviations from the short run to the long run; the error correction model and the lagged error correction term integrates short run

Table 1. Results of augmented dickey fuller (ADF) unit root test

	ADF test Intercept only. Ho: there is unit root (non stationary)					
	At level I(0)			At first difference I(1)		
Variables	T stat	Prob. value	Inference	T stat	Prob. value	Inference
Lnindexagr	-0.8099	0.8062	Accept Ho	-4.7032	0.0004	Reject Ho
InAcapexp	-2.2133	0.2046	Accept Ho	-9.4066	0.0000	Reject Ho
InAgrcred	-0.4455	0.8921	Accept Ho	-5.7893	0.0001	Reject Ho
InEx.rate	-0.2241	0.9277	Accept Ho	-5.3879	0.0000	Reject Ho
InInf.rate	-2.4318	0.1751	Accept Ho	-7.2702	0.0000	Reject Ho
InInt.rate	-1.4532	0.5478	Accept Ho	-6.3524	0.0021	Reject Ho
Lnfert	-0.6182	0.4322	Accept Ho	-8.2210	0.0000	Reject Ho

Note: Critical at 1%, 5% and 10% are -3.5925, -2.9314 and -2.6039 respectively; number of lags is based on Schwarz Information Criterion (SIC)

Table 2. Johansen cointegration test (unrestricted cointegration rank test-Max Eigen value)

Hypothesized No. of CE(s)	Eigen value	Max Eigen statistics	0.05% Critical value	Prob.**	Rank
None *	0.6746	49.3974	46.231	0.0222	r=0
At most 1	0.4967	30.2106	40.077	0.4102	r=1
At most 2	0.4539	26.6248	33.876	0.284	r=2
At most 3	0.3703	20.3512	27.584	0.3173	r=3
At most 4	0.3054	16.0317	21.132	0.223	r=4
At most 5	0.1761	8.5208	14.265	0.3282	r=5
At most 6	0.0228	0.0228	3.8415	0.3133	r=6

*Note: Max-eigen value test indicates 1 cointegrating equation at 0.05% level, * denotes rejection of the hypothesis at 5% ** indicates MacKinnon-Haug-Michelis (1999) p-values*

dynamics into long run function. Table 3 displayed the results of the long run equilibrium relationship between the series. From the results, agricultural capital expenditure was found to have a positive influence on agricultural output during the period of study. The coefficient was positive and statistically significant at 10 percent revealing that food production increased by 0.05% as capital expenditure on agriculture is increased by 1 percent. The findings implied that agricultural activities and economic growth responded slowly to government spending thus, indicating the need for the increase in budgetary allocation. Various studies also found similar relationship example, [24,25,26,27]. Available data showed that, average annual capital expenditure on agriculture during the study period was N 7.2 Billion Naira; this was low and translated into low investment in research, low infrastructure, low inputs supply and farm structures, thus impacting on overall economic growth. [26] reported that, less than 4% of total federal expenditure was allocated to agriculture during 1980 to 2011 and was far lower than the spending in other sectors. There was also positive relationship between fertilizer consumption and crop output. Production increases by 0.12 percent when supply and distribution of essential inputs are raised by 1%. The result implied that, inputs procurement, distribution and subsidies as government obligation needs to be restructured and enhanced to attain food self sufficiency and overall economic growth [28,29] has reported low usage and inadequate supply of fertilizer in Nigeria using only 8 kg ha^{-1} against world average of 91 kg ha^{-1}

The empirical findings (Table 3) further revealed that there was negative relationship between index of agricultural production and nominal exchange rate during the period of study. The coefficient of the exchange rate was statistically significant at 1% probability level and indicated that, production come down by 0.15 percent as exchange rate increases by 1 percent. Yaqub [30] had similar findings from 1970 - 2008. An appreciation of the exchange rate is beneficial if it is caused by the economy becoming more productive and competitive. According to [31] positive relationship existed between aggregate output and real exchange rate in Nigeria during 1970-2003. It could be inferred that the exchange rate policy the country adopted during the period of the study did not achieve the desired economic growth. Similarly, as theoretically expected, inflation in the long run impacted negatively on food production and was statistically significant at 1 percent probability level. As inflation increases by 10 percent, food production reduces by 1.6 percent. Low agricultural production growth with high food importation is inherent during period of inflation. The average inflation rate in Nigeria during the period of study was 18.3% and was highest in 1995 (72.8%). [4] also reported negative relationship between inflation and agricultural production between 1970 and 2006 and maintained that investment in real sector is discouraged during inflation due to eroding power of money thereby raising the nominal prices. Interest rate and credit to agriculture were negative and statistically nonsignificant in the long run a rise in lending rate by 1 percent constrained farmers and reduced production by 0.04%. [12] found similar result for interest rate between 1970 and 2009 using the same methodology. Similarly coefficient of credit to agriculture was unexpectedly negative, low and statistically not significant (-0.036) thus, indicating inadequate, inefficient utilization and possible diversion of credit to other nonfarm activities. Purokayo and Umaru [25] found negative and statistically significant relationship (-0.037) during the period of 1990 to 2004.

