

Macroeconomic Policy and Agricultural Output in Nigeria: Implications for Food Security

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Abstract This paper empirically investigates the impact of macroeconomic policies on agricultural output specifically on crop production in Nigeria. The Multivariate Vector Error Correction approach has been applied to examine both short run and long run relationship between the series over the period of 1978-2011. The study finds a cointegrating relationship among agricultural output, government expenditure, agricultural credit, inflation, interest and exchange rates. The findings show that in the long run, agricultural output is responsive to changes in government spending, agricultural credit, inflation rate, interest rate and exchange rate. The results of impulse response functions suggest that one standard deviation innovation on government expenditure and interest rate reduces the agricultural output thus threatening food security in the short, medium and long term. While results of the variance decomposition indicate that, a significant variation in Nigeria's agricultural food output is due to changes in exchange rate and government expenditure movements. This implies the imperative of the role played by both fiscal and monetary policy in an effort to ensure food security. It is recommended that to achieve a sustainable food security, an expansionary fiscal policy that is not inflationary should be rigorously pursued along with a realistic exchange rate that takes account of the prevailing internal macroeconomic environment rather than the dynamics of international undertones.

Keywords Fiscal Policy, Causality, Food Security, Cointegration

1. Introduction

Agriculture has often been touted crucial in the economic development as well as one of the major window out of Poverty of most third world countries. Recent researches on the causes of development and underdevelopment have identified agricultural transformation as key to the economic emancipation of failing States. In this perspective, it is assumed that agricultural sector is the major determinants of whether the battle over poverty and achievement of long-term economic development will be won or lost. However, how we go about the contest for economic development using agriculture as weapon, and how we hope to win, indeed, remains a moot issue. Generally, the sector contributes to the development of an economy in four major ways: product contribution, factor contribution, market contribution and foreign exchange contribution [1, 22, 39]. In the global world, the contribution of agriculture in the above-mentioned major ways, most especially in product contribution that encompasses food production has been worsening, the impact of which resulted into food price hikes in 2007 and 2008.

The devastating effects of declining agricultural output prompted the inclusion of food security in the G-8 Summits in Hokkaido, Japan (2008). The declaration entails among others encouraging countries to release surplus food stocks, removal of export restrictions as well as raising 22 billion over three years for agricultural investment. The implementation of the above served as foundation for the creation of Global Agriculture and Food security Programme (GAFSP), along with a declaration of three years Agricultural Action Plan in 2010 by the World Bank. The above aims at raising the level of funds level from 4.1 billion dollars per annum to 8.3 billion per year [35]. With this encouraging increase in funding to small and large scale agricultural investors, it is still not clear whether the priority being given to funding has improved projects that increase domestic food production. In a rider to the above, it has been confirmed that the basic component of food security in terms of availability, accessibility and utilization cannot be met by about 1.0 billion people in low income, food deficit developing countries most of whom lives in the rural areas depending solely on Agricultural sector for food supply and income [14].

In Nigeria, the development of agricultural policy for some years back has been based on the understanding that agriculture is the only panacea to the achievement of an inclusive growth due to its inward linkages. Hence, the focus of the agricultural development efforts have been to improve

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and sustain the sector to play this assigned role with special emphasis on the attainment of a sustainable level in the production of basic food [11].

It is noteworthy that Nigeria's total agricultural land is estimated to be 76200sqkm [39] with about 165million population making it the 8th most populous countries in the world. Food crops constitute the largest component of the crops sub-sector of Nigeria's agricultural sector. The sector employs about 32.31% of its total population, but still the sector only accounts for 40% of the country's GDP [25]. Thus, output in that sector has lagged behind other sectors leading to food insecurity and increasing level of poverty in the country. The poverty rate in terms of food poor increased from 33.6% in 2004 to 41% in 2010 and this incidence is more dangerous among the rural dwellers that rely on agricultural productivity as a means of survival. Among the urban population, the rate of poverty has been on the increase with the level of food poor as high as 48.3% compared to 26.7% in the urban areas [25]. Recognising the unhealthy condition of Nigeria's Agricultural sector since 1970 and its implication on food security and improved well-being of its citizens, the Nigerian government introduced series of macroeconomic programmes and policies (both monetary and fiscal policy) aimed at improving the sector performance. These include but not limited to DFRRI, NEEDS, Fadama, selective credit control, agricultural Subsidies, exchange rate and interest rate management, etc. The following table lend support to this situation, especially between 2006 to 2011.

These governmental efforts notwithstanding, agricultural sector performance in terms of its output have been disappointing. The share of agriculture contribution to GDP declined from 42.20% in 2007 to 40% in 2010 and to a more worsening rate of 32.7% in 2011, [29, 30, 36]. From table 1

above, the growth rate of cereals crop production that stood at 0.11% in 2006 declined to -1.03% in 2011. The above resulted into increased food import bills into the country coupled with the already depreciating exchange of Naira, thus culminating to rise in food prices and worsening poverty level (see table 1). This is evidenced by the increase in the rate of inflation measured in terms of food poor from 3.9% in 2006 to 15.5% in 2009, while experiencing a marginal improvement in 2011, though still higher compared to that of 2006. A critical look at table 1 shows a declining growth rate in food crops production far below the government set target of annual growth rate of about 5% to 10% for food crops production as well as population average growth rate of about 2.67%. These are indications of serious food insecurity for the country and poor macroeconomic policies performance.

In view of the above, the paper aims to empirically investigate the impact of macroeconomic policies on the Nigerian agricultural output in relation to its role as a source of food supply. However, while earlier studies have focused either only on monetary policy or fiscal policy impact on agricultural output, the present study differs by using a specific measure of agricultural output (food crops only) employing reliable Time Series analysis method, as well as using extended macroeconomic variables (both fiscal and monetary policy instruments) in the model. In the light of this, the paper is collapsed into five sections including this introduction as section one. Section 2 reviews the related literatures and conceptual framework, while section 3 examines Nigeria's agricultural macroeconomic policies, Section 4 deals with the methodology and analysis of the results. Section 5 concludes the paper with some recommendations.

Table 1. Some Economic Indicators and Agricultural Output in Nigeria (2006 – 2011)

Year	Pop. Growth Rate	Food Import Bill (\$)	Interest Rate	Cereal Prod. ('000 metric tons)	Cereals Crop Prod. (Growth rate)	Inflation Rate (food Weight)%	Govt Rec. Exp. Agric	Ave. Off. Exch. Rate	ACGS Fund	Agric :Land (cereals Prod, growth Rate)
2006	2.48	17.95	16.89	28864	0.109	3.9	19919.03	128.65	3703384	0.046
2007	2.49	20.05	16.94	27171	-0.059	8.2	32484	125.83	3871443	0.014
2008	2.49	09.77	15.14	30209	0.112	18.0	65399.01	118.56	4775375	-0.026
2009	2.51	11.82	18.36	21229	-0.297	15.5	22435.20	146.90	5496286	-0.266
2010	2.52	10.24	17.59	24590	0.158	12.7	28217.95	150.29	5194976	0.161
2011	2.67	30.56	-	22048	-0.103	11.0	41169.88	153.83	6817862	0.029

Sources: World Bank, 2013; NBS, 2012; CBN, 2011

2. Literature Review and Conceptual Framework

In this section, we review the relevant literatures in order to place our argument and discussions in proper theoretical and empirical perspective. It is noteworthy that achievement of a sustainable and inclusive growth has been the major objectives of most economies of the world hence this has generated a lot of attention among the various schools of thought ranging from the Classical to the Neo-classical. The Neo-classical Exogenous Growth theory has been the dominant school of thought in the discussion of growth theory for decades. The Solow –Swan Neo-classical Growth Model explains the long-run growth rate of output based on two exogenous variables. The theory concludes that output growth is determined by technical progress and growth in capital and labour inputs. This model provides few channels for macro-policy influences. Thus, technical progress is assumed to be exogenous and most empirical studies do not suggest that macro-policies have much influence on labour force growth hence it does not matter what the government did [16].

