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Effects of Commercial Loan to Agriculture on Rice Yield Response in Nigeria from 1966 to 2015: An Application of Autoregressive Distributed Lag (ARDL) Approach

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Abstract

This study examined effects of commercial loan to agriculture (CLA) on rice yield response in Nigeria from 1966 to 2015. The Augmented-Dickey Fuller test was used to test the stationarity of the individual series and the Autoregressive Distributed Lags (ARDL), via bounds testing was used to estimate the short-run and long-run elasticities of rice yield. The empirical results revealed that effects of commercial loan to agriculture on rice yield in the short run was found to be elastic (0.19) and insignificant but it was elastic (0.29) and significant (5%) in the long-run, implying that rice yield was responsive to commercial loan to agriculture both in the short-run and long-run. It was therefore concluded that commercial loan to agriculture made intense impact on rice yield in the long-run. On this premise, it is recommended that commercial loan to agriculture be increased, because increasing it will certainly boost rice yield premised on farmer's ability to purchase all the necessary inputs needed for enhancing rice yield.

Keywords: Commercial Loan to Agriculture; Autoregressive distributed lags; Farmers

Abbreviations: CLA: Commercial Loan to Agriculture; ARDL: Autoregressive Distributed Lags; CBN: Central Bank of Nigeria; CACS: Commercial Agricultural Credit Scheme; NACB: Nigerian Agricultural and Cooperative Bank; ACGSF: Agricultural Credit Guarantee Scheme Fund; NIRSAL: Nigerian Incentive-based Risk Sharing for Agricultural Lending; NPC: National Population Commission; ADF: Augmented Dickey Fuller

Introduction

Nigerian agricultural sector is arguably the single sector with the largest producer of food for man, raw material for industry, main employer of labour and source of income to farmers to mention but a few. Several studies, Longtau, Bello, Ben-Chendo et al. [1-3] have identified Nigeria as the largest producer of rice in West Africa, and one of the most consumed staples in Nigeria, with consumption per capita of 32kg and reaching the highest production of 3.7 million tonnes in 2017 [4]. The impetus on rice draws strength from the fact that it is the staple food crop in Nigeria; as such its availability is critical to achieving the food security target. Despite this urgent need, the nation has been facing consistent shortages and inconsistencies as it is plagued by diverse challenges. Over time, rice yield in Nigeria has been fundamentally low, making rice production to be at its primitive stage. Longtau [1] attributed low rice yield in Nigeria to high cost of inputs, such as fertilizers, tractorisation, herbicides, insecticides, manual labour and transportation of produce, attributing this further to agronomical constraint. PWC [4], unveils that average rice yield in Nigeria has been consistent at 2 tonne per hectare, which is about half of the average achieved in Asia, adding that small scale farmers dominated rice production by 80% while 20% are commercial farmers with a low capacity (less than 300kg/ ha) and obsolete mills. This therefore implies that most of the farmers' apply conservative technology in rice production; as such the situation is not good enough considering the enormous population of Nigeria as a country. In the light of this, the need to improve technology becomes absolutely consequential if self-sufficiency in rice production is a target. Nyerere highlights factors necessary to surge rice yield as investment in rural infrastructure, human capacity, and technology, this will in no doubt make remarkable progress in rice yield by providing the basic necessity required to engender conducive environment for its production. USDA data has revealed progressive intense decline of rice yield in Nigeria. Idachaba [5], however, emphasized that the public policy in agriculture and rural development is characterized by a high degree of policy instability, frequent policy modifications and exasperating policy reversal. Longtau [1], attributes low productivity to farmers' field as a major challenge encountered by most countries of West Africa adding that Nigeria is yet to witness any significant improvement in rice yield.

Rice can thrive virtually in all ecological zones of Nigeria but vary in prospects from one location to the other. Following Food and Agriculture Organization statistics (FAOSTAT) [6], revelation, paddy rice production has been growing at a very slow rate relative to consumption in Nigeria within the last five years. Attributing this reduction in paddy production to a couple of factors namely, lack of improved seed varieties, poor agronomic and post-harvest handling practices.

