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APPROACH

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MONETARY POLICY AND AGRICULTURAL SECTOR PERFORMANCE IN NIGERIA: A GRANGER CAUSALITY APPROACH

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Abstract

Purpose: The agricultural sector provides a formidable basis for the Nigeria's economic diversification. To achieve this in the short-run, to start with, the use of appropriate monetary policy instruments is indispensable. Hence, this study examined the short-run causality between monetary policy and agricultural sector performance.

Methodology: Time series data for the study were obtained from the Central Bank of Nigeria between 1981 and 2020. The monetary policy instruments in the model were money supply (MS), monetary rediscount rate (MR), exchange rate (ER), prime lending rate (PR) and agricultural sector implicit price deflator (ASI) while agricultural sector performance was proxied by the gross domestic product for the sector. After first differencing, the Augmented Dickey-Fuller test confirmed the stationarity of the variables. Optimal lag selection-order recommended four lags. The vector autoregressive model, pairwise Granger causality test and Wald coefficient test were used to show the robustness and validation of the causality test.

Findings: The result shows that the t-statistics of LnMS (2.70), LnMR (3.00), LnER (2.05) and LnPR (3.53) were statistically significant ($p<0.05$), suggesting bidirectional relationship between monetary policy and agricultural sector performance. There was a unidirectional causality running from LnASI to LnASG. It was concluded that monetary policy Granger-caused agricultural sector performance in the short-run.

Unique contribution to theory, policy and practice: The study recommended that monetary authorities should note that that changes to MS, MR, ER, PR and ASI would affect ASG and vice versa in the short-run as well as the overall macroeconomic growth; and policy decisions that are aimed at altering ASG would affect MS, MR, ER, PR.

Keywords: *Monetary policy, Agricultural Financing, Granger Causality*

1.0 INTRODUCTION

As a growth performance measure, the Central Bank of Nigeria (CBN) identifies crop, fisheries, livestock and forestry as the subsectors of the agricultural sector. Before the advent of the oil sector, agriculture was the mainstay of Nigeria's economy (Adekunle & Ndukwe, 2018). In spite of the fact that the oil sector makes the most contribution to budgetary financing,

the agricultural sector has continued to provide food for humans, feed for animals and raw materials for various industries (Anh *et al*., 2020; Ndor *et al*., 2020). In fact, the famous and contemporary diversification policy of the Federal Government of Nigeria focuses substantially on revamping the agricultural sector. Similarly, the paradigm shift towards non-oil revenue and export has heavy reliance on agriculture. To this end, the contribution of agriculture to national development cannot be overemphasized, especially in developing African economies.

Nigeria's agriculture is dominantly rural in nature. It is characterized by smallholdings ranging from less than one to three hectares, although commercial production has begun to emerge as consequences of Agricultural Transformation Agenda and the renewed funding by the various financial policy interventions of the CBN. These challenges notwithstanding, Adongo *et al*. (2020) emphasized that there is a strong correlation between agricultural development and national economic growth. In order to sustain national economic growth, it is a global practice to rely on the use of policies. Adongo *et al*. (2020) also stressed that policy interventions or regulations that would improve agribusiness and access to market, strengthen research and extension, enhance land use and crop development as well as enhance farmers' access to affordable credit facilities and production inputs are expedient for prosperity of the agricultural sector. All these depend on favorable policies, among others.

Policies are used to attain desirable results. In other words, government uses policies to achieve growth as well as discourages negative tendencies. Corroborating, Ashamu (2020) stated that government adopts various economic policies so as to influence economic activities. Like other real sectors of Nigeria's economy, the government regulates the activities of the agricultural sector through the instrumentality of various policies. A key policy that affects agriculture in all ramifications, ranging from input supply and production, including credit supplies and interest rates, through processing and consumption to export is the monetary policy. According to Ogbanje & Ihemezie (2021), monetary policies affect agricultural economy in diverse manners. Nwoko *et al*. (2016) added that monetary policy has serious implications for both fiscal and income policy measures.