A reaction to deficiencies inherent in Solow-Swan Neo-classical Growth Model led to the development of Endogenous Growth Theory by Romer [31] and Lucas [21]. It is a new theory that tries to explain the achievement of sustainable or steady growth rate of output based on endogenous factors. The theory recognises that technological change can be endogenous and that changes in the stock of capital: human as well as non-human may generate positive externalities and is not necessarily subject to diminishing returns. However, most policy implications are microeconomic in nature and the theory does not assign any specific role to macroeconomic policies. Nevertheless, evidences based on the experiences of the 1970s and 1980s, made many Economists to assume that sound macroeconomic policies were sufficient and necessary conditions for the achievement of a long-run sustainable growth. For example, Romar [32] in his Advanced Model of Endogenous Technological change of 1990 cited an example of Japan that has very few natural resources but was open to new Western ideas and technology through which it achieved a sustainable growth (Jhingan, 2010). However the growth performance of the four Asian ‘tigers’ and later the South-East Asian economies also seems to have been associated with policies favouring low inflation and sound fiscal policies. At the same time, the ‘lost decade’ of the 1980s in Latin America and depressing developments in most of Africa countries can be traced, not only to political instability, but also to inward-looking policies that stimulated domestic demand growth, while paying little attention to the costs in terms of inflation and external imbalances [20].

Macroeconomic policies are instruments through which government of an economy tries to regulate economic affairs

of a country in line with set objectives. This can be either monetary or fiscal. Monetary policy involves government control of the money supply in an economy using certain instruments. In other words, monetary policy is a deliberate attempt to control money supply and credit condition through manipulation of interest rate for achieving certain broad economic objectives like economic growth, stability in the rate of inflation and exchange rate as well as employment, Rightsman [41]. Monetary policy can be either expansionary or contractionary. It is contractionary if it aimed at reducing the size of money supply or raising the interest rate, while for an expansionary policy the reverse is the case. Fiscal policy on the other hand involves the use of government expenditure, taxes and subsidies in form of reliefs to promote growth. These instruments can be grouped in to two, i.e. automatic stabilizers and discretionary fiscal policy. Automatic stabilizers relate to government spending or cut in tax which does not involve deliberate government actions but helpful in regulation fluctuations in economy, while discretionary fiscal policy involves deliberate actions taken by the government in order to achieve certain macroeconomic objectives. [17].

As a whole, the macroeconomic policies consists of the fiscal, monetary, exchange rate regimes and trade policies, that determine production outcomes in the real sectors and other sectors including the agricultural sector. Regrettably, macroeconomic policy outcomes in any economy differ depending in part on the policy instruments employed, policy objectives as well as operating environment [3]. Fischer [13] as cited by Lachaal [20] listed five conditions, which together imply that a macroeconomic framework is conducive to growth. These are: a low and predictable inflation rate; an appropriate real interest rate; a stable and sustainable fiscal policy; a competitive and predictable real exchange rate and a balance of payment that is regarded as viable. Thus, it can be inferred that a sound macroeconomic policy among other factors is *pre facie* for the achievement of food security and poverty reduction through agricultural growth in an economy.

Food security entails producing food that will go round every citizen both in quantity and in quality. In its broader meaning, it connotes food sustainability. Sustainability is the ability of the agricultural system to maintain a well-defined level of performance overtime that will ensure increase in output, improved welfare without damaging the essential ecology and integrity of the system [11]. Von Braun [37] defines food security as access by all people at all times to the food required for a healthy life. An achievement of food security entails two important factors that are interdependent. These are access to food and availability of food. Availability of food does not guarantee accessibility, but access to food depends on its availability [7]. It should be noted that access to food is associated with income and health, therefore, access to food by a household depends to some extent on their level of poverty.

2.1. Empirical Studies on Macroeconomic Policies and Agricultural Output

Several authors like Jose et al [18]; Lachaal [20]; Yaqub [42]; Sunday [34]; Enoma [10] have reported the influence of macroeconomic variables fluctuations on agricultural productivity. Jose et al [18] investigating food security and agricultural spending in Bolivia adopted a supply-side approach that analyzes the role of agricultural spending on vulnerability to food insecurity. Econometric analysis indicates that levels of public agricultural spending are positively associated with high or very high vulnerability, especially investments in infrastructure, research and extension. The authors interpret this to indicate that agricultural spending allocation is driven by high or very high vulnerability levels, but has small effects on reducing high vulnerability.

Zepda [43], examining agricultural investment and productivity in the context of developing countries using econometrics models to measure the changes in output and relative contribution of various outputs. His study reveals that there is a strong relationship between investment in technology and human capital compared to that of physical capital and growth that was found to be weak. Other factors that were found to have positive relationship with growth in agricultural output were good policy environment and political stability.

Using econometric approach to estimate total factor productivity for the United States dairy industry between 1972-1992, Lachaal [20] examines how protectionist policies in the form of direct subsidies to agriculture reduced productivity growth in the United States dairy industry. He found that government subsidies encouraged using materials at the expense of feed and raised the cost of production by 1.8% for each 10% increase in subsidy. In a related study on the impact of trade restrictions on agricultural productivity, Fan et al [12] found that import restrictions result into inefficient use of limited resources. They further opine that oil export in Nigeria has led to increased inflow of foreign currency. This does not only have depreciating effects on the value of Naira but also reduced the competitiveness of the country's domestic produced agricultural goods in comparison with low-priced imported goods, leading to a reduction in agricultural output and exposing the teeming population to food insecurity.

In Nigeria, a study by Yaqub [42] on the sectoral analysis of the impact of exchange rate on output in Nigeria, using seemingly unrelated regression estimation technique found that exchange rate had a significant contractionary effect on Agricultural output, hence existing structures do not support an expansionary depreciation argument. In a related study by Adetoun [2], using the descriptive statistical analysis, his result reveals that change in monetary policy instruments cause changes in agricultural output with a long-run equilibrium relationship between the monetary policy variables and growth in output. The study further recommended that enlightening the farmers on how

monetary policy changes affect agricultural output is the first step in making farmers and agro-businesses become active players in the policy making process.

Looking at the impact of agricultural finance on output in Nigeria, using a cross sectional data, Egbuwalo [8] observes that agricultural finance remained a thing of interest in the effort to raise agricultural output. The above is in line with Enoma [10] who examines the impact of agricultural credit on the growth of GDP in Nigeria. In his study, measures aimed at increasing agricultural production were discussed and the relationship between agricultural development and economic growth were highlighted. The author concludes that agricultural credit, interest rate and exchange rates were all important in affecting aggregate output in Nigeria. In the same measure, Sunday et al [34] investigating the short-run and long-run elasticity of agricultural productivity with respect to some key macro-economic variables, using the techniques of co-integration and error correction models. Their result revealed that in the short and long-run periods, the coefficients of real total exports, external reserves, inflation rate and external debt have significant negative relationship with agricultural productivity in the country, whereas industry's capacity utilization rate and nominal exchange rate have positive association with agricultural productivity in both periods.