Loan availability to farmers is critical to the sustenance of the agricultural sector in Nigeria. It is in line with this that the Federal Government, through various intervention programmes and policies established agricultural credit schemes so as to finance the sector. Central Bank of Nigeria (CBN) [7], avers that one of the major inputs identified over the years in the advancement of the agricultural sector, has been agricultural credit. Some of these agricultural credit schemes include Commercial Agricultural Credit Scheme (CACS), Nigerian Agricultural and Cooperative Bank (NACB), Agricultural Credit Guarantee Scheme Fund (ACGSF), and Nigerian Incentive-based Risk Sharing for Agricultural Lending (NIRSAL). One of the paradigms of commercial loan to agriculture is to give farmers opportunity to access credit facilities to enable the procurement of inputs and to carryout farm operations with relative ease.

The Federal Government has committed humongous amount of resources through this scheme to ensure agricultural sustainability in the country. Despite this record, it remains unclear whether this policy is effective in stimulating grain yield, especially rice. Hence, this study is aimed at analyzing the effects of commercial loan to agriculture on rice yield in Nigeria from the period 1966 to 2015.

As shown in Figure 1, Rice yield was at its peak in 1988 but decreased from 2.0tonnes/ha in 1989 to 1.3tonnes/ha in 2008.

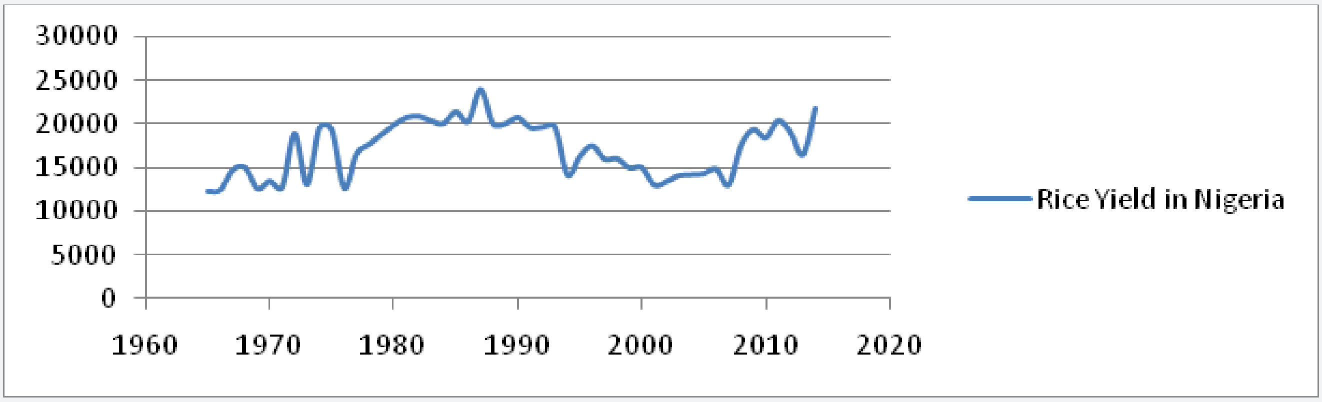

Figure 1: Trend of rice yield in Nigeria.

Literature Review

Theoretical framework

The theoretical framework for this study is underpinned on the concept of supply response in agricultural production. Supply response generally indicates the variation of agricultural output and increase mainly as a result of variation in price [8].

Studies [9-11] have acknowledged that supply response is strategic in agricultural development economics. This is because of its effect on aggregate responsiveness of agricultural output of agriculture's terms of trade. This alludes to Rao [12], who admits that aggregate data is a major underpinning in measuring supply response which forms a basis for policy formulation.

Autoregressive distributed Lag (ARDL): The empirical determination of the ARDL methodology involves three steps:

i. Identifying the order of integration of variables using the unit root tests;

ii. Testing for the existence of a unique co-integrating relationship using the bounds testing procedures; and

iii. Estimation of the ARDL to obtain the short-run and long-run coefficients.

Pesaran and Shin [13] comment that co-integrating systems can be estimated as ARDL models, with the advantage that the variables in the co-integrating relationship can be either I(0) or I(1), without needing to pre-specify which are I(0) or I(1), adding that unlike other methods of estimating cointegrating relationships, the ARDL representation does not require symmetry of lag lengths; each variable can have a different number of lag terms.

An ARDL is a least squares regression containing lags of the dependent and explanatory variables. ARDL is expressed as

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$(p, q_1 \ldots\ldots\ldots\ldots\ldots q_k)$,

where

p is the number of lags of the dependent variable,

q is the number of lags of the first explanatory variable, and

q_k is the number of lags of the k-th explanatory variable.