Monetary policy is a set of instruments that a country's Central Bank uses to promote sustainable economic growth. This is done by controlling the overall supply of money to the banks, its consumers, and its businesses (CBN, 2021). According to Nwoko *et al*. (2016), monetary policy refers to the combination of measures that are designed to regulate the value, supply and cost of money in an economy. This is done in consonance with the level of economic activities. The policy is used to control the direction and movement of monetary and credit facilities in pursuance of stable price and sustainable economic growth.

Musa (2015) viewed monetary policy as a deliberate action taken by the Central Bank to control money supply and credit availability in an economy through the manipulation of the interest rates so as to be consistent with economic growth and the price objectives that are set by the government. According to Mashinini *et al*. (2019), monetary policy is adopted by government to control the supply of money as well as credit condition in an economy to achieve economic goals such as the economic growth, stability in inflation rate as well as exchange rate and employment. Arize (2003) added that if the CBN varies exchange rate, currency substitution effect can be generated, with resultant effect on investors.

Monetary can be expansionary or contractionary. According to Anyanwu & Kalu (2015), the former refers to increase in money supply and reduction in interest rate, while the latter refers to decrease in money supply and increase in interest rate. The goal is to keep the economy humming at a rate that is neither too harsh nor too benevolent. Whenever the CBN raises interest rates, the aim is to discourage spending. On the other hand, a downward review of interest rates encourages more borrowing and spending. The CBN sets the rates it charges to loan money to the nation's banks, and all financial institutions tweak the rates they charge all of their customers. Caldara *et al*. (2020) added that a huge increase in the monetary base could lead to an inflation breakout. Also, large bank reserves might make it difficult to meet funds target when that eventually becomes necessary. Similarly, Dhannur & John (2021) indicated that while a stern monetary policy stance tends to adversely affect investments and subsequently the exports, a growth-oriented monetary policy regime would accelerate investments increase export volumes.

Monetary policy focuses on the control of the quantity of money that is available in an economy at a time as well as the channels through which money is supplied. By regulating money supply, a central bank seeks to influence macroeconomic factors such as inflation, the rate of consumption, economic growth, and overall liquidity. In addition to modifying the interest rate, the central bank of a country may buy or sell government bonds, regulate foreign exchange (forex) rates, and revise the amount of cash that the banks are required to maintain as reserves (Chiang, 2008; Okanya & Paseda, 2020).

The goal of this control measures which are inherent in monetary policy is to enhance access to funding for growth in key sectors of the economy, especially, agriculture. According to Onyiriuba *et al*. (2020), financing for agricultural production remains a subject of national interest in both developing countries and emerging markets. The fact also remains that the outcome of agricultural activities can impact or inform the selection or redirection of certain monetary policy instruments. This submission alludes to the possibility of directional relationship between monetary policy and agricultural sector performance. From analytical perspective, the investigation falls within the purview of Granger causality. Causality has been widely used in empirical literature to determine the direction between economic variables (Anochiwa & Maduka, 2015; Elias & Worku, 2015; Hussain, 2014; Odionye *et al*., 2017; Ogbanje *et al*., 2016). Three forms of direction are available in causality analysis. According to Ogbole *et al*. (2011) and Ogbanje & Igboko (2019), causality can be null, unidirectional or bidirectional.

The nexus is that while causality is concerned with short-run dynamics, the short-run concept also falls within the purview of monetary policy. According to Asaleye *et al*. (2021), monetary policy is used to achieve short-term objectives, such as ensuring stability in the economy. Nonetheless, the effects of the short-term implications generate long-term consequences for sustainable growth and development. This nexus constitutes the central relevance of this paper as it strives to fill up yawning gaps in literature and lends empirical evidence to the monetary policy-agricultural sector performance relationship. For instance, Asaleye *et al*. (2021) observed that the implications of monetary policy on agricultural performance have not been given adequate attention in literature to date. Although, the CBN is alive to its responsibility of ensuring economic stability through monetary policy, macroeconomic indices, including those that relate to the agricultural sector, indicate poor growth, high inflation, growing food

insecurity, high food prices and inflation, as well as food imports, to mention but a few. These could be the reasons that Udeaja & Udoh, (2014) emphasized that monetary policy appears to have failed in directing credit to the agricultural sector. Ehinomen & Charles (2012) had earlier shown that although CBN's monetary policies play crucial role in influencing the level of agricultural productivity in the country, it has not recorded significant progress in terms of providing enabling environment for better performance of the agricultural sector.