$$\begin{aligned} LNINDEXAG = ECT + 0.0475 lnAcapexp \\ - 0.0361 lnCred + 0.1204 lnFert \\ - 0.0491 lnint.rate \\ - 0.1563 lnex.rate \\ - 0.1607 lninf.rate - 2.142C \end{aligned}$$

3.2.2 Short run dynamics relationship

The results of short run elasticities are displayed in Table 4. R squared is 77.3 percent indicating that the model is well fitted. The F statistics also provided the proof that the model was good (significant at 5%). The error correction term which measures deviation from equilibrium has the expected negative sign and is significant at 1% level this further indicated that the variables in the model are cointegrated. The coefficient of ECT-1 relatively showed slow feedback of 28.89 percent of the previous year's disequilibrium adjusted for long term values.

In the short run, coefficient of dependent variable lagged by 3 years was significant at 1 percent level, meaning that current agricultural production is influenced by the previous production. Capital expenditure was also significant in the short run; two years lagged period was significant at 1 percent probability level and indicated an increase in food production by 0.5 percent when it is raised by 10 percent. [24,27] obtained positive relationships (0.4 and 0.2) between agricultural output and agricultural expenditure in the short run from 1970 to 2008 and 1961 to 2010 respectively. Unlike, in the long run, credit supply to agriculture is positive and significant at 10% level in the short run (credit lagged one) implying that food production responds to loans supplied by government and some banks during the study period. The coefficient of credit lag one indicates elasticity of 0.053 whereas 2 years lagged period was negative (-0.023). Similarly, fertilizer and exchange rate were also determinants of index of agricultural production in the short run. Exchange rate lagged by three years period was significant at one percent and causes 0.1 percent change in production when increased by one percent. Meaning that, unlike, in the long run, devaluation of Naira has produced enabling environment for the increase in agricultural production. Coefficients of interest rate and inflation rate were found statistically not different from zero in the short run.

3.3 Diagnostic Checks

Lower segment of Table 4 further displayed diagnostic check about the whole model and the results justified the validity of the findings. The

Table 3. Results of VECM showing long run relationship

Variables	Coefficient	Std error	T statistics
ECT-1	-0.2889	0.1003	-2.8808***
InAcapexp	0.0475	0.0272	1.7486*
Lncred	-0.0361	0.0259	-1.3878 NS
Infert.cons	0.1204	0.0283	4.2514***
Inint rate	-0.0491	-0.0917	-0.5361 NS
Inex rate	-0.1563	-0.0507	-3.0795***
Ininf rate	-0.1607	-0.0384	4.1885***
Constant	-2.142	-	-

Note:, *** denotes significant at 10 and 1 percent level, while NS denotes nonsignificant respectively*

DW statistics (2.11) indicted the absence of autocorrelation for first order serial correlation. Serial correlation LM test for higher order correlation also rejected the null hypothesis at 5%. Residuals were similarly tested for Heteroscedasticity using ARCH and Breusch-Pagan-Godfrey tests, the results showed absence of ARCH (2.759, prob. 0.0967) and errors were Homoscedastic (923.15, prob. 0.7254). Non normality of the data was also rejected at 5 percent significant level by Jarque-Bera test.

3.4 Granger Causality Results

The results of Granger causality test depicting the direction of causation is presented in Table 5. The null hypothesis that capital expenditures do not granger cause index of agricultural production is accepted since the probability of computed F statistics is greater than 5%, whereas, the null hypothesis of an index of agricultural production does not cause capital expenditure is rejected affirming unidirectional causality. Similarly, the null hypothesis of lnfert does not granger cause lnindexagr is rejected at 5 percent level, thus lnfert granger causes lnindexagr. Likewise, causality runs from lnindexagr to lnfert at 1 percent probability level, therefore bidirectional causality exists between the two series. Unidirectional causality also exists between lnint.rate and lnindexagr. Causality runs from lnint.rate to lnindexagr at 1 percent level, while the null hypothesis between lnindexagr and lnint.rate could not be rejected. The null hypotheses between lnex.rate and lnindexagr and between lnindexagr and lnex.rate are all rejected at 5 percent probability level, implying that bidirectional causality exists between the variables. The Table also displayed the result of joint significance of the independent variables; the null hypothesis was rejected at 5%

Table 4. Results of vector error correction model depicting short run relationship