Review of related empirical studies

Copious studies have been carried out on yield response in Nigeria, Boansi [14], carried out a study on yield response of rice in Nigeria: Through the use of Johansen's Full Information Maximum Likelihood test estimated a yield response model for Nigeria using national level data for the period 1966-2008. The results indicate that in the long-run, yield of paddy rice is dependent on real producer price of rice, aggregate output of paddy observed and real producer price of maize. In the short-run however, observed yield is dependent on lagged yield, real producer price of rice, aggregate output of paddy rice, real producer price of maize, and the quantity of fertilizer used. A total of about 59.82% of variation in yields of paddy rice for Nigeria is explained by variables in the implicit yield response function specified in the current study. Approximately 26% of total deviations in yield from the long-run equilibrium are restored in the current period, and this restoration is found significant at the 5% level. Diagnostic tests conducted indicate that the residual series is normally distributed, non-serially correlated and homoscedastic.

Tanko et al. [15] examined the determinants of rice yield in Northern Region of Ghana, the Role of Policy. Applying the multivariate empirical regression model used to determine the parameters of the internal and external factors that influence rice yield. The results revealed that yield increased with producer price of rice and labour availability because of improvement in purchasing power and labour efficiency in farming activities. It was decreased with increasing harvested area and price of fertilizer due to fertility inadequacy in application and also increased with a rise in producer price of maize because of a shift in resource allocation in favour of maize production.

Haile et al. [16] examined worldwide acreage and yield response to international price change and volatility: A Dynamic Panel Data Analysis for Wheat, Rice, Corn, and Soybeans. Applying a newly-developed multi-country, crop-calendar-specific, seasonally disaggregated model with price changes and price volatility applied accordingly. The findings revealed that, although higher output prices serve as an incentive to improve global crop supply as expected, output price volatility acts as a disincentive. The simulation analysis shows that the increase in own-crop price volatility from 2006-2010 dampened yields by about 1-2% for the crops under consideration.

Rahji et al. [17] examined the response of rice supply to its demand in Nigeria for the period 1967-2004, applying the Nerlovian adjustment model to the Nigerian rice data set. The estimated trend equations showed that time had significant influence on output, area and yield of rice over the period and sub-periods at 1% level mostly. The results tend to imply that almost all growth in output has been due to increases in area cultivated to rice. The results also showed that for the entire period, area contributed 113% to output as against -7.4% by yield.

Methodology

Study area

This study was conducted in Nigeria. Nigeria lies between latitude 4° and 14° North of the equator and longitudes 3° and 14° East of the Greenwich Meridian. The country lies entirely within the tropical zone. It occupies about 923,773km^2 (made up of 909,890 square kilometers of land area and 13,879 square kilometers of water area). According to National Population Commission (NPC) [18], Nigeria's population was currently 182 million. To the north the country is bounded by the Niger Republic and Chad; in the west by the Benin Republic, in the East by the Cameroon Republic and to the south by the Atlantic Ocean [19]. The rainfall distribution ranges from a unimodal pattern of the Sudan, Sahel and the Northern Guinea with annual precipitation of 400-600mm to the bimodal pattern of the Southern Guinea with annual rain fall of 1100-1400mm [20].

Method of data collection

The data for this study relied on a comprehensive database covering the period 1966-2015. The empirical model uses country-level data to estimate yield response for rice in Nigeria. Time series data in respect of yields (tons/hectare), producer price of rice (Naira), producer price of wheat (Naira), producer price of maize (Naira) were sourced from Food and Agriculture Organization (FAO), weather variable (that is, rainfall (mm) were obtained from The World Bank., fertilizer consumption (kg), availability of labor (agricultural labor force as proxy, ("000") persons, were sourced from International Rice Research Institute (IRRI) and Commercial Loans to Agriculture was sourced from the Central Bank of Nigeria (CBN).

Estimation procedure

This study applied inferential statistics in the data analysis. Augmented Dickey Fuller (ADF) test was employed to determine whether or not the variables are stationary by detecting the presence of unit root. This is followed by the application of Autoregressive Distributed Lags (ADRL) to achieve the objective.