It is important to point out that some authors have been able to establish a direct relationship between macroeconomic policy and Agricultural output. *Ojede et al [28] employs a two-stage procedure to investigate the impact of macroeconomic policy reforms on the agricultural productivity growth of 33 African countries from 1981 to 2001.. Their results indicate a strong positive correlation between the extent of SAP intensity and agricultural productivity, suggesting that the macroeconomic policy reforms improved agricultural productivity growth in the sample countries.* Omojimito [29] on an investigation of the impact of macroeconomic variables on agricultural growth using fully modified ordinary least squares approach. The results indicate that the volume of credit to the agricultural sector, deficit financing income and institutional reform were positively and significantly accounted for innovations in agricultural output for the period studied thus confirming a direct relationship between growth in output and macroeconomic variables. The above result is supported by an earlier study on the impacts of macro-economic and government expenditure policies on Nigeria's agriculture sector by Obasi et al [27]. Applying the ordinary least squares multiple regression analysis technique to an agricultural output function, aggregate agricultural output was found to be directly related to the public expenditures elasticity, labour, capital and weather index

A handful of other researchers have also attempted to investigate the relationship between agricultural growth and macroeconomics policy through the test of causality albeit with mixed results. Looking at the causality between exports and Agricultural output in Pakistan using ARDL Memon et al., [24] found bi-directional Granger-causality relationship

between total exports and agricultural GDP while Salih [33], present empirical evidence showing a significant long run relationship between agricultural output growth and economic growth (income) that assumes bidirectional causation. In the case of Nigeria [34] investigate the relationship between value of agricultural GDP as the ratio of total GDP and some key macroeconomic variables. Estimating the chain of causality using F-statistic for both short and long run period the test result reveal that there exists a unidirectional relationship running from macroeconomic variables to agricultural productivity. He concludes, total variation in agricultural productivity are induced by changes in macroeconomic variables

From the above, one can conclude that the role of agriculture as a source of achieving sustainable food supply, eradication of poverty and improved welfare in the country is largely hinged on the stability of some key macroeconomic fundamentals.

3. Review of Nigeria's Agricultural Macroeconomic Policies

The food crisis in the 70's forced the Nigerian government to play a more dynamic role in agricultural production by adopting different strategies and policies in order to ensure food security. A review of these policies reveals weaknesses and policy misalignment, which can be grouped into financial policy, pricing and marketing policy and institutional reform.

3.1. Financial Policy

This aim at ensuring stability of the financial system as well as guaranteed the sources of credit to the farmers through manipulation of interest rate and exchange rate. To achieve this objective, credit finance to the sector were given at a concessionary interest rate between 1970 and 1985. In order to safeguard the biasness in the allocation of credit to the agricultural sector, financial institutions were compelled to support agricultural sector through credit quotas [23].

With the inception of the Structural Adjustment Programme (SAP) in 1986, there was financial market reform, which led to the total deregulation of the economy. Thus in 1990, interest rates were deregulated and indirect monetary policy control was put in place hence agricultural sector had to compete for funding with the other sectors of the economy and this marked the cancellation of sectoral credit allocation policy. The consequences of this were increased food import bills and hike in prices, hence declining welfare of citizens. For example, the food import figure of 6.36% in 1991 increased to 27.02% and further to 30.56% in 1999 and 2011 respectively [40]. Due to the above negative impact of SAP and to safe-guard the sector from competition as well as enhance flow of credit, the share capital of the Agricultural Credit Guaranteed Scheme (ACGS) fund established in 1977 was increased from ₦199 million to ₦3.0 billion in 2001 [6].

It is worth mentioning that to complement the funding capacity through ACGS fund, other financial development institutions were formed with the objectives of making more credit available to the real sector. Hence in 2000, Nigerian Agricultural and Commerce Bank (NACB), Peoples Bank and Family Economic Advancement Programme (FEAP) were merged and recapitalized to form the new Nigerian Agricultural Commerce and Rural Development Bank (NACRDB), thus between 2000 – 2007 about ₦234.3 billion were granted to the Agricultural sector as credit [6]. As part of the comprehensive reform in the financial system and in line with its developmental role, the Central Bank of Nigeria (CBN) launched the National Micro Finance Policy in 2006. The main objectives of the policy includes: to make credit facilities accessible to a large segment of the potentially productive Nigerian population which otherwise would have little or no access to financial services e.g. rural farmers; to promote synergy and mainstreaming of the informal sub-sector into the national financial system, etc. Also Agricultural Credit Support Scheme (ACSS) was established through the initiative of the Federal Government and the Central Bank of Nigeria with the active support and participation of the Bankers Committee. The purpose of the ACSS is to develop the agricultural sector of the Nigerian economy by providing credit facilities to farmers at single digit interest rate. This, is to enable farmers exploit the untapped potentials of the sector with a view to reducing the cost of agricultural production and increase output on a sustainable basis. These efforts are expected to lead to fall in the prices of agricultural products, especially food items, thereby leading to reduction in inflation rate, generate surplus for export and diversify the revenue base of the economy.

The above notwithstanding, the effectiveness of these policies remained questionable as the interest rate remained high as well as inflation rate throughout the period. The average interest rate stood at 19.9%, experienced a marginal reduction in 2006 and escalated to 17.59% in 2010. The food inflation showed indiscernible pattern of movement as well as it rose from 3.9 % in 2006 to 8.2 % in 2007 rising to a peak of 18.0 % in 2008. It fell again to 15.5% in 2009 and to 12.7% in 2010. (See table 1).

3.2. Pricing Policy

The objectives behind government's pricing policy are to ensure that farmers receive profitable prices for their products, stabilises prices and ensure parity in agricultural prices in comparison to non- Agricultural prices in Nigeria [11]. To achieve these objectives, Commodity Boards were formed with the responsibility of marketing and fixing prices. In 1986, marking the beginning of deregulation strategy (SAP era), the Board was abolished and market-based pricing of agriculture export commodities was introduced and subsidies on some agricultural inputs were reduced. This resulted into reduction in utilization of fertilizers and consequently in the output of food crops. With respect to

marketing, different policies were introduced such as trade liberalization, export promotion, backward integration, agricultural investment promotion, etc. These were aimed at diversifying the country's export to boost growth as well as improved crop outputs thereby discouraging export. Also, during the period, the exchange rate policy adopted was aimed at re-aligning exchange rate of the Naira *vis- a-vis* the world currencies through promotion of competitive market where foreign currencies are fully traded under a free market mechanism. To achieve the above objectives, Abuja Stock Exchange was established in 1998. This was later changed to Abuja Securities and Commodity Exchange in 2003 with the responsibility of trading in agricultural products and solid minerals among others.