Similar studies have been conducted in this all-important area of research. Examples include the impact of monetary policy on agricultural development in Nigeria by Ehinomen & Charles (2012) using data from 1970 to 2010, impact of the monetary policy factors on the foreign direct investments in Romania by Magdalena *et al*. (2012), monetary policy actions and agricultural sector outcomes: empirical evidence from south Africa by Muroyiwa & Sibanda (2014), effect of monetary policy on agricultural sector in Nigeria from 1970 to 2010 by Udeaja & Udoh (2014), the impact of monetary policy on the economic growth of Nigeria by Nwoko *et al*. (2016), assessing the effect of monetary policy on agricultural growth and food prices by Wagan *et al*. (2018) and impact of broad money supply and exchange rate on agricultural gross domestic production by (Ogbanje & Ihemezie, 2021). None of these studies examined the direction of relationship between monetary policy and agricultural sector performance in the short-run.

Furthermore, empirical literature reveals divergent results on the impact of monetary policy on agriculture. For instance, between 1981 and 2019 in Kenya, broad money supply had a positive influence on agricultural GDP while exchange rate displayed a negative impact on the performance agricultural sector (Adongo *et al*., 2020). Mashinini *et al*. (2019) found that, in the short run, the variation in agriculture GDP was largely and significantly caused by the lagged agricultural GDP, interest rate, exchange rate as well as inflation in Eswatini. Oye *et al*. (2018) reported and inverse relationship between real effective exchange rate and decrease in gross agricultural output in Nigeria. Musa (2015) showed that monetary policy rate did not impact agricultural sector. In Muroyiwa & Sibanda (2014), inflationary shocks and the money market rate had an enormous negative impact on the performance of the Agricultural GDP in South Africa.

Thus, it is imperative to review the direction of relationship between monetary policy instruments and the agricultural sector with the view to guiding effective policy adjustment that will engender robust growth of this sector that has the greatest capacity to achieving the goals of economic diversification, food security and employment. Apart from the analytical framework, it is important to include additional monetary policy instruments to the debate. According to Asaleye *et al*. (2021), understanding the channels (instruments or tools) with which monetary policy affects the agricultural performance in developing economies may promote long-term output, employment and growth. Udeaja & Udoh (2014) held that monetary policy, if properly executed, can correct distortions as well as streamline economic activities in an economy.

Hence, the objectives of the study were to assess the mean and coefficient of variation of selected monetary policy instruments and agricultural sector performance, proxy of gross domestic product; determine the existence and direction of causality between selected

monetary policy instruments and agricultural sector performance. It was hypothesized that monetary policy does not Granger-cause agricultural sector performance in Nigeria.

2.0 THEORETICAL FRAMEWORK

Two theories were reviewed. These include the monetarist theory of Friedmann and Schwartz of 1963 and Schumpeter's theory of economic development of 1934.

Monetarist theory: Monetarism is mainly associated with the work of Milton Friedman and Anna Schwartz in 1963 (Jahan et al., 2014). The theory stipulates that money supply is the most important determinant of the rate of economic growth. It is governed by the quantity theory of money, which is given as:

$MV = PQ$
where,
M = money supply, V = velocity of money, P = price of goods, and Q = quantity of goods and services.
Assuming that V is constant, when M is increased, either P, Q, or both P and Q would rise.

In simple terms, if a nation's supply of money increases, economic activity will increase. This relates to a case of unidirectional causality running basically from monetary policy to economic development. The reverse is also a possibility. This implies that the level of economic activity can also influence monetary policy. This underscores the concept of bidirectional causality.

Monetarism gained prominence in the 1970s. In 1979, with U.S. inflation attaining all-time high of 20 percent, the government switched its operating strategy to reflect monetarist theory. But monetarism faded in the following decades as its ability to explain the U.S. economy seemed to wane (Jahan et al., 2014). However, some of the insights that monetarists brought to economic analysis have been adopted by non-monetarist economists.