This study adopts Pesaran et al. [21] model to the bounds testing procedure by a general VAR in the order of p;

$$Q_t = \alpha + \beta_t + \sum_{i=1}^{p} \Pi Q_{t-1} + e \qquad 1$$

Where,

t is time = 1,2,3.....T

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Q is the dependent variable,

α is the vector of intercept

β is the coefficient of the trend

Π is the coefficient of the lagged form of the dependent variable Q

VECM. This is based on the assumption of a unique cointegrating relationship among the variables, the VECM is modeled as

$$\Delta Q_t = \alpha + \beta_t + \Pi Q_{t-1} + \delta X_{t-1} + \sum_{i=1}^{p} \varphi \Delta Q_{t-1} + \Sigma_{i=1}^{p-1} + \lozenge \Delta X_{t-1} + e_t \quad (2)$$

Where

δ and $\lozenge$ are the coefficients of lagged and differenced lag for of the explanatory variables X_i respectively and all the other parameters are previously defined.

Drawing from the above, the conditional VECM as specified for this study is

$$\Delta LnRY_t = \alpha + \omega_1 PPR_t + \omega_2 LnPPW_t + \omega_3 LnPPM_t + \omega_4 LnRO_t + \omega_5 LnRHA_t + \omega_6 LnRF_t$$
$$+\omega_7 LnRF_t + \omega_8 LnFconS_t + \Sigma_{i=1}^{q}.\lozenge_1 \Delta LnRO_{t-1} + \Sigma_{i=1}^{q}.\lozenge_2 \Delta LnRHA_{t-1} + \Sigma_{i=1}^{q}.\lozenge_3 \Delta LnPPR_{t-1}$$
$$+\Sigma_{i=1}^{q}.\lozenge_3 \Delta LnPPR_{t-1} + \Sigma_{i=1}^{q}.\lozenge_4 \Delta LnPPW_{i=1} + \Sigma_{i=1}^{q}.\lozenge_5 \Delta LnPPM_{t-1} + \Sigma_{i=1}^{q}.\lozenge_6 \Delta LnRF_{t-1}$$
$$+\Sigma_{i=1}^{q}.\lozenge_7 \Delta LnCLA_{t-1} + \Sigma_{i=1}^{q}.\lozenge_8 \Delta LnFconS_{t-1} + \Sigma_{i=1}^{q}.\lozenge_9 \Delta LnLAGR_{t-1} \quad (3)$$

Ω and $\lozenge_i$ are vectors of the long run multipliers and the short run dynamics coefficients respectively and Ln connotes the natural logarithm. RY is rice yield, PPR is producer price of rice, PPW is producer price of wheat, PPM is producer price of maize, RO is rice output, RHA is rice hectarage, RF is rainfall, CLA is commercial loan to agriculture, Fcons is fertilizer consumed.

The direction of the relationship between domestic rice yield response to its real price and other variables are determined by analyzing the null hypothesis of no cointegration through a joint significance test of the coefficient of lagged dependent variables. Under the null hypothesis of (no cointegration) $H_0 = \omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = \omega_6 = 0$ and the alternative hypothesis is

$$H_0 = \omega_1 \neq \omega_2 \neq \omega_3 \neq \omega_4 \neq \omega_5 \neq \omega_6 \neq 0$$

This was followed by conducting a bound test to initiate cointegration equation. The asymptotic distribution of F-statistic obtained from bound test is non-standard regardless of the degree of integration of the variables. The F ratio estimate in the hypothesis test was set as a standard and compared against the critical values tabulated on C111 of Paseran Shin and Smith [21] for a case of intercept without trend, i.e. K=8, Where K= number of regressors+1. The rule is if the F Ratio is less than the lower bound, the null hypothesis of no cointegration is not rejected. On the other hand, if the calculated F is greater than the upper bound, the null hypothesis of no cointegration is rejected. However, in a situation where the F ratio falls between the two bounds, such is declared inconclusive.