3.3. Institutional Reform

The post SAP era (1994-date) includes the New Agricultural Policy established in 2001 which is an attempt to overcome the pitfalls of the past policies. It has the overall goal of attaining self-sustaining growth in all the sub-sectors of agriculture, the structural transformation necessary for the overall socioeconomic development of the country, and the improvement of the quality of life of Nigerians [6, 11]. These policies are being pursued within the framework of National Economic Empowerment and Development Strategy (NEEDS). NEEDS was formulated with the objective of reducing poverty, generating employment and creating wealth.

Recently, an attempt to put an end to institutional problems militating against sustainable growth in the Agricultural sector led to introduction Agricultural Transformation Agenda (ATA). ATA is the largest ever government-enabled private sector-led effort to grow agriculture in Nigeria. This comprehensive effort aims to increase domestic food production, reduce dependence on food imports and expand value addition to locally produced agricultural products. Through de-regulation, attractive financing, concentrated infrastructure investments, and competitive policies, the sector will be more productive, efficient and competitive. Specifically, the plan aims at adding about 20 million tons of food to domestic supply and creates 3.5 million jobs by 2015. Part of the instruments through which ATA is to achieve its objective is a micro programme tagged e-Wallet. The programme aims at having

a direct contact with the farmers as well as making available agricultural inputs at a subsidised rate. This is believed will eliminate the bottleneck problems caused by middlemen associated with earlier programmes and rent seeking behaviour hence, encourage large scale farming that brings along with it economies of scale and consequently food security.

4. Methodology and Result Analysis

4.1. Study Area and Data Source

The study was conducted in Nigeria; the country is situated on the Gulf of Guinea in the sub-Saharan Africa. Nigeria lies between 40° and 140° North of the Equator and between Longitude 30° and 150° East of the Greenwich. Nigeria has a total land area of 9, 107,70 square kilometres with a total agricultural land area estimated at 76,200sqkm and a population of over 165 million [25, 40]. Annual data covering 1978 -2011 were used, the data were sourced from the World Bank Data Bank [40]; Central Bank of Nigeria Statistical Bulletin and National Bureau of Statistics (Various Issues). The choice of the period was dictated by the availability of data since the starting date marked the commencement of Agricultural Credit Guarantees Scheme (ACGS) in Nigeria.

4.2. Model Specification

Different factors have been identified to be responsible for changes in agricultural output. Based on theoretical exposition and following the extant literatures as evidenced in the works of Sunday [34]; Enoma [10] and Isedu [15], the Vector Error Correction Model (VECM) is used in the study. As stated by Engle and Granger [9] that there exist both Short-run and long-run equilibrium model in VECM once the variables are co-integrated of the order 1(1). Hence, the short-run analysis of the system should include the error correction term with a view to modelling the adjustment for deviation from its long-run equilibrium. The VECM specifications employed in this study are presented in six endogenous variables as stated below in six equations labelled equation 1 to 6.

$$\Delta(Outp)_t = \beta_0 + \beta Outp\varphi_{t-1} + \sum_{i=1}^{q_1} \beta_{1i} \Delta(Outp)_{t-i} + \sum_{i=1}^{r_1} \Psi_{1i} \Delta(INF)_{t-i} + \sum_{i=1}^{s_1} \eta_{1i} \Delta(GE)_{t-i} + \sum_{i=1}^{l_1} \gamma_{1i} \Delta(ACGS)_{t-i} + \sum_{i=1}^{u_1} \Pi_{1i} \Delta(IR)_{t-i} + \sum_{i=1}^{v_1} \delta_{1i} \Delta(EXCR)_{t-i} + \varepsilon_{1t} \quad (1)$$

$$\Delta(GE)_t = \eta_0 + \eta GE\varphi_{t-1} + \sum_{i=1}^{q_3} \beta_{3i} \Delta(Outp)_{t-i} + \sum_{i=1}^{r_3} \Psi_{3i} \Delta(INF)_{t-i} + \sum_{i=1}^{s_3} \eta_{3i} \Delta(GE)_{t-i} + \sum_{i=1}^{l_3} \gamma_{3i} \Delta(ACGS)_{t-i} + \sum_{i=1}^{u_3} \Pi_{3i} \Delta(IR)_{t-i} + \sum_{i=1}^{v_3} \delta_{3i} \Delta(EXCR)_{t-i} + \varepsilon_{3t} \quad (2)$$

$$\begin{aligned} \Delta(INF)_t = & \Psi_0 + \Psi INF \varphi_{t-1} + \sum_{i=1}^{q_2} \beta_{2i} \Delta(Outp)_{t-i} + \sum_{i=1}^{r_2} \Psi_{2i} \Delta(INF)_{t-i} + \sum_{i=1}^{s_2} \eta_{2i} \Delta(GE)_{t-i} \\ & + \sum_{i=1}^{t_2} \gamma_{2i} \Delta(ACGS)_{t-i} + \sum_{i=1}^{u_2} \Pi_{2i} \Delta(IR)_{t-i} + \sum_{i=1}^{v_2} \delta_{2i} \Delta(EXCR)_{t-i} + \varepsilon_{2t} \end{aligned} \tag{3}$$

$$\begin{aligned} \Delta(ACGS)_t = & \gamma_0 + \gamma ACGS \varphi_{t-1} + \sum_{i=1}^{q_4} \beta_{3i} \Delta(Outp)_{t-i} + \sum_{i=1}^{r_4} \Psi_{4i} \Delta(INF)_{t-i} + \sum_{i=1}^{s_4} \eta_{4i} \Delta(GE)_{t-i} \\ & + \sum_{i=1}^{t_4} \gamma_{4i} \Delta(ACGS)_{t-i} + \sum_{i=1}^{u_4} \Pi_{4i} \Delta(IR)_{t-i} + \sum_{i=1}^{v_4} \delta_{4i} \Delta(EXCR)_{t-i} + \varepsilon_{4t} \end{aligned} \tag{4}$$

$$\begin{aligned} \Delta(IR)_t = & \Pi_0 + \Pi IR \varphi_{t-1} + \sum_{i=1}^{q_5} \beta_{5i} \Delta(Outp)_{t-i} + \sum_{i=1}^{r_5} \Psi_{5i} \Delta(INF)_{t-i} + \sum_{i=1}^{s_5} \eta_{5i} \Delta(GE)_{t-i} \\ & + \sum_{i=1}^{t_5} \gamma_{5i} \Delta(ACGS)_{t-i} + \sum_{i=1}^{u_5} \Pi_{5i} \Delta(IR)_{t-i} + \sum_{i=1}^{v_5} \delta_{5i} \Delta(EXCR)_{t-i} + \varepsilon_{5t} \end{aligned} \tag{5}$$

$$\begin{aligned} \Delta(EXCR)_t = & \delta_0 + \delta EXCR \varphi_{t-1} + \sum_{i=1}^{q_6} \beta_{6i} \Delta(Outp)_{t-i} + \sum_{i=1}^{r_6} \Psi_{6i} \Delta(INF)_{t-i} + \sum_{i=1}^{s_6} \eta_{6i} \Delta(GE)_{t-i} \\ & + \sum_{i=1}^{t_6} \gamma_{6i} \Delta(ACGS)_{t-i} + \sum_{i=1}^{u_6} \Pi_{6i} \Delta(IR)_{t-i} + \sum_{i=1}^{v_6} \delta_{6i} \Delta(EXCR)_{t-i} + \varepsilon_{6t} \end{aligned} \tag{6}$$

Where:

- Outp = Agricultural Output.
- GE = Government Recurrent expenditure on Agricultural.
- ACGS = Agricultural Credit to Farmers.
- INF = Inflation Rate.
- EXCR = Average Official Exchange Rate in Nigeria.
- IR = Interest rate

To capture food crops production, annual crop production was used as a proxy for Agricultural Gross Domestic Product, while annual government recurrent expenditure on agriculture was employed as a proxy for government fiscal policy. The annual value of loan granted under the Agricultural Credit Guaranteed Scheme (ACGS) was used as a measure of agricultural credit to farmers while annual rate of implicit deflator was used as a proxy for inflation rate. Average official Exchange Rate and Prime Rate were employed as proxies for exchange rate and interest rate respectively. All the variables are expressed in their natural log form.

