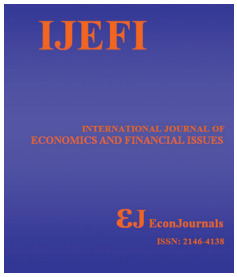

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Credit Supply and Rice Output in Nigeria: Empirical Insight from Vector Error Correction Model Approach

Osaretin Kayode Omoregie[1], Fredrick Ikpesu[2]*, Abraham Emmanuel Okpe[3]

[1]Lagos Business School, Pan-Atlantic University, Nigeria,[2] School of Management and Social Science, Pan-Atlantic University, Nigeria,[3]Federal University of Agriculture, Makurdi, Benue State, Nigeria. *Email: fikpesu@pau.edu.ng

ABSTRACT

This study investigated the effect of credit supply on rice output (RO) in Nigeria within the periods 1981–2016 by employing the vector error correction model approach. Findings from the research revealed that a rise in credit supply would lead to increase in RO. In addition, the study indicated that a shock in investment, and labour would cause decline in RO while a shock in money supply and inflation rate would cause RO to rise in the country. Based on the result of the study, it is recommended that government in partnership with deposit money banks should create a scheme that will provide an interest free loan to farmers that are involved in rice production. Also, government should encourage rice farmers by supplying them farm inputs (which includes the provision of high yielding varieties, fertilizers, land, irrigation) at a subsidizes rate.

Keywords: Credit Supply, Rice Output, Vector Error Correction Model
JEL Classifications: C5, Q1, Q14

1. INTRODUCTION

The role of credit in boosting the agricultural sector, have long been recognized by development economists. Strands of literature have shown that the supply of credit to agricultural sector is a key path in achieving sustainable growth in the sector and reduction of poverty among the populace (Diagne and Zeller, 2001; Diagne, 2002; Fall, 2008; Adeola and Ikpesu, 2016; Anetor et al., 2016). The supply of credit to the agricultural sector not only stimulates but also strengthens the growth of the sector (Obansa and Maduekwe, 2013). In a similar vein, Ruete (2015) documented that the engine for sustainable growth is having access to credit to finance the agricultural sector. Several studies have been carried out to underscore agricultural credit contributing immensely to the growth of the economy Garba, 2011, Lawal and Abdullahi, 2011, these studies emphasis success of agricultural credit in translating into aggregate output in the Nigerian economy.

According to IRRI (2006), Wang and Valent (2009) rice is an important staple food consumed by half of the world population representing over 4.8 billion people in 176 countries. In Nigeria, the most consumed staple is rice with consumption per capital of 32 kg (PWC, report). Based on National Bureau of Statistics and PWC report, in 2011, household expenditure on rice annually accounted for 6.6% of total household spending and 10% on household food spending. The cultivation of rice in the country is mostly done by small-scale farmers who employed traditional farming techniques, and have poor or no access to agricultural credit to enhance their output (Adesiji et al., 2011).

The government in a bid to boost rice production and make the country self-reliance in rice production completed the Zauro irrigation project, provided inputs (improved seedling and fertilizers) and set up various development schemes to encourage rice farmers. In addition, land concessions were granted to large scale farmers as an incentive. The government through the Central Bank of Nigeria (CBN) provided funds to rice at affordable rates through the anchor borrower's programme (PWC report).

However, despite government policies on rice production, rice import bill for the country which stood at $130 million in 1996 (Alarima, 2014) rose tremendously to $1.8 billion in 2016 (Dangote, 2016) due to the perceived preference for imported rice by urban consumers as a result of its high quality. According

to Ijaiya and Ijaiya (2003) the importation is occasioned by the neglect of agricultural sector by the government overtime.

In the literature, empirical studies have shown that credit supply positively and significantly affect rice output (RO). This implies that through access to credit, rice farmers have been able to increase their output (Adesiji et al., 2011; Duy et al., 2012; Wicaksono, 2014; Mahoukede et al., 2015; John et al., 2017).

While attempting to reduce poverty in Nigeria is a monumental challenge, there is a salient question that this study intends to address which is, does credit supply impact RO in Nigeria. The objective of this paper therefore is to examine the effect of credit supply on RO in Nigeria using a vector error correction model (VECM) approach. Findings from the study will aid policymakers in designing and implementing appropriate policies that will ensure not only sustainable RO in the country but also make the country self-sufficient in the production of rice.