Schumpeter's theory of economic development: This theory assigns critical roles to the entrepreneur and his innovations in the economic development process. Specifically, the theory, which was propounded in 1934, states that economic development is the natural result of forces internal to the market and is created by the opportunity to seek profit (Emami-Langroodi, 2018). According to theorist, the process of production is marked by a combination of material and immaterial productive forces. The material productive forces often arise from the traditional factors of production (land and labour, capital, entrepreneur), while the immaterial productive forces are regulated by the technical facts and 'acts of social organization. The Schumpeterian production function is written as:

$Q = f(k, r, l, u, v)$

where, Q = output, k = Schumpeterian concept of "produced means of production", r = natural resources, l = employed labour force, u = the society's fund of technical knowledge, and ν = the facts of social organization, i.e., the socio-cultural milieu within which the economy operates. To this extent, Croitoru (2012) emphasized that one of the most important aspects of the analysis is the distinction between exogenous and endogenous factors of the economic system. This perspective allows analysis of economic phenomena through economic factors and maintains a useful distance between these phenomena and elements from the other spheres of the reality.

The above function shows that the rate of growth of the output of a real sector depends upon the rate of growth of productive factors, the rate of growth of technology and the rate of growth of investment friendly socio-cultural environment. These productive factors can be procured with capital whose availability if regulated by monetary policy instruments such as money supply and interest rate. Obviously, the alterations in the supply of productive factors can only bring about gradual, continuous and slow evolution of the economic system.

The monetarist theory is more relevant to this work. This is because of the underlying quantity theory of money which equates the product of money supply and velocity of money to the product of prices of goods and quantity of goods and services. In agricultural production, money supply substantially affects the capital (or credit) that regulates the level of production as well as availability. Credit is obtained at an interest rate which is regulated by the Central Bank. Food availability affects prices. When farmers obtain high income and reinvest it, the demand for credit reduces and the interest rate crashes, thereby making more fund availability in the next cycle of production.

3.0 METHODOLOGY

The study area is Nigeria. It is a Western Africa lies between 4^0N and 14^0N, and between 3^0E and 15^0E. With a total area of 923,800 km^2, the country is located within the tropics with a mean average temperature of 27^0C. The average maximum temperatures vary from 32^0C along the coast to 41^0C in the northern part of the country. The mean minimum temperature ranges from 21^0C in the coastal areas to 13^0C in the northern parts of the country. The annual rainfall pattern of the country declines from a wet coastal area (3,500 mm) to the relatively dry northern parts (600 mm) of the country (Oyinbo & Rekwot, 2014; Nkwi et al., 2021).

Although, Nigeria's economy is largely dependent on the oil sector, agriculture is taunted as the mainstay of the economy. For instance, the agricultural sector provides vast employment for rural inhabitants, raw materials for agroindustries and contributes remarkably to non-oil revenue and export. As remarked by Abdullahi et al. (2021), Nigeria is an agrarian country where agricultural activities are the primary source of economic survivals and livelihoods. Consequently, several administrations evolved series of policy interventions to enable the

sector maintain its indispensable roles. Besides these policies, monetary policy plays supportive roles in ensuring optimum money supply, regulating lending rate, exchange rate and sectoral inflation in manner that will guarantee sustainable growth in key sectors like agriculture. Because of the widespread nature of agricultural sector, key monetary policy instruments could be influenced by the former.

This study adopts an *ex post facto* research design. The study used time series data from 1981 to 2020 to estimate direction of causality between agricultural sector performance and monetary policy. The data were obtained from the statistical bulletin of the Central Bank of Nigeria. The econometric software, STATA 14, was deployed for data analysis. Both descriptive and inferential statistical techniques were used to achieve the objectives of the study.

The Augmented Dickey-Fuller (ADF) test was used to ascertain the stationarity of the time series variables in order to forestall unreliable results. According to Bamba & Reed (2017), the ADF assumes that the errors are statistically independent and have a constant variance. In order to remove the possibility of serial correlation in the residuals, literature recommends the regression of the dependent variable on a sufficiently large number of lags so as to remove the serial correlation existing in the residuals. In line with Oyinbo & Rekwot (2014) and Nkwi *et al*. (2021), the null hypothesis (H_0: $\beta=0$) of the ADF test would imply that the data series was not stationary while the alternative hypothesis (H_I: $\beta<0$) would indicate that the data series was stationary. In addition, optimal lag selection-order was used to determine the lag length. Furthermore, causality analysis was estimated with three different approaches (vector autoregressive model, pairwise Granger-causality test and Wald coefficient test) for robustness and validation.