Variables	Coefficient	Std error	T statistics	Probability
ECT-1	-0.2889	0.1003	-2.8808	0.0096
$\Delta lnindexagr_{t-1}$	0.1159	0.1626	0.7128	0.4846
$\Delta lnindexagr_{t-2}$	0.2261	0.1507	1.4997	0.1501
$\Delta lnindexagr_{t-3}$	0.4948	0.1426	3.4697	0.0026
$\Delta lnAcapexp_{t-1}$	0.0283	0.0144	1.9708	0.0635
$\Delta lnAcapexp_{t-2}$	0.0514	0.0161	3.1877	0.0048
$\Delta lnAcapexp_{t-3}$	-0.0079	0.0133	-0.5954	0.5586
$\Delta lncredit_{t-1}$	0.0526	0.0257	2.0402	0.0555
$\Delta lncredit_{t-2}$	-0.0324	0.0231	-1.4015	0.1772
$\Delta lncredit_{t-3}$	0.0184	0.0215	0.8582	0.4015
$\Delta lnfert_{t-1}$	0.0566	0.0172	3.2862	0.0039
$\Delta lnfert_{t-2}$	0.0308	0.0146	2.1058	0.0487
$\Delta lnfert_{t-3}$	-0.0452	0.0135	-3.3607	0.0033
$\Delta lnint.rate_{t-1}$	-0.0030	0.0149	-0.2017	0.8423
$\Delta lnint.rate_{t-2}$	0.0144	0.0126	1.1427	0.2673
$\Delta lnint.rate_{t-3}$	0.0154	0.0133	1.1643	0.2587
$\Delta lnex.rate_{t-1}$	-0.0171	0.0304	-0.5611	0.5813
$\Delta lnex.rate_{t-2}$	0.0257	0.0280	0.9173	0.3705
$\Delta lnex.rate_{t-3}$	0.1022	0.0330	3.0954	0.006
$\Delta lninf.rate_{t-1}$	-0.0030	0.0149	-0.2017	0.8423
$\Delta lninf.rate_{t-2}$	0.0144	0.0126	1.1427	0.2673
$\Delta lninf.rate_{t-3}$	0.0154	0.0133	1.1643	0.2587
$constant$	0.0470	0.0127	3.6951	0.0015
Diagnostic checking				
R^2		0.77		
R^2 Adjusted		0.51		
F stat.		2.936 prob. = 0.010		
DW Stat.		2.11		
Serial corr. LM test		2.919 prob. = 0.2322		
Heteroscedasticity (ARCH)		2.759 prob. = 0.0967		
Breusch-Pagan-Godfrey test		23.15 prob. = 0.7254		
Normality –Jarque-Bera		0.8589 prob. = 0.6508		

Table 5. Results of wald test (short run) and pair wise granger causality

Null hypothesis	F statistic	Prob.
Short run causality $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$	2.7108	0.0184
Granger causality		
Incapexp does not Granger cause Inindexagr	0.1082	0.8977
Inindexagr does not Granger cause Incapexp	5.8028	0.0062
Incredit does not Granger cause Inindexagr	0.7899	0.4610
Inindexagr does not Granger cause Incredit	1.7348	0.1898
Infert does not Granger cause Inindexagr	3.8228	0.0305
Inindexagr does not Granger cause Infert	5.7902	0.0063
Ininf.rate does not Granger cause Inindexagr	0.2431	0.7853
Inindexagr does not Granger cause Ininf.rate	0.7759	0.4672
Inint.rate does not Granger cause Inindexagr	8.2910	0.0010
Inindexagr does not Granger cause Inint.rate	0.7188	0.4937
Inex.rate does not Granger cause Inindexagr	3.7694	0.0319
Inindexagr does not Granger cause Inex.rate	5.1041	0.0107

level, thus indicating short run causality running between the independent variables to Inindexagr.

4. CONCLUSION AND RECOMMENDATIONS

The study assessed the relationship between index of agricultural production and agricultural capital expenditure, credit to crops as proxy to credit policy, nominal exchange rate, inflation rate, interest rate and fertilizer consumption as proxy to inputs distribution and subsidy policy using time series data from 1970 to 2015. Johansen VECM was employed and the findings revealed that, all the variables were integrated of the same order I (1) after subjecting them to first difference by ADF unit root test. Johansen Max Eigen test also indicated the existence of one cointegrating equation implying that there was a long run relationship between the variables. Significant variables that positively influenced agricultural production in the long run were agricultural capital expenditures and fertilizer consumption as theoretically expected. However, low response of Indexagr to agricultural expenditures was linked to low budgetary allocation (< 4% of budget). Inflation rate, interest rate, credit supply and exchange rate decreased production during the study period. Negative relationship with exchange rate was linked to low productive sectors of the economy which led to low exports. The results implied that policies and there institutions had not achieved the desired economic growth. Deviation due to shocks was found to be slow in converging to equilibrium position. The following recommendations emerged from the study;

- Budget allocation for agriculture (capital expenditure) should be increased to meet the stipulated Moputa 2003 convention requirement (10% of total budget) or even higher as suggested by Food and Agricultural Organization so as to provide adequate investment in all facets of agriculture with particular reference to research, equipments and farm inputs support.
- Interest rate policy should be low, liberalized and designated to favour credit spread so that any expansionary intention could have the desired positive impact.
- Exchange rate policy should be made to support exports in times of production and curve the menace of inflation during the period of imports. Flexible exchange rate policy may be considered with some degree of intervention by the Central Bank where necessary.
- Inputs distribution and subsidy policy should be very effective to ensure access to productive resources by farmers. The current Growth Enhancement Support Scheme (GES) should be maintained and fully supported by all tiers of government.
- The institutions should imperatively provide level playing ground to allow implementation of all policies and programmes for sustainable economic growth.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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