The structure of this paper is as follows: Section two presents the review of literature. Section three provides methodology and data. Section four is the presentation and interpretation of results, while section five provides recommendation and conclusion.

2. REVIEW OF LITERATURE

Empirical studies in the literature have examined the relationship between credit supply and agricultural output. For instance, Anthony (2010) research findings showed that agricultural credit has influence the growth of export in Nigeria. Similarily, Adetiloye (2012) findings showed that in Nigeria, agricultural credit has impacted positively on the agricultural sector. Using logit regression analysis Hussain and Taqi (2014) concluded that agricultural credit has positive influence agricultural output in Pakistan. Also, employing a simple regression model, Ammani (2012) showed that through agricultural credit, agricultural output has been increased. Furthermore, Anetor et al. (2016) concluded that credit supply affects agricultural output positively.

Using the ordinary least square method of multiple regressions, Imoisi et al. (2012) research findings revealed that in Nigeria, agricultural credit has positively influenced agricultural output. Furthermore, Chisasa (2014) concludes that in South Africa, agricultural credit has a significant impact on agricultural output. In addition, Khan et al. (2015) findings showed that agricultural credit positively influenced agricultural output in Pakistan. Research findings by Nnamocha and Charles (2015) indicate that in Nigeria, the relationship between agricultural credit and agricultural output is a long-run relationship. In a similar vein, Osa-Afiana and Kelikume (2015) concludes that credit supply influence agricultural output in Nigeria positively.

In the literature, studies have been conducted to investigate whether credit supply positively influences RO. For instance, Odu et al. (2011) research findings showed that access to formal credit significantly improved rice farming. The researchers thus recommend the introduction of special credit scheme for the production of rice. Similarly, the study of Chandio et al. (2017) revealed that credit supply has positively and significantly impacted RO in Sindh, Pakistan. Investigating the role of financial cooperative in promoting RO in Tanzania, John et al. (2017) revealed that access to credit has enabled their members to increase their RO. Research findings by Mahoukede et al. (2015) showed that credit supply has a positive and significant effect on RO. The study further revealed that through access to credit, it has enabled rice farmers to increase their input (labour, rice land and fertilizers) which in turn has led to increase in RO.

Furthermore, investigating the effect of credit supply on rice production, Rahman (2013) research showed that agricultural credit has a significant and positive impact on RO in Gazipur district in Bangladesh. Also, Duy et al. (2012) concludes that in Vietnam's, agricultural credit has improved rice production significantly. Similarily, Adesiji et al. (2011) research findings showed that through access to agricultural credit, rice farmers have been able to increase their output. The study also indicates that cooperative societies, esusu, savings groups and banks are the main source of credit to rice farmers. In addition, their study further highlighted the hindrance faced by rice farmers which includes lack of collaterals, insufficient fund, and high rate of interest. Wicaksono (2014) concludes that agricultural credit has a positive impact on RO in Indonesia.

Based on the review of literature, empirical studies have shown that credit supply has a positive and significant effect on rice production. This study employed the VECM approach to investigate the effect of credit supply on RO in Nigeria by using the impulse response function (IRF) and the variance decomposition (VDC) of VECM. The justification for employing the IRF is to ascertain the effect of shocks in agricultural credit on RO in Nigeria while the VDC was used to measure the relative importance of shocks in credit supply on RO.

3. METHODOLOGY AND DATA

3.1. Theoretical Framework

The objective of this paper is to investigate the effect of credit supply on rice output in Nigeria. The study adopts the Cobb-Douglas production function.

The general form of Cobb-Douglas production function is expressed as:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} \quad (1)$$

Where Yt denotes output (in this study rice output (RO)) at time t,
A_t denotes total factor productivity (TFP)
K_t denotes capital stock at time t
L_t labour at time t
α and β are output elasticities

The study assumed that total factor productivity is a function of commercial loan to agriculture. With respect to rice output (RO), we added money supply (M2), inflation rate (INF) and other exogenous factors (C). Thus, total factor productivity is model as:

$$A_t = f(CLA_t, M2_t, INF_t, C) \quad (2)$$

Equation (2) can be expressed explicitly as follows:

$$A_t = CLA_t^{\varnothing} M2_t^{\pi} INF_t^{\theta} C_t \quad (3)$$

Combining equation (3) and (1), we obtain,

$$RO_t = C_t K_t^{\alpha} L_t^{\beta} CLA_t^{\varnothing} M2_t^{\pi} INF_t^{\theta} \quad (4)$$