$$\Delta LnRY_t = \alpha + \omega_1 PPR_t + \alpha + \omega_2 LnPPW_t + \omega_3 LnPPM_t + \omega_4 LnRO_t + \omega_5 LnRHA_t$$
$$\omega_6 LnRF_t + \omega_7 LnRCLAN_t + \omega_8 LnFconS_t + \Sigma_{i=1}^{q}.\lozenge_1 \Delta LnRO_{t-1}$$
$$+\sum_{i=1}^{q}.\lozenge_2 \Delta LnRHA_{t-1} + \sum_{i=1}^{q}.\lozenge_3 \Delta LnPPR_{t-1} + \sum_{i=1}^{q}.\lozenge_3 \Delta LnPPR_{t-1} + \sum_{i=1}^{q}.\lozenge_4 \Delta LnPPW_{i=1}$$
$$+\sum_{i=1}^{q}.\lozenge_4 \Delta LnPPW_{i=1} + \sum_{i=1}^{q}.\lozenge_5 \Delta LnPPM_{t-1} + \sum_{i=1}^{q}.\lozenge_6 \Delta LnRF_{t-1} + \sum_{i=1}^{q}.\lozenge_7 \Delta LnCLAN_{t-1}$$
$$+\sum_{i=1}^{q}.\lozenge_7 \Delta LnCLAN_{t-1} + \sum_{i=1}^{q}.\lozenge_8 \Delta LnF3onS_{t-1} + \sum_{i=1}^{q}.\lozenge_9 \Delta LnCLAGR_{t-1} \lambda ECT_{t-1}$$

In a situation where the coefficients are the short-run or long-run dynamics elasticities of the model convergence to long run equilibrium, ECT_{t-1} is a one period lagged error correction term and λ is the speed of adjustment to attain equilibrium in the event of shock to the system. The study adopts the Cointegration and Long run form in the selection of the preferred ECM.

The outcome is now subjected to diverse diagnostic test, such as serial correlation LM Test, Breuche-Pagan-Godfrey heteroskedasticity Test, normality Test and structural stability (sensitivity analysis).

Results and Discussion

Unit root test of variables used in the analysis

The unit root test as presented in Table 1 shows that Rainfall (RF) is stable at level I(0). Producer Price of Rice (PPR), Producer Price of Wheat (PPW), Producer Price of Maize (PPM), Rice Hectarage (RHA), Rice Yield (RY), Commercial Loan to Agriculture (CLA), Fertilizer Consumed (FCONS) and Labour (LAGR) are integrated of order I(1). Thus the variables is a mixture of I(0) and I(1) variables. Based on this combination, the ARDL analytical technique was applied via the bounds testing approach to examine the short and long run effects.

The bounds testing result for co-integration of variables

The critical value for the case of unrestricted intercept and restricted trend for k=8 at 1% indicates lower bound I(0) = 2.79 and upper bound I(1) = 4.1. A lag of 1 for the dependent variables and a lag of 3 for the independent variables were selected. The F-Statistics of 8.84 when yield is used as dependent variable falls above the upper bound which is significant at 0.05% implying that the null hypothesis of no co-integration is rejected. It is concluded that there is co-integration among the variables when yield appears as dependent variable at 0.05%. Therefore, we cannot reject the existence of long-run relationship among variables. After establishing that there is co-integration in the model, the co-integration and long run form was employed to investigate the speed of adjustment and short run elasticity (Table 2).

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Effects of commercial loan to agriculture on short-run and long-run elasticities of rice yield in Nigeria

Table 1: Result for unit root test of variables.

Variable	ADF in Levels	ADF in First Difference	Integration Order
RO	-1.253729	-8.941832***	I(1)
PPR	-2.976775	-9.337294***	I(1)
RY	-1.713355	-11.06756***	I(1)
PPW	-2.526088	-6.620830***	I(1)
PPM	-1.988887	-10.88379***	I(1)
RHA	-1.093405	-9.915511***	I(1)
CLA	-1.254203	-10.40131***	I(1)
FCONS	-2.393449	-6.307241***	I(1)
RF	-6.006146***	-6.594163	I(0)
LAGR	-1.129439	-6.786790***	I(1)

Source: Author's computation- The unit root equation includes a constant and time trend for level series, but only includes a constant for first differenced series. *** P<.01, **P<.05, *P<.10 (one-tailed test) based on critical values for rejection of the hypothesis of a unit root by MacKinnon (1991).

Table 2: Bounds Testing Results for co-integration of yield variables.

Dependent variable	Yield
F-statistic	8.837622**
I0 Bound	2.79
I1 Bound	4.1

Source: Authors' Computation and EViews 9 Output.