The model for the five-way Granger causality test was specified as follows:

$$lnasg_t = a + \sum_{i=1}^{k} \beta_i lnasg_{t-i} + \sum_{j=1}^{k} \beta_i lnms_{t-j} + \sum_{j=1}^{k} \beta_i lnmr_{t-j} + \sum_{l=1}^{k} \beta_i lner_{t-l}$$
$$+ \sum_{m=1}^{k} \beta_i lnpr_{t-m} + \sum_{n=1}^{k} \beta_i lnasi_{t-n} + u_{1t}$$

$$lnms_t = a + \sum_{i=1}^{k} \beta_i lnasg_{t-i} + \sum_{j=1}^{k} \beta_i lnms_{t-j} + \sum_{j=1}^{k} \beta_i lnmr_{t-j} + \sum_{l=1}^{k} \beta_i lner_{t-l}$$
$$+ \sum_{m=1}^{k} \beta_i lnpr_{t-m} + \sum_{n=1}^{k} \beta_i lnasi_{t-n} + u_{2t}$$

$$lnmr_t = a + \sum_{i=1}^{k} \beta_i lnasg_{t-i} + \sum_{j=1}^{k} \beta_i lnms_{t-j} + \sum_{j=1}^{k} \beta_i lnmr_{t-j} + \sum_{l=1}^{k} \beta_i lner_{t-l}$$
$$+ \sum_{m=1}^{k} \beta_i lnpr_{t-m} + \sum_{n=1}^{k} \beta_i lnasi_{t-n} + u_{3t}$$

$$lner_t = a + \sum_{i=1}^{k} \beta_i lnasg_{t-i} + \sum_{j=1}^{k} \beta_i lnms_{t-j} + \sum_{j=1}^{k} \beta_i lnmr_{t-j} + \sum_{l=1}^{k} \beta_i lner_{t-l}$$
$$+ \sum_{m=1}^{k} \beta_i lnpr_{t-m} + \sum_{n=1}^{k} \beta_i lnasi_{t-n} + u_{4t}$$

$$lnpr_t = a + \sum_{i=1}^{k} \beta_i lnasg_{t-i} + \sum_{j=1}^{k} \beta_i lnms_{t-j} + \sum_{j=1}^{k} \beta_i lnmr_{t-j} + \sum_{l=1}^{k} \beta_i lner_{t-l}$$
$$+ \sum_{m=1}^{k} \beta_i lnpr_{t-m} + \sum_{n=1}^{k} \beta_i lnasi_{t-n} + u_{5t}$$

$$lnasi_t = a + \sum_{i=1}^{k} \beta_i lnasg_{t-i} + \sum_{j=1}^{k} \beta_i lnms_{t-j} + \sum_{j=1}^{k} \beta_i lnmr_{t-j} + \sum_{l=1}^{k} \beta_i lner_{t-l}$$
$$+ \sum_{m=1}^{k} \beta_i lnpr_{t-m} + \sum_{n=1}^{k} \beta_i lnasi_{t-n} + u_{6t}$$

where,

LnASG = log of agricultural sector Gross Domestic Product, a proxy for agricultural sector performance

LnMS = log of money supply

LnMR = log of monetary rediscount rate

LnER = log of exchange rate

LnPR = log of prime lending rate

LnASI = log of agricultural sector implicit price deflator, a proxy for inflation

The causality approaches and associated hypothetical postulations are as follow:

Vector autoregressive (VAR) model:
If z-statistic is statistically significant, causality can be inferred.
Pairwise Granger-causality:
Ho: There is no Granger causality
H_1: The null hypothesis is not true
Decision criterion: Reject Ho if the probability value of the chi-square statistic is ≤ 0.05
Wald coefficient test:
Ho: Coefficient(s) = 0
H_1: Coefficient(s) $\neq$ 0
Decision criterion: Reject Ho if the probability value of the chi-square statistic is ≤ 0.05

4.0 FINDINGS

The result of the descriptive statistics of monetary policy instruments and agricultural sector performance in Nigeria is presented in Table 1. The result shows that mean monetary supply (Nb) is 7,321.04 with a coefficient of variation of 1.48. The relatively high level of coefficient of variation implies erratic supply of money to facilitate economic growth, especially the agricultural which remains a paramount sector of the economy. The fluctuation discourages planning.