3.2. Model Specification

Following the theoretical framework of the study, the study model is expressed as:

$$RO_t = f(INV_t, LAB_t, CLA_t, M2_t, INF_t, C) \quad (5)$$

The econometric form of equation (4) can be expressed as follows:

$$RO_t = c + \alpha INV_t + \beta LAB_t + \varnothing CLA_t + \pi M2_t + \theta INF_t + \mu \quad (6)$$

Where:
C is constant; α; β; ∅; and θ are parameters; μ is error terms; t is time trend.

3.3.VECM

The study employed the VECM following the co-integrating properties of the variables. The VECM is based on the vector autoregressive (VAR) model. Using the VAR model, each of the variables is regressed on finite number of lags of itself and other variables. The VECM is the long-run estimation variant of VAR. The VECM was employed to investigate the effect of agricultural credit on RO in Nigeria applying the IRF and the VDC of VECM. The justification for employing the IRF is to ascertain the effect of shocks in agricultural credit on RO in Nigeria while the VDC was used to measure the relative importance of shocks in agricultural credit on RO.

The VECM model is expressed as follows:

$$RO_t = \propto_1 + \sum_{j=1}^{n} \theta_j RO_{t-j} + \sum_{j=1}^{n} \beta_j INV_{t-j} + \sum_{j=1}^{n} \gamma_j LAB_{t-j} + \sum_{j=1}^{n} \alpha_j CLA_{t-j} + \sum_{j=1}^{n} \rho_j M2_{t-j} + \sum_{j=1}^{n} \pi_j INF_{t-j} + \mu_{1t}$$

$$INV_t = \propto_2 + \sum_{j=1}^{n} \beta_j INV_{t-j} + \sum_{j=1}^{n} \theta_j RO_{t-j} + \sum_{j=1}^{n} \Upsilon_j LAB_{t-j} + \sum_{j=1}^{n} \alpha_j CLA_{t-j} + \sum_{j=1}^{n} \rho_j M2_{t-j} + \sum_{j=1}^{n} \pi_j INF_{t-j} + \mu_{2t}$$

$$LAB_t = \propto_3 + \sum_{j=1}^{n} \gamma_j LAB_{t-j} + \sum_{j=1}^{n} \theta_j RO_{t-j} + \sum_{j=1}^{n} \beta_j INV_{t-j} + \sum_{j=1}^{n} \alpha_j CLA_{t-j} + \sum_{j=1}^{n} \rho_j M2_{t-j} + \sum_{j=1}^{n} \pi_j INF_{t-j} + \mu_{3t}$$

$$CLA_t = \propto_4 + \sum_{j=1}^{n} \acute{a}_j CLA_{t-j} + \sum_{j=1}^{n} \theta_j RO_{t-j} + \sum_{j=1}^{n} \beta_j INV_{t-j} + \sum_{j=1}^{n} \gamma_j LAB_{t-j} + \sum_{j=1}^{n} \rho_j M2_{t-j} + \sum_{j=1}^{n} \pi_j INF_{t-j} + \mu_{4t}$$

$$M2_t = \propto_5 + \sum_{j=1}^{n} \rho_j M2_{t-j} + \sum_{j=1}^{n} \theta_j RO_{t-j} + \sum_{j=1}^{n} \beta_j INV_{t-j} + \sum_{j=1}^{n} \gamma_j LAB_{t-j} + \sum_{j=1}^{n} \alpha_j CLA_{t-j} + \sum_{j=1}^{n} \pi_j INF_{t-j} + \mu_{5t}$$

$$INF_t = \propto_6 + \sum_{j=1}^{n} \pi_j INF_{t-j} + \sum_{j=1}^{n} \theta_j RO_{t-j} + \sum_{j=1}^{n} \beta_j INV_{t-j} + \sum_{j=1}^{n} \gamma_j LAB_{t-j} + \sum_{j=1}^{n} \alpha_j CLA_{t-j} + \sum_{j=1}^{n} \rho_j M2_{t-j} + \mu_{6t}$$

Where:
$\propto_1$ to $\propto_5$ = constant parameters
θ_j, β_j, γ_j, α_j, ρ_j = coefficient parameters
μ_1 to μ_5 = error terms
t = time trends

3.4. Data and Identification of Variables

This study utilizes time series data covering the period 1981–2016. The data have been collected from different sources, including CBN statistical bulletin and Food Agriculture Organization data base. The variables used in the study are RO, agricultural credit (CLA) which was proxy as commercial Loan to Agriculture, Money Supply (M2), investment (INV), Labour (LAB), and inflation rate (INF). Table 1 show the abbreviation, description and sources of all the variables used in the study.