Note: the estimates are significant at **5%

Producer price of rice was positive and significant at 10% with elasticity of 0.3424, implying that 1% increase in rice yield will increase producer price of rice by 0.3% in the short run. The implication is that the farmers where able to meet the cost of certain vital inputs essential to improve yield and increase output. This is an indication that producer price of rice is responsive to rice yield in the short run. This is similar to the estimates obtained by Boansi [14], in a study in Nigeria, with a short run coefficient of 0.600, implying that a unit increase in the producer price of rice led to 0.6% to increase in rice yield.

The estimated coefficient of producer price of maize is negative and significant at 5%. The result indicates that a unit increase in producer price of maize will decrease rice yield by 0.4805. This implies that maize is a close substitute to rice yield in the short run, such that resource allocation tends to favour maize in the period when producer price of maize is increasing and producer price of rice appears to be static or declining. In situation like this farmers tend to give preference to the production of maize rather than rice. In a similar study in Nigeria Boansi [14], obtained a decrease in yield estimate of 0.248 in the short run.

Rice hectarage was positive and insignificant to rice yield in the short run. This reveals that increase in hectarage signals increase in yield in the short run. The implication is that more hectarage is needed to increase and attain the required rice yield. This outcome varies with Boansi [14] who carried out a similar study in Cote d' ivoire, result showed that that rice yield was negative and significant, where a unit increase in rice yield led to a decrease 0.574 of hectarage. Similarly, in another study by Boansi [14], in Nigeria, obtained a significant rice hectarage at 10% level coefficient of -0.261, implying that a 1% increase in area harvested of rice led to a 0.261% decrease in yield, adding that increasing area harvested of rice which in essence is believed to pave way for exploitation of economies of scale and serves as a platform for mechanizing rice production, increasing area cultivated without completing it with other vital inputs of production like fertilizer, pesticides and adequate supply of water among other factors, would results in the observed adverse effect by virtue of induced competition on the plants for the limited resources available in the soil. This in the long-run leads to sub-optimal yields and a subsequent decrease in output if fertility measures are ignored for longer periods (Table 3).

Commercial loan to agriculture was elastic (0.1903) but not significant in the short run. This implies that commercial loan to agriculture impacted positively on rice yield. This is reflected in the purchase and cultivation of high yielding variety as occasioned by the availability of loan. The result resonates with Boansi [14], which reveals that increasing government support to farmers is observed to have beneficial effects on yield of rice in Nigeria, adding that it enables farmers to access adequate amounts of such vital inputs of production for cropping. Ability of farmers to access and properly use sufficient amounts of vital subsidized inputs of production, would lead to the obvious significant positive effects on yield. The null hypothesis that there is no relationship between commercial loan to agriculture and rice yield in the short run in Nigeria is not rejected following the non-significance.

Rainfall was positive and insignificant in the short run, implying that rainfall impact on rice yield in the short run. This implied that rainfall contributed positive to increase in yield. Ogazi [22] commented that rainfall is a major factor that affect rice yield, throughout the production period and as many times

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the crop is harvested in the sub-Saharan Africa countries. The implication is that, in as much as rice farmers respond to prices, such exogenous variables such as rainfall and other salient factors do have a daunting influence on yield. Similarly, Rahji and Adewumi [17], observed that increases in yield of local rice thus tend to be influenced more by weather than technology. Estimated long run result shows that producer price of rice was significant at 1% with elasticity of 0.6619; this shows that yield response to producer price of rice is positive which implies that 1% increase in producer price of rice will lead to a 0.66% increase in rice yield in the long run; increase in rice yield will increase producer price of rice. This is considered good and beneficial to the rice fa rmers as it demonstrates the prospect of the rice sector and the cultivation of high yielding variety. This outcome resonates with Boansi [14], which shows that a unit increase in producer price of rice leads to a 0.611% increase in yield in the long-run, revealing that with cost of vital inputs in the country reported to be high, increasing the farm gate price of rice, increases the financial base of rice farmers as well as their purchasing power. This ensures relatively effective covering and meeting of the cost of vital inputs of production.

Table 3: Long and Short-run elasticities of rice yield response in Nigeria, 1966-2016.