The result further shows that average minimum rediscount rate (%) was 13.04 and maximum of 26.00. The MR regulates the rate of interest on loanable funds for economic growth. The average rate is above single digit interest rate that favours growth in developing economies like Nigeria. At this rate, borrowing is discouraged. Invariably, investment slows down due to high cost of fund. The coefficient of variation for MRR was 0.31 for the period under review. This implies that the high interest rate policy remained high for most of the period of this study.

In addition, mean exchange rate for the period was N106.39 and maximum of N358.81. The ER records a minimum of 0.62 when the naira was at its best in relation to the US dollar and could facilitate the growth of key sectors of the economy. At N358.81, sectors that are dependent on exchange rate experienced devastation as it became relatively more difficult for businesses to cope. The low coefficient of variation (0.92) indicates that the average ER persisted for most of the time, thereby hindering economic growth for economies whose consumption profile was above its production base and disposition.

The result in Table 1 also shows that the prime lending rate had a mean of 17.45%, maximum of 29.80% and minimum of 7.75%. The minimum PR implies that there was a time in the country when the cost of capital was very low and favourable for the commercial banks to contribute substantially to the growth of the key sectors of the economy. Like the MR, average and maximum PR were above single digit thereby discouraging the use of debt capital by investors to meaningfully contribute to the growth the of the real sectors. This is worrisome because equity capital, where it is available, does not make remarkable contribution to business start-up, robustness and establishment of new lines of production. The low coefficient of

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variation of PR (0.26) suggests that during the period of the study, the high lending rate was dominant.

Agricultural sector performance, proxied by the Gross Domestic Product of the sector, had a mean of N7,696.41 billion. The wide gap between the minimum (N17.05b) and maximum (37,241.61b) is an indication large increase within the period of the study. The difference could be due to the recalibration of GDP. The coefficient of variation (1.30) is suggestive of wide fluctuation

Table 1: Descriptive Statistics of Monetary Policy Instruments and Agricultural Sector Performance

Statistics	Mean	Maximum	Minimum	Coefficient of variation
Money Supply (Nb)	7,321.04	36,014.88	14.47	1.48
Minimum Rediscount Rate (%)	13.04	26.00	6.00	0.31
Exchange Rate (N)	106.39	358.81	0.62	0.92
Prime Lending Rate (%)	17.45	29.80	7.75	0.26
Agric Sector GDP (Nb)	7,696.41	37,241.61	17.05	1.30
Agric Sector Implicit Price Deflator	57.13	202.97	0.72	0.99

Source: Central Bank of Nigeria, 2020

Stationarity test

Stationarity test was carried out with Augmented Dickey-Fuller test, the result of which is presented in Table 2. The result shows that, at levels, the absolute values of z-statistics of all the variables in the systems equation were less that the critical value (5%). Consequently, the study failed to reject the null hypotheses of the presence of unit roots. This was in line with Gujarati (2003), Awe (2013) and Anwana & Affia (2018). However, after first differencing, the z-statistics of the variables in the systems were greater than the critical value in absolute terms. Hence, they were adjudged stationary. In other words, the variables no longer have unit roots. The relevance of stationary variables is that the results obtained from any estimation involving them will be reliable. These submissions are in line with Aminu (2020), Afolabi *et al.* (2021) and Ogbanje & Ihemezie (2021). The models of the ADF used were trend and drift and as dictated by the line graphs of the respective variables.

Table 2: Unit Root Test

Variable	At level I(0)		At first difference I(1)		Model
	Test statistic (Z(t))	5% Critical value	Test statistic (Z(t))	5% Critical value	
LNASGDP	-0.918	-3.548	-4.349	-3.552	Trend
LNMSNB	-0.833	-3.548	-3.021	-1.691	Drift
LNMRR	-2.549	-3.548	-5.412	-3.552	Trend
LNEXR	-1.613	-3.548	-3.709	-3.552	Trend
LNPLR	-2.247	-3.548	-5.81	-3.552	Trend
LNASIPD	-1.279	-3.548	-4.098	-3.552	Trend

Optimal Lag Selection-Order

The result of the optimal lag selection-order is presented in Table 3, using various criteria. Five criteria namely, Likelihood ratio (LR), Final Predictor Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC), and Schwarz Information Criterion (SBIC) recommended four lags. The lag selection was based on the least value for each criterion as indicated by the asterisk (*) from the STATA software package. As a rule of thumb, the lower the value, the better the selection. Hence, as suggested and adopted by Adongo *et al*. (2020) and Ogbanje & Ihemezie (2021), the ensuing causality test was run with four (4) lags.