From equation (1) through (6), the variables in the left hand side of each equation are expressed in their first difference, while those on the right hand side an optimum lagged difference of the six variables and one period lagged error term (ECM) of the co-integrating equation are included. β_0, \dots, δ_0 are the intercept terms, while the disturbance terms are denoted by $\varepsilon_{1t}, \dots, \varepsilon_{6t}$. We should note that there are two sources of causality using VECM framework i.e. from the ECM term and through the lagged dynamic terms. In the present study two tests of causality between Nigeria’s agricultural output and macroeconomic variables are carried out, i.e. the short-run Granger

non-causality test and the long-run causality through Wald test.

4.3. Estimation Procedure

First, the times series properties of the variables used in the model were investigated to confirm their order of integration to avoid spurious regression using Augmented Dicky Fuller and Philip Peron in order to allow for robustness. The test for unit root for a series is carried out using the following equation:

$$\Delta X_t = \alpha_0 + \alpha_1 t + \alpha_2 X_{t-1} + \sum_{i=0}^p \lambda_i \Delta X_{t-i} + \varepsilon_t \tag{7}$$

Where $\alpha_0, \alpha_1, \alpha_2$ and $\lambda_1, \dots, \lambda_p$ are parameters to be estimated while ε_t is the error term, which is assumed to be normally and identically distributed.

Immediately after the above, a co-integration test was carried out using Johansen co-integration test procedure, and this was followed by estimation of Vector Error Correction Model. We also examined the short-run and long-run causation test between Agricultural output and macroeconomics variables. To test for long-run causality, the null hypothesis that the coefficient of ϕ_{t-1} is zero is tested in each equation in order to determine whether the variables on the right-hand side Granger cause the variable on the left-hand side. In equation (1) through (6), this test is carried out by testing the null hypothesis $\beta_{OUTP}, \dots, \delta_{IR} = 0$, against the alternative hypothesis $\beta_{OUTP}, \dots, \delta_{IR} \neq 0$.

Moreover, in equation (1) through (6), six short-run Granger causality tests (a Wald F-test for short-run non-causality) are performed by setting the coefficients of all

order-lagged differences of each of the variables on the right-hand side equal to zero. In equation (1) for example, a test for short-run non-causality from Government Expenditure (GE) to Agricultural output (OUTP) is executed by testing whether the coefficients of the lagged differences of the GE are all equal to zero. The same is done regarding the short-run causality from other variables in the system such as GE, ACGS, INF, IR and EXCR on OUTP.

4.4. Result and Discussion of Findings

4.4.1. Unit Root Test

The table below presents the result of the unit root test carried out on each of the series.

Table (2) indicates that all the variables are non-stationary at level but at first difference i.e. at 1(1) and this is in consistence with the entire unit root test employed. Since our variables are integrated of order one, the application VAR has theoretical support. The test for optimum lag was carried out and the result is presented below.

Table 2. Unit Root Test Results

Variable	ADF		PP	
	No trend	Trend	No trend	Trend
OUTP	-2.4818	-3.1050	-2.7987***	-3.1940
GE	-0.56415	-2.9314	-0.7615	-3.1382
ACGS	-1.7046	-2.7456	-0.6443	-2.7455
INF	-0.0172	-2.8374	-0.0613	-2.8325
IR	-2.5024	-2.2571	-2.4387	-2.0654
EXCR	-1.0548	-1.0626	-1.0548	-1.2958
Δ OUTP	-5.7176**	-5.9773*	-5.7379*	-6.0613*
Δ GE	-8.0617*	-5.6425*	-9.6077*	-9.4820*
Δ ACGS	-6.5416*	-6.4009*	-6.5298*	-6.4221*
Δ INF	-5.1048*	-5.2167*	-5.1052*	-5.2161*
Δ IR	-8.1739*	-8.5065*	-8.1983*	-8.7011*
Δ EXCR	-4.8869*	-4.9577*	-4.8869*	-4.9363*

Note: For ADF and PP, the null hypothesis is that the variable has a unit root (i.e. non-stationary) *, ** and *** represent significant at 1%, 5% and 10% respectively while Δ denote order of integration.

Source: Authors Computation using E-view 7

Table 3. Optimum Lag Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-113.5035	NA	8.99e+05	7.709902	7.987448	7.800305
1	24.74416	214.0609*	1.29e-07*	1.113280	3.056101*	1.746591*
2	52.25906	31.95279	2.95e-07	1.660705	5.268802	2.836855
3	109.2103	44.09125	1.84e-07	0.309015*	5.582388	2.028003

*indicates lag order selected by the criterion

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: Authors' computations using E-views7.1.

Table 4. Johansen Cointegration Test Results

Hypothesis		Eigen value	λ_{max}	5% critical value	λ_{trace}	5% critical value
Null	Alternative					
$r = 0$	$r \geq 1$	0.674421	35.90880	40.07757	105.9710*	95.75366
$r \leq 1$	$r \geq 2$	0.552939	25.76190	33.87687	70.06216*	69.81889
$r \leq 2$	$r \geq 3$	0.497310	22.00903	27.58434	44.30026	47.85613
$r \leq 3$	$r \geq 4$	0.340687	13.32984	21.13162	22.29122	29.79707

r indicates the number of cointegrating vectors. *Indicates rejection of the null hypothesis at 5% level of significance.

Source: Authors' Computations using E-view7.1

Table 5. Long-Run Coefficient of the Cointegrating Vector Normalised On OUTP

Outp	CONSTANT	GE	INF	ACGS	IR	EXCR	AC ⁺
1	-28.93666	3.230074 (5.07471)	-1.228400 (-1.70629)	-0.000251 (-0.00067)	5.615307 (2.85422)	-4.567393 (-3.88019)	-0.133154 ((-0.04056)

(*) and (**) indicate 1% and 5% level of significance respectively. Figures in parentheses are t-values.

⁺ Adjustment Coefficient.

Source: Authors' Computations using E-view7.1

From table (3), it can be seen that all the criteria selected maximum lag of 1 with the exception of Akaike information criterion. Therefore, the highest lag employed in the VECM is 1. Consequently, a co-integration test was carried out using Johansen Cointegration Test, the result is presented below.

From the result, trace test statistics indicates that the hypothesis of no cointegration among the variables is rejected at the 5% level of significance. The result shows that there are at least two cointegrating vectors. Hence, the existence of long-run equilibrium relationship among the non-stationary variables justifies the use of VECM. The VECM model was estimated and the coefficient of the normalised long-run co-integration equation is presented below.