Variable	Coefficient	Std. Error	t-Statistic
D(LOGPPR)	0.342*	0.117	2.919
D(LOGPPR(-1))	-0.312	0.151	-2.068
D(LOGPPW)	0.114	0.067	1.722
D(LOGPPW(-1))	-0.076	0.06	-1.265
D(LOGPPM)	-0.481**	0.143	-3.367
D(LOGPPM(-1))	0.512**	0.152	3.371
D(LOGPPM(-2))	0.308*	0.099	3.097
D(LOGRHA)	0.145	0.147	0.986
D(LOGRHA(-1))	-0.471*	0.154	-3.068
D(LOGRHA(-2))	0.151	0.11	1.364
D(LOGCLAN)	0.19	0.093	2.055
D(LOGCLAN(-1))	-0.244	0.106	-2.31
D(LOGFCONS)	0.064	0.081	0.785
D(LOGFCONS(-1))	0.305	0.113	2.711
D(LOGRF)	0.214	0.24	0.891
D(LOGRF(-1))	0.205	0.223	0.919
D(LOGRF(-2))	0.46	0.254	1.809
D(LOGLAGR)	1.136	1.016	1.118
D(LOGLAGR(-1))	0.534	0.972	0.55
D(LOGLAGR(-2))	-1.298	0.71	-1.828
ECM(-1)	1.364***	0.17	-8.039
Long Run Coefficients			
Variable	Coefficient	Std. Error	t-Statistic
LOGPPR	0.662***	0.15	4.418
LOGPPW	0.142	0.075	1.902
LOGPPM	1.384***	0.229	-6.055
LOGRHA	0.388**	0.103	3.763
LOGCLAN	0.289**	0.074	3.908
LOGFCONS	-0.200*	0.068	-2.936
LOGRF	-0.6	0.314	-1.91
LOGLAGR	1.861	0.805	2.312
C	-8.233	8.57	-0.961
R-squared	0.872	Mean dependent var	0.008
Adjusted R-squared	0.653	S.D. dependent var	0.162
S.E. of regression	0.096	Akaike info criterion	-1.591
Sum squared resid	0.156	Schwarz criterion	-0.41
Log likelihood	67.393	Hannan-Quinn criter.	-1.147
F-statistic	3.986	Durbin-Watson stat	2.284
Prob(F-statistic)	0.002		

Source: Compiled from result print out of E-Views 9 Output.

Note: All variables are lagged. The dependent variable is also lagged. Dependent variable is yield of rice planted in hectare; the estimates are significant at *=10%, ** = 5%, and *** = 1%, respectively. Where-Rice output is (RO), Rice Hectarage is (RHA), Producer Price of Rice is (PPR), Producer Price of Wheat is (PPW), Producer Price of Maize is (PPM), Rainfall is (RF), Commercial Loan to Agriculture is (CLA), Fertilizer Consumed is (FCONS), Rice Yield is (RY) and Labour is (LAGR).

Producer price of maize is negative and highly significant at 1% (Table 3). This shows that a 1% increase in producer price of maize will reduce rice yield by 1.4% in the long run. This suggests that resources will be diverted to maize production relative to rice production leading to fall in rice yield. This is premised on the fact that maize is a close substitute to rice. This result is in consonance to Boansi [14], where rice yield decreases by 0.5% in the long run for a unit increase in the producer price of maize. Attributing this to influences from resource reallocation in favor of maize production in times of increasing prices for maize and stagnation or decline in that for rice. The results indicate that rice hectarage was significant at 5%, with elasticity of 0.3875 to rice yield, which implies that a 1% increase in rice hectarage will lead to a 0.39 % increase in rice yield in the long run.

This result indicates that the rice yield of the farmers increases with increase in farm rice hectarage occasioned by the application of the right input mix as well as cultivating high yielding variety. The result contradicts a study by Boansi [14], who found rice hectarage to have a high significant (1%) inverse relationship with rice yield. A unit increase in rice yield led to a decrease of rice hectarage by 0.860 in the long run.

Commercial loan to agriculture was positive and significant at 5%. This shows an elasticity of 0.288712, implying that a 1% increase in commercial loan to agriculture, increases rice yield

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by 0.3% in the long run. This reveals that commercial loan to agriculture has contributed considerably to rice yield in Nigeria and has been consistent. Thus, the null hypothesis that there is no relationship between commercial loan to agriculture and rice yield in the long run in Nigeria is rejected following its significance at 1%. According to Boansi [23], whether it is positive or negative (and significant or not) usually depends on the extent to which one effect supersedes the other and to how consistent the measure is, adding that noted problem with yield for Nigeria is inconsistency. Ahmed [24], emphasized that increase in government credit program will surge agricultural supply.