Table 3: Optimal Lag Selection-Order

lag	LL	LR	df	p-value	FPE	AIC	HQIC	SBIC
0	-42.7211				6.00E-07	2.70673	2.79884	2.97065
1	182.015	449.47	36	0.001	1.70E-11	-7.77861	-7.1338	-5.9312*
2	219.884	75.738	36	0.001	1.90E-11	-7.88245	-6.68495	-4.45149
3	267.189	94.609	36	0.001	1.70E-11	-8.51049	-6.7603	-3.49601
4	335.692	137.01*	36	0.001	9.3e-12*	-10.316*	-8.0134*	-3.71823

Robust Causality Test

Three approaches were used to test causality. These were the vector autoregressive (VAR), using z-statistics as a decision criterion, Granger Wald test and the test of linear hypothesis using chi-square statistics, respectively. These approaches were adopted to guarantee robustness of the result as presented in Table 4. In the ASG model, the VAR model shows that lag 4 of LnMS, lag 3 of LnMR, lag 1 of LnER, lag 1 of LnPR, lags 2 and 4 of LnASI, exhibited statistically significant (p<0.01) effect. In the MS model, only lags 1 and 3 of lnER had statistically significant (p<0.01) effect. For the MR model, lag 2 of LnASG, lag 4 of LnMS, lags 2 and 3 of LnER, lag 3 of LnPR, and lags 1 and 2 of LnASI had had statistically significant (p<0.01).

The result further showed that lag 2 of LnASG, lags 1, 3 and 4 of LnMS, lag 1 of LnPR, and lags 1 (4.10) and 2 (3.37) of LnASI had statistically significant (p<0.01) effect on LnER. For model PR, lags 1 and 2 of LnASG, lags 1 and 4 of LnMS, lags 3 and 4 of LnMR, lag 4 of LnEX and lag 1 of LnASI had statistically significant (p<0.01). Finally, in the ASI model, lag 4 of LnMS, lag 1 of LnEX, lags 1 and 3 of LnPR had statistically significant (p<0.01).

The Granger Wald test approach in the LnASG model shows that the respective Chi-squared statistics of LnMS (22.0), LnMR (9.91), LnER (21.73), and LnPR (47.96) were statistically significant (p<0.05). Consequently and in line with Ogbole *et al*. (2011), the study rejected the

null hypothesis. The implication, according to the postulation in Ogbanje & Igboko (2019), Ogbanje *et al*. (2016) and Verter (2017), is that there was causality running from LnMS, LnMR, LnER and LnPR to LnASG. The result for the models of these independent variables showed that there was feedback. Hence, according to (E .C. Ogbanje *et al*., 2016), there was bi-directional causality between LnMS, LnMR, LnER and LnPR on one hand and LnASG on the other hand. In addition, uni-directional casuality ran from ASI to ASG without feedback.

For the LnMS model, there was bi-directional causality with LnER and LnASI. In the LnMR model, there was uni-directional causality running from LnMS, LnER and LnASI to LnMR without feedback. The model depicted bi-directional causality between LnMR and LnPR. In the LnER model, there was bi-directional causality with LnPR and LnASI. For the LnPR model, there was uni-directional causality running from LnMS to LnPR without feedback. There was also bi-directional causality with LnASI with feedback.