4. RESULTS AND DISCUSSION

4.1. Unit Root Test

Table 2 represents the outcome of the stationarity test. The study employed the Kwiatkowski, Phillips, Schmidt, and Shin test in testing for the order of integration and stationarity of the variable. The outcome of the unit root test revealed that all the variables become stationary at first difference.

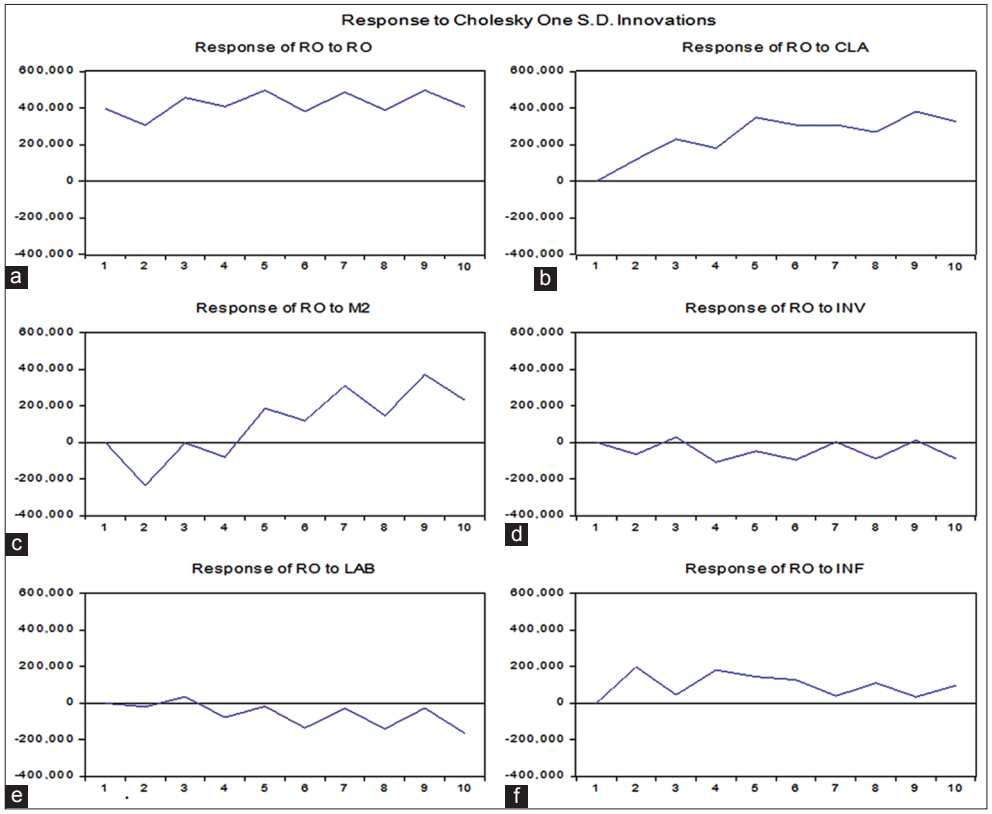
4.2. Optimal Lag Selection Criteria

Table 3 shows the outcome of the optimum lag selection criteria. The result indicates that all the test criteria select the optimum lag length 2. Hence, for the purpose of our estimation lag 2 will be employed in the estimation of the co-integration test and VECM model.