The normalised co-integration equation in the table (5) reveals that GE is positively related to OUTF in the long-run and significant. This implies that an increase in government expenditure on agriculture in Nigeria will positively influence the sector's output. This is not surprising because a-priori, a well-targeted government fiscal policy in terms of subsidies on agricultural inputs and provision of extension services to farmers is expected to boost output. This may not be unconnected with the various government policies reform on agriculture like SAP and the ongoing transformation agenda in the country. In addition to the above, it also implies that government expansionary fiscal policy does not have crowding-out effects on agricultural sector which may be as a result of the fact that the government do not get directly involved in agricultural production in Nigeria. This result further corroborates earlier works carried out by Kwanashie et al [19] and Yaqub [42].

In relation to inflation rate, the result indicates that price instability has a negative impact on agricultural output and this is in line with theoretical expectation. Economic theory posits that during inflation, investment in the real sector is discouraged due to eroding power of money and investors take to speculations. In a specific term, increase in inflation will raise the nominal price of agricultural inputs through its multiplier effects thereby discouraging agricultural investment. Many investigations have found that persistent rise in prices discourages investment in crops production, reduce agricultural output and consequently the objective of food security becomes threatened [34].

The result of the relationship between agricultural credit and its output in the long-run co-integration equation for Nigeria indicates that it is negatively related though not significant, while interest rate is positively related to agricultural output and statistically significant at 1% level. Surprisingly both do not follow the a-priori expectations that are derived from economic theory. It is expected that as agricultural credit increases, investment in agricultural activities will also increase and consequently the output improves. The result is not highly surprising given the high level of corruption and poor institutions in the country which do not allow for easy access of the loan by the "real farmers"

in agricultural sector. In most cases these loans are usually advanced at a distortionary rate. Worst still is the fact that for those who are able to access the loan facility and the extent to which these resources are actually utilized for the targeted purposes remains doubtful. Majority end up diverting such loans to investment that can generate quick returns as a result of high inflation rate that does not encourage long-term investment. The above is further corroborated by the negative impact of inflation on the output of agricultural sector and in line with the result of the earlier works conducted by Enoma [10] and Sunday et al [34]. As for the interest rate, it is expected that an increase in the lending rate will worsen growth in output because of its disincentive impact on loan advancement, hence making finance difficult for agricultural activities. This result may be due to the government's concessionary policy in terms of interest rate most especially in the real sector of the economy.

Also from table (5) there is a negative relationship between exchange rate and Agricultural output at 1% level of significance. It should be noted that monetary authority has taken to devaluation of the country's currency as a strategy for achieving a favourable balance of payment to improve net export and discourage import. The implication of this is that increase in the nominal official exchange rate (₦/\$) will constrain importation by depreciating the domestic currency (₦) against appreciating US dollar. This makes export cheaper and import dearer, reduced importation, decreases the supply of major agricultural inputs like machinery, high yields seed, chemicals, fertilizer, etc, that can aid large-scale production and consequently reduce food supply. This is in line with the findings of Yaqub [42].

Diagnostics test for serial auto correlations, normality and heteroskedasticity were carried out for the estimated model at lag 1. This is shown in table (6) below

Table 6. Diagnostic Test

Tests	Coefficient	Prob.
Autocorrelation ¹ (LM Stat)	42.3854	0.2148
Normality ²	3.1042	0.20248
Heteroskedasticity ³ (x ²)	277.0237	0.7534

¹Serial correlation LM Test

²Jarque bera (JB) Residual Normality Test

³Residual Heteroskedasticity Test (No Cross Term)

The Lagrange multiplier (LM) shows that there is no serial correlation at the chosen lag. In addition, the model passes the normality test through the joint Jarque-Bera (JB) statistics indicating that residual have normal and identical distribution. It also passes through the heteroskedasticity test with the chi-square distribution of 277. The adjustment co-efficient is also significant and correctly signed i.e. negative which indicates that the restrictions are meaningful [38].

4.4.2. Causality Test Result

Granger causality test was carried out using Wald tests. The test carefully looks at the different ways in which

macroeconomic policy variables can granger cause agricultural output. These are weak ergogeneity (long run causality), short run non - causality and over all causality (i.e. strong ergogeneity) tests. The granger non – causality test results are presented in table (6) below.

In table (7a) above, the long run causality shows evidence of causality between OOTP and other variables in the model with 5% level of significant. The strong

ergogeneity (i.e. the overall causality) in the system shows that the null hypothesis that all the variables in the system (i.e. GE, INF, ACGS, IR and EXCR) do not granger cause OOTP is rejected either at 1%, or 5% level of significant. The short run causality shows that with the exception of GE and EXCR that are significant at 5% other variables do not granger cause OOTP.

Table 7. Granger Non-Causality Test Results

Table (7a). A: Causality from other variables to OOTP

Hypothesis	Weak Exogeneity	Short Run Non- Causality	Strong Exogeneity
Ho: $\Delta GE \rightarrow \Delta OOTP$	$\beta_{outp} \phi_{t-1} = 0$	$\Delta GE_{t-i} = 0$	$\Delta GE_{t-i} = \beta_{outp} \phi_{t-1} = 0$
χ^2	5.435608(1)*	4.184085(1)*	12.86700(2)*
Ho: $\Delta INF \rightarrow \Delta OOTP$	$\beta_{outp} \phi_{t-1} = 0$	$\Delta INF_{t-i} = 0$	$\Delta INF_{t-i} = \beta_{outp} \phi_{t-1} = 0$
χ^2	5.435608(1)*	0.452413(1)	7.04148(2)**
Ho: $\Delta ACGS \rightarrow \Delta OOTP$	$\beta_{outp} \phi_{t-1} = 0$	$\Delta ACGS_{t-i} = 0$	$\Delta AGRCRDT_{t-i} = \beta_{outp} \phi_{t-1} = 0$
χ^2	5.435608(1)*	1.50e-07(1)	7.884874(2)*
Ho: $\Delta IR \rightarrow \Delta OOTP$	$\beta_{outp} \phi_{t-1} = 0$	$\Delta IR_{t-i} = 0$	$\Delta IR_{t-i} = \beta_{outp} \phi_{t-1} = 0$
χ^2	5.435608(1)*	2.69177(1)	6.417230(2)**
Ho: $\Delta EXCR \rightarrow \Delta OOTP$	$\beta_{outp} \phi_{t-1} = 0$	$\Delta EXCR_{t-i} = 0$	$\Delta AEXR_{t-i} = \beta_{outp} \phi_{t-1} = 0$
χ^2	5.435608(1)*	4.725869(1)**	10.76996(2)*