Drawing on these results with particular reference to the agricultural sector performance model, it is obvious that monetary policy Granger-cause agricultural sector performance in the short-run. The finding re-affirmed Udeaja & Udoh (2014) that exchange rate had positive and significant effect on agricultural output and, hence agricultural sector in Nigeria. Ogbanje & Ihemezie (2021) added that money supply significantly affected agricultural sector GDP in Nigeria in the short-run. Using time series data from 1970 to 2011, Muroyiwa & Sibanda (2014) also found that inflationary shocks and the money market rate have an enormous negative impact on the performance of the Agricultural GDP in Nigeria in the long-run. In Kenya, Adongo *et al*. (2020) found that broad money supply has a positive influence on agricultural GDP while exchange rate displayed a negative impact on the performance agricultural sector.

Table 4: Robustness of Causality Results (@ 5% Significance level)

Model (Dependent variable)	T-statistics from VAR model (z-stat)	Granger Wald test (Chi^2 stat)	Wald Coefficient test (Chi^2 stat)	Decision
LnASG	LnMS_4: (2.70)* LnMR_3: 3.00* LnER_1: 2.05* LnPR_1: (3.53)* LnASI_2: (2.38)* LnASI_4: 2.19*	LnMS: 22* LnMR: 9.91* LnER: 21.73* LnPR: 47.96* LnASI: 13.75*	LnMS: 22* LnMR: 9.91* LnER: 21.73* LnPR: 47.96* LnASI: 13.75*	*LnMS* Granger-cause *LnASG* with feedback *LnMR* Granger-cause *LnASG* with feedback *LnER* Granger-cause *LnASG* with feedback *LnPR* Granger-cause *LnASG* with feedback *LnASI* Granger-cause *LnASG* without feedback
LnMS	LnER_1: 1.99* LnER_3: (2.42)*	LnASG: 14.41* LnMR: 6.42 LnER: 11.69* LnPR: 9.74		

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		LnASI: 13.75* ALL 110.63*
LnMR	LnASG_2: 2.27* LnMS_4: 4.92* LnER_2: 3.35* LnER_3: (2.68)* LnPR_3: 3.32* LnASI_1: 3.01* LnASI_2: 2.08*	LnASG: 20.97* LnMS: 38.32* LnER: 27.07* LnPR: 12.96* LnASI: 17.55* ALL 129.55*
LnER	LnASG_2: 2.64* LnMS_1: 2.63* LnMS_3: 3.17* LnMS_4: 2.81* LnPR_1: 3.28* LnASI_1: 4.10* LnASI_2: 3.37*	LnASG: 10.02* LnMS: 21.48* LnMR: 2.17 LnPR: 20.29* LnASI: 22.84* ALL 134.69*
LnPR	LnASG_1: 2.86* LnASG_2: (2.51)* LnMS_1: 2.16* LnMS_4: (2.30)* LnMR_3: 2.64* LnMR_4: 2.52* LnER_4: (2.71)*	LnASG: 12.78* LnMS: 20.96* LnMR: 10.70* LnER: 69.66* LnASI: 28.89* ALL 117.95*

LnASI	LnASI_1: (3.04)*	
	LnMS_4: (2.89)*	LnASG: 2.21
	LnER_1: 5.57*	LnMS: 21.12*
		LnMR: 2.04
	LnPR_1: (5.47)*	LnER: 88.74*
		LnPR: 68.29*
	LnPR_3: 5.27*	ALL 393.67.95*

5.0 CONCLUSION AND RECOMMENDATIONS

The study focused on the causality between monetary policy and agricultural sector performance. While the monetary policy instruments in the model include money supply (MS), monetary rediscount rate (MR), exchange rate (ER), prime lending rate (PR) and agricultural sector implicit price deflator (ASI), agricultural sector performance was proxied by the gross domestic product for the sector. The time series data for the study were obtained from the statistical bulletin of the Central Bank of Nigeria between 1981 and 2020. Using causality approach, the study found that MS, MR, ER and PR had bidirectional relationship with ASG, while there was unidirectional relationship running from ASI to ASG. Consequently, the study established that monetary policy Granger-causes agricultural sector performance in Nigeria in the short-run.

The study recommends that monetary policy authority in Nigeria should note that changes to money supply, monetary rediscount rate, exchange rate, prime lending rate and agricultural sector implicit price deflator (ASI) would affect agricultural sector performance in the short-run as well as the overall macroeconomic growth; and policy decisions that are aimed at altering agricultural sector performance would affect money supply, monetary rediscount rate, exchange rate, and prime lending rate.

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