4.3. Cointegration Test

The trace and the maximum eigenvalue tests of Johansen-Juselius cointegration test was employed in-order to establish the existence of a long-run relationship between the variables since all the variables are integrated at 1(1). The null hypothesis of absence

Figure 1: (a-f) Impulse response function graph



Source: Author estimation using EViews

Table 1: Data description and sources

Variables	Abbreviation	Description	Sources
rice output	RO	This refers to the total rice production in a given year	FAO data base
Credit supply	CLA	This refers to the loans and advances granted to the agricultural sector by commercial banks	CBN Statistical Bulletin
Money supply	M2	This refers to total amount of money in circulation	CBN Statistical Bulletin
Investment	INV	This refers to gross domestic investment	WDI
Labour	LAB	This refers to the working population	WDI
Inflation	INF	This refers to the general increased in the price of goods and services	CBN Statistical Bulletin; WDI

Source: Authors', 2018. FAO: Food Agriculture Organization, CBN: Central Bank of Nigeria, WDI: World Development Indicator

Table 2: KPSS unit root test result

Critical values					
Series	LM-Stat	1%	5%	10%	Order of integration
RO	0.0779	0.2160	0.1460	0.1190	1 (1)
CLA	0.1448	0.2160	0.1460	0.1190	1 (1)
M2	0.2175	0.2160	0.1460	0.1190	1 (1)
INV	0.1066	0.2160	0.1460	0.1190	1 (1)
LAB	0.0532	0.2160	0.1460	0.1190	1 (1)
INF	0.0324	0.2160	0.1460	0.1190	1 (1)

Source: Author computations using EViews 9. KPSS: Kwiatkowski, Phillips, Schmidt, and Shin

of cointegration (r) is rejected at 5% significance level if the probability value does not exceed 5%. The cointegration test is reported in Table 4. A cursory look at Table 4 indicates the presence of long-run relationship (i.e. the variables are cointegrated). For instance, the Trace test and Maximum-Eigenvalue test both indicate the presence of 4 cointegration equation at 5%. Hence, the study concludes that using both tests, there is a presence of long-run relationship among the variables. Thus, the use of VECM approach becomes appropriate.

4.4.IRF

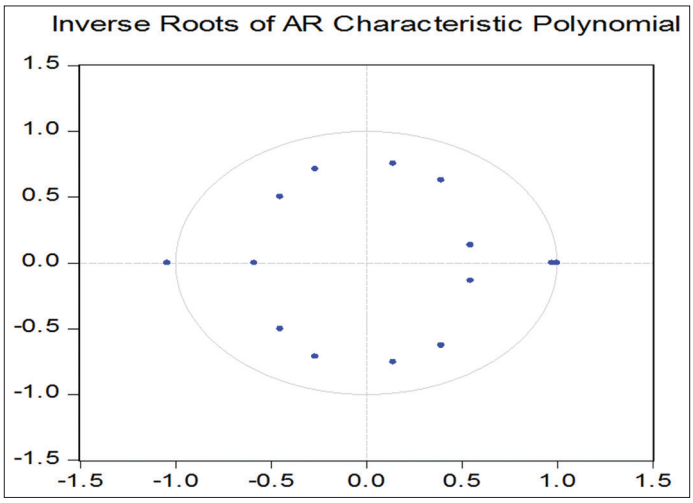
Figure 1 present the IRF. Panel A shows the response of RO to its own shock. The IRF result indicates that RO react positively to its own shock in all the period. Panel B shows the response of RO to shock in credit supply (CLA). The IRF outcome showed that a shock in credit supply will produce a positive response on RO. This implies that an increase in agricultural credit would leads to rise in the country's RO. Panel C depicts the response of RO to shock in money supply (M2). The IRF result revealed that from the initial period to the fourth period, a shock in money supply will affects RO negatively. However, from the fifth to the tenth period a shock in money supply will affects RO positively. Panel D shows the response of RO to shock in investment (INV). The IRF result indicates that a shock in investment will affects RO

negatively. Panel E shows the response of RO to shock in labour (LAB). The IRF outcome revealed that a shock in labour would affect RO negatively. Panel F shows the response of RO to a shock in inflation rate (INF). The IRF result indicates that a shock in inflation rate would have a positive response in RO.

4.5. VDC

Table 5 presents the result of the VDC of RO. The result revealed that credit supply (CLA) accounts for the major variation in RO. For instance, in period 3 credit supply accounts for 10.66% variation in RO compared to other economic variables. In period 6, credit supply accounts for 19.62% variation in RO compared to other economic variables. In period 10, credit supply accounts for 22.79% variation in RO compared to other economic variables.