Table (7b). Causality from OOTP to other variables

Ho: $\Delta OOTP \rightarrow \Delta GE$	$\eta GE \phi_{t-1} = 0$	$\Delta OOTP_{t-i}$	$\beta GE \phi_{t-1} = \Delta OOTP_{t-i} = 0$
χ^2	0.165017(1)	0.563456(1)	1.385836(2)
Ho: $\Delta OOTP \rightarrow \Delta INF$	$\Psi INF \phi_{t-1} = 0$	$\Delta OOTP_{t-i}$	$\Psi INF \phi_{t-1} = \Delta OOTP_{t-i} = 0$
χ^2	2.873522(1)**	0.563456(1)	3.989808(2)
Ho: $\Delta OOTP \rightarrow \Delta ACGS$	$\gamma ACGS \phi_{t-1} = 0$	$\Delta OOTP_{t-i}$	$\gamma ACGS \phi_{t-1} = \Delta OOTP_{t-i} = 0$
χ^2	0.294162.(1)	0.563456(1)	1.265292(2)
Ho: $\Delta OOTP \rightarrow \Delta IR$	$\Pi IR \phi_{t-1} = 0$	$\Delta OOTP_{t-i}$	$\Pi IR \phi_{t-1} = 0 = \Delta OOTP_{t-i} = 0$
χ^2	0.741927(1)	0.375028(1)	0.741927(2)
Ho: $\Delta OOTP \rightarrow \Delta EXCR$	$\delta EXCR \phi_{t-1} = 0$	$\Delta OOTP_{t-i}$	$\delta EXCR \phi_{t-1} = \Delta OOTP_{t-i} = 0$
χ^2	2.450331(1)	2-256432(1)	2.450331(2)

*, **, and ** denote statistical significance at 1%, 5% and 10% levels respectively. Figures in parenthesis indicates the degree of freedom
Source: Authors' Computations using E-view7.1

Table (8). An Estimated VECM with Agricultural Output (OUP)

Dependent Variable	C	ϕ_{t-1}	$q_1 \sum_{i=1} \Delta OUTP_{t-i}$	$r_1 \sum_{i=1} \Delta GE_{t-i}$	$s_1 \sum_{i=1} \Delta INF_{t-i}$	$t_1 \sum_{i=1} \Delta ACGS_{t-i}$	$u_1 \sum_{i=1} \Delta IR_{t-i}$	$v_1 \sum_{i=1} \Delta EXCR_{t-i}$	Eq.
ΔOUP	0.15561 (1.30506)	-0.13315* (-3.28312)	0.111268 (1.30381)	0.28611** (2.47923)	0.05908 (0.15025)	-0.32125** (-2.06631)	0.16129 (0.49460)	-0.23230 (-0.81015)	(8)
ΔGE	0.15561 (2.28608)	-0.03744 (-0.46674)	-0.63910 (-0.87130)	-0.19758 (-0.86572)	-0.545938 (-0.70208)	0.01874 (0.06095)	1.38966** (2.15479)	-0.73019 (-1.27753)	(9)
ΔINF	0.07674 (0.65618)	0.10785 (2.71143)	-0.16377 (-0.45023)	-0.24392** (-2.15514)	0.05389 (-0.13976)	0.28923*** (1.89692)	-0.08291 (-0.25924)	0.32076 (1.13165)	(10)
$\Delta ACGS$	0.18951 (1.15828)	-0.03167 (-0.56918)	0.07134 (0.14017)	-0.05585 (-0.35273)	0.24779 (0.45928)	-0.23256 (-1.09015)	-0.355479 (-0.79445)	0.378645 (0.95480)	(11)
ΔIR	0.07048 (1.05705)	-0.01446 (-0.63773)	-0.21734 (-1.04797)	-0.02038 (-0.31578)	-0.38142*** (-1.73481)	0.06524 (0.75039)	-0.36812** (-2.01880)	0.14493 (0.89678)	(12)
$\Delta EXCR$	0.26402 (2.56075)	0.04855 (1.38456)	-0.44824 (-1.39770)	-0.06249 (-0.62634)	-0.49559 (-1.45771)	0.12764 (0.94947)	0.11403 (0.40439)	0.03658 (0.14638)	(13)

*, **, and *** denote statistical significance at 1%, 5% and 10% levels respectively. The figures in parentheses are the t-statistics.

Looking at table 7b above the null hypothesis that OUP do not ganger cause other variables in the system is accepted in respect of all the variables thus confirming a unidirectional relationship between agricultural crops output and other variables in the model.

4.4.3. Estimated Vector Error Correction Model

To further complement the result of the causality test, the estimated VECM result is presented below. According to the result of co-integration, there exist at least two co-integrating vectors at 5% level of significance. Consequently, the VECM is estimated using optimum lag of 1. Table (8) presents the estimated VECM for Agricultural output (OUP), Government spending (GE), Exchange rate (EXCR), Agricultural Credit (ACGS), Inflation rate (INF) and Interest Rate (IR).

For easy exposition of estimated version of the VECM equations, each of the estimated equations (1) through (6) is labeled (8) through (13).The significance of the ECM coefficient at 1% in equation (8) shows evidence of long-run causality from GE, INF,ACGS, IR, EXCR and one lagged period of OUP on Agricultural output. The significance of ECM also suggests that the agricultural output system has the tendency of correcting its previous disequilibrium for the long-run term. This means short-term deviation from the long-run equilibrium will feed back on the changes in the dependent variables in order to force the movement towards long-run equilibrium. In the case of the short-run causality between agricultural output and other right hand side variables, there is no evidence of causality with the exception of GE and ACGS buttressed by the result in table (7). Furthermore, result in equation (9) indicates that there is short run causality running from IR to GE, while no long run causality exist between GE and all other variables in the

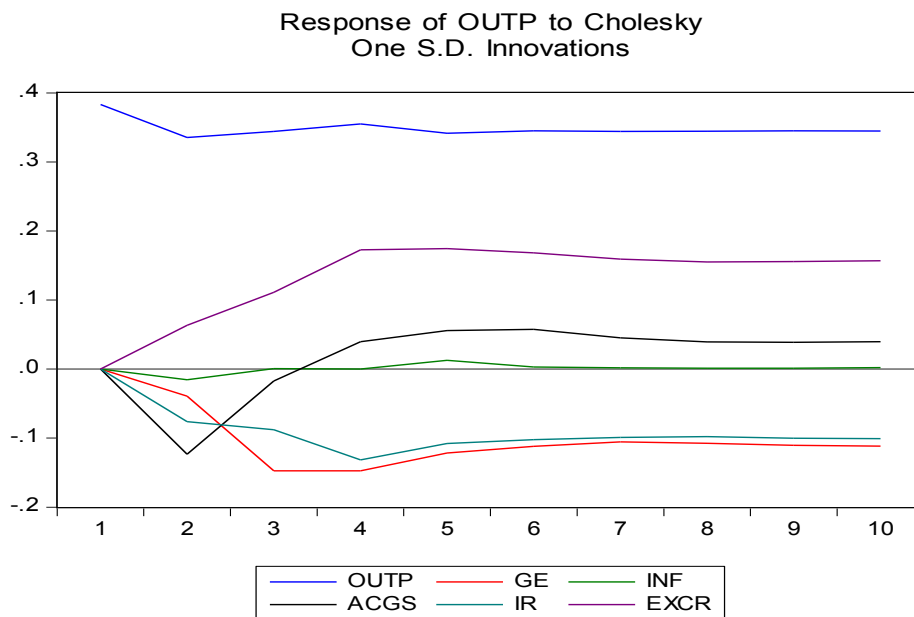
model.

Result in equation (10) also reveals that there is no evidence of long-run causality between inflation and all other variables on the right hand side. In terms of short-run causality, equation (10) shows evidence of short-run causality running from GE and ACGS to INF. Equation (11), representing the estimated ACGS equation indicates that there is no evidence of whatsoever from either long-run or short-run between ACGS and all other variables in the model, while equation (12) only shows an evidence of evidence of short run causality between IR and INF as well as a weak response of interest rate to its pass level.