Figure 2: Inverse root graph



Source: Authors' Computation and EViews 9 Output

4.6. Inverse Roots of AR

Figure 2 reports the inverse root graph. The study plotted the AR inverse root graph to establish the stability and reliability of the IRF and the robustness of the VECM model. The IRF and VDC are both stable and reliable if the polynomial roots falls within the unit circle. The outcome of the inverse roots graph indicates that the VECM model is stable and the IRF reliable since all the polynomial roots lies within the unit circle.

4.7. Diagnostic Result

Table 6 shows the outcome of the serial correlation test and the heteroscedasticity test. The serial correlation test and the heteroscedasticity test indicate that the model is free from serial correlation and heteroscedasticity. For instance, the P-values of the serial correlation LM-Stat is more than 5%. Hence, the null hypothesis of no serial correlation is accepted. Also, the P-value of the Chi-square in the case of heteroscedasticity is more than 5% which indicate that the model is free from heteroscedasticity.

4.8. Concluding Remarks

This study investigated the impact of agricultural credit on RO in Nigeria within the period 1981 to 2016 using the VECM approach.

Table 3: Determination of optimum lag criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−3581.090	NA	1.05e+87	217.3994	217.6715	217.4909
1	−3397.532	289.2425	1.42e+83	208.4565	210.3611	209.0973
2	−3333.132	78.06027*	3.21e+82*	206.7353*	210.2725*	207.9254*

*Indicates lag order selected by the criterion. Source: Author's Computation and EViews 9 Output

Table 4: Results of Johansen-Juselius Cointegration

Trace test			Maximum eigenvalue		
Null hypothesis	t-test	P value	Null hypothesis	t-test	P value
r=0*	170.8478	0.0000	r=0*	70.34637	0.0000
r≤1*	100.5014	0.0000	r≤1	35.63676	0.0305
r≤2*	64.86466	0.0006	r≤2	30.16353	0.0228
r≤3*	34.70114	0.0126	r≤3	24.48947	0.0162
r≤4	10.21166	0.2648	r≤4	7.906430	0.3883
r≤5	2.305231	0.1289	r≤5	2.305231	0.1289

*Indicates $P \leq 0.05$ and rejection of null hypothesis. Source: Author estimation using EViews 9

Table 5: VDC of RO

Periods	S.E.	RO	CLA	M2	INV	LAB	INF
1	397538.7	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	605386.7	68.84032	3.897930	15.29297	1.160471	0.101041	10.70726
3	795265.3	72.88331	10.66406	8.864115	0.799218	0.259526	6.529768
4	943094.1	70.59535	11.28207	7.038744	1.891486	0.858700	8.333655
5	1147300	66.49951	16.87283	7.359894	1.460323	0.602774	7.204662
6	1270475	63.25628	19.61792	6.857034	1.753077	1.629484	6.886208
7	1429664	61.56476	20.15418	10.05707	1.384445	1.326164	5.513375
8	1525942	60.55326	20.78537	9.721402	1.560813	2.009709	5.369445
9	1691307	57.94351	22.00376	12.70384	1.274721	1.661269	4.412906
10	1797029	56.44424	22.79416	12.88684	1.373961	2.301673	4.199129

VDC: Variance decomposition, Source: Authors' Computation and EViews 9 output. These figures show the VDC of CAB

Table 6: Diagnostic test

VEC residual serial correlation LM tests			VEC residual heteroskedasticity tests		
Lags	LM-Stat	P	Chi-square	df	P
1	44.07705	0.1670	572.4940	546	0.2092

Source: Authors' computation and EViews 9 output

The variables used in the study are RO, investment (INV), labour (LAB), credit supply (CLA), inflation rate (INF) and money supply (M2). Findings from the research revealed that the variables are cointegrated. The study further revealed that a rise in credit supply would lead to increase in RO. Also, the study indicated that a shock in investment, and labour would cause decline in RO while a shock in money supply and inflation rate would cause RO to rise in the country. In addition, the study showed that the major variation in RO is credit supply.

Based on the result of the study, it is recommended that government in partnership with deposit money banks should create a scheme that will provide an interest free loan to farmers that are involved in rice production, as these will motivate them as well as increase RO in Nigeria. Also, there is need for government to encourage rice farmers by supplying them farm inputs(which includes the provision of high yielding varieties, fertilizers, land, irrigation) at a subsidizes rate.

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