Result in equation (13) is particularly revealing in that, there is no causality of whatsoever form from the right hand side variables to EXCR. This implies that exchange rate in Nigeria is not statistically influenced by changes in the identified variables. It is important to note that the performance of the agricultural sector in the country is not strong enough to provide the much needed backward linkages required to improve the level of employment and consequently increase output for exports and that the growth in output achieved is hinged financially on crude oil. Also the Structural Adjustment Programme (SAP) introduced in 1986 which set the tone for total liberalization in an import depended economy are explanation as to why exchange rate has been on the increasing trend. Therefore, one can conclude that the devaluation of the currency which has been the practice in the country has proved to be less useful in promoting agricultural output and ensuring food security in the country.

4.4.4. Impulse Response Functions

The impulse responses in the Agricultural sector over a five period horizon are presented in figure (1) below:



Source: Authors Computation Using E-View 7.1

Figure (1). Impulse Response Function

The innovation accounting test results shows that the co-efficient of agricultural output is large and fluctuating up till 5th period when it becomes relatively stable. The effect of shocks to IR (interest rate) and Government expenditure (GE) exert a negative effect throughout the period. As for the response of agricultural productivity to shock in government expenditure, it took a sharp acceleration in the 3rd period, assumes a decreasing trend in the next period up till 8th period when its assume an increasing trend. This signifies instability in the country's fiscal policy.

The response of agricultural productivity to shock (increase) in interest is negative and continues to fluctuates both in the long run and short-run periods implying an unstable relationship in both time horizons. Also the response of agricultural productivity to changes (increase) in the official exchange rate (EXCR) is positive in all periods. The response took a sharp acceleration from period 1 to 5 and thereafter assumes almost constant fluctuations from the 7th period. However, the response was further away from the origin signifying increasing instability in the long-run period.

The co-efficient of inflation rate (INF) and agricultural credit (ACGS) are reported to have negative signs in the short-run. However, the co-efficient of INF transitioned to a positive sign from 2nd period to the end of the 10th period, while that of ACGS becomes positive in the 3rd period horizon. However, their responses were close to zero in both short and long-run periods implying a stable relationship in both time horizons.

An examination of the variations in OUP in both short run and long run is further supplemented by the Variance decomposition analysis result Presented in table 9 below

From table (9), the result shows a relative contribution of various macroeconomic variables to the variation in the OUP. In the second period, the result shows that Agricultural credit and interest rate were the major exogenous contributors to changes in OUP in the short-run. A careful look at the result reveals that OUP shock constitutes a significant source of variation in its own variation both in the short and long-run which was as high as 73% at the end of the 10th period horizon. In the long-run EXCR accounted for about 12% of the shocks in OUP followed by GE that stood at 7.2%. The implication of this is

that a significant variation in Nigeria's OUP is due to changes in exchange rate and GE. Shocks from Inflation rate constitute the least source of variations in the output of agriculture. This result corroborates the findings earlier reported in the long and short-run model analyses.

5. Conclusions and Recommendations

The paper has attempted to empirically investigate the impact of macroeconomic policy on agricultural output in Nigeria covering a period of 1978 to 2011 using a multivariate Vector Error Correction framework. The stationarity properties of the data employed in the model was first investigated using the Augmented Dickey-Fuller unit root test and Philip-Peron test. The result indicates that the series used in the analysis were I(1). The results of the co-integration test based on Johansen's procedure indicated the existence of co-integration between agricultural output and macroeconomic variables in the country. The ECM term had the appropriate sign and was statistically significant at 1% probability level indicating the possibility of convergence to equilibrium in each period, with intermediate adjustments captured by the differenced terms. The findings show that some key macroeconomic fundamentals in Nigeria's economy interact in each period to re-establish the long-run equilibrium in the agricultural output following a short-run random disturbance. The empirical result from the estimation of the long-run co-integration equation normalised on agricultural output in the country thus revealing a significant relationship with respect to GE, INF, ACGS and EXCR.

The result of impulse response function shows that in the long-run one standard deviation innovation on government expenditure reduces agricultural output while that of agricultural credit, reduces agricultural crop production. To complement impulse response function we further generate variance decomposition. The variance decomposition result indicates that a significant variation in output of agriculture is due to changes in government expenditure and exchange rate. Thus this indicates a consistency in the result of variance decomposition and the impulse response function.

Table 9. Variance Decomposition of OUP

Period	S.E.	OUP	GE	INF	ACGS	IR	EXCR
1	0.383237	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.535061	90.61882	0.536562	0.084837	5.325610	2.027622	1.406548
3	0.668520	84.56513	5.210403	0.054403	3.478068	3.021725	3.670270
4	0.802023	78.33266	6.998357	0.037802	2.661355	4.791014	7.178817
5	0.905547	75.66497	7.296776	0.049456	2.466876	5.177500	9.344424
6	0.996817	74.42874	7.279727	0.041719	2.367929	5.324740	10.55714
7	1.077270	73.94110	7.189742	0.035993	2.203813	5.402853	11.22650
8	1.151452	73.66356	7.165572	0.031637	2.046140	5.453032	11.64006
9	1.221806	73.39837	7.180891	0.028205	1.917338	5.513988	11.96121
10	1.288639	73.14421	7.205234	0.025599	1.818519	5.569427	12.23701

Source: Authors Computation Using E-View 7.1

A major finding of this study is that government spending on agriculture plays a significant role in achieving food security in Nigeria. This underscores the fact that agricultural investment requires huge resources in terms of manpower development through extension service, provision of seed varieties, chemicals, research and development for innovation as well as social infrastructures. In addition, the exchange rate policy that has been adopted so far has not yielded any positive result in an effort to achieve food security in the country. Noteworthy is the fact that the devaluation policy in the 70s and the Structural Adjustment Programme (SAP) introduced in 1986 which marked the beginning of full deregulation in the country and set the tone for total liberalisation of exchange rate did not yield any improvement in agricultural output and hence threatened food security in the country. It is also useful to observe that the government agricultural credit policy has not generated a positive impact on agricultural output, this combined with increasing rate of inflation remained a threatening force in the path to sustainable food security. The study also reveals that a concessionary interest rate policy for agricultural sector will also improve higher investment in agricultural production. Arising from the following conclusion and findings, the paper recommends the following:

Firstly, for Nigeria to achieve a sustainable food security, an effective coordination of both fiscal and monetary policies is required.

Secondly, an expansionary fiscal policy that is not inflationary should be rigorously pursued to improve food production in the country. This may be in terms of research funding and establishment of more fertilizer plants to make available agricultural input locally. This will also aid the sector in avoiding the negative impact of depreciation of Naira due to increasing rate of exchange.

Thirdly, there is need for a realistic exchange rate that takes account of the prevailing internal macroeconomic environment rather than the dynamics of international undertones. In addition, the need to promote agricultural value-chain for employment generation, hence poverty reduction cannot be over emphasized, as this will enhance access to income hence food security.

Finally, the quality of the institution in the country should be improved in order to ensure positive impact of agricultural credit policy on the sector performance as well as effectiveness of the e-wallet programme. Based on this, the paper recommends a further study that will take into account the role of institution. It is important to note that the results of the study are based on the proxies adopted and that the findings may be country specific.

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