Fertilizer consumed was negative (-0.2002) and statistically significant at 10% in the long run. This implies that fertilizer has not contributed significantly to rice yield. The estimate revealed that a 1% increase in fertilizer consumed will decrease yield by 0.2%. This could be attributed to high cost of fertilizer and could only be purchased by a few. This result is contrary to Boansi [23], who obtained a coefficient of 0.005 that is insignificant, attributing the coefficient to reflect general inefficiency in use of fertilizer in Nigeria as quantity of fertilizer used leads to inelastic changes in yields in both the long and short-run regardless of the significant response in the short-run (where most inputs of production are deemed constant). This result is in sync with a study by Haile et al. [16], that doubling of international fertilizer price indices brings about 1% to 7% reduction in crop productivity.

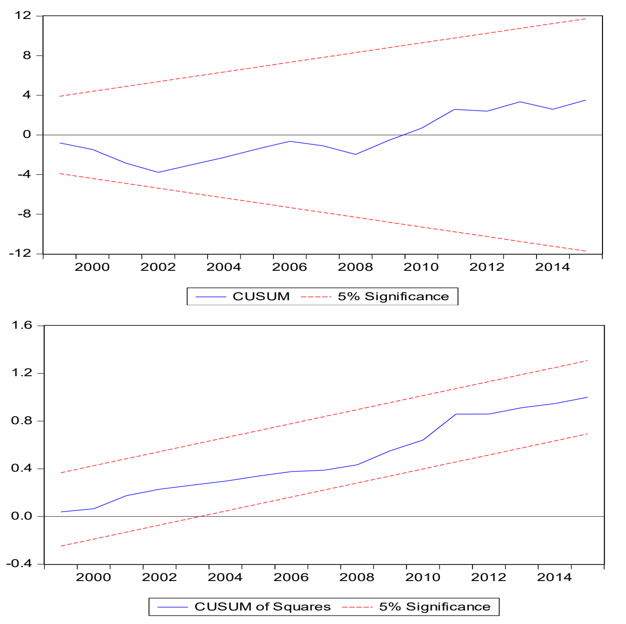

Figure 2: CUSUM Test for short and long run elasticities of rice yield Fig. 4: CUSUMSQ Test for short and long run elasticities of rice yield.

The bounds testing outcome of the cointegrated ARDL is (1, 2, 2, 3, 3, 2, 2, 3, 3). All the diagnostic tests for serial correlation, heteroskedasticity, normality and structural stability (sensitivity analysis) are considered in this study and the results show that the model passed all the diagnostic tests. R^2 value of 0.87 indicated that 87% of the changes in yield were explained by the explanatory variables included in the model. The adjusted R^2 of 0.65 or 65% suggested that the explanatory variable were robust in explaining the variation in agricultural production and was a good fit. F ratio was statistical significance at 1% level of error. The stability of the short and long run model was tested using cumulative sum (cusum) (Figure 2) and cumulative sum of square (cusum square) plots (Figure 2). The result revealed the clarity of the stability of the model as the residuals are within the 5% bound and because they are located between the two up and down straight lines, hence indicating the stability of the long run coefficients in the model.

The residual which is the error correction term is significant at 1% and has the expected negative sign. It measures the adjustment to equilibrium. According to Bannerjee et al. as cited in the highly significant error correction term further confirms the existence of a stable long run relationship. The negative sign on the error correction term indicates that adjustments are made towards restoring long run equilibrium [25,26].

Conclusion and Recommendations

The results revealed that producer price of rice was positive and highly significant both in the long and short run. Implying that increase in yield increased the producer income. Rice yield was not responsive to producer price of maize both in the short and long run. The implication is that maize is a close substitute to rice which means that resources will be diverted to maize production relative to rice production leading to fall in rice output if the price is good and vice. Rice yield was not responsive to rice hectarage in the short run but becomes responsive in the long run. The long run elasticity is consistently larger than the short run elasticity. The result seems to suggest that even when sufficient time for adjustment is allowed, hectarage planted will increase over time. Commercial loan to agriculture was elastic both in the short and long run, but was significant only in the long run. This analysis shows that commercial loan to agriculture made positive impact on yield which was reflected in purchase and cultivation of high yielding variety. Fertilizer consumed was positive and insignificant in the short run but negative and significant in the long run. This implies that producers did not have access to the required quantity of fertilizer in the long run. The null hypothesis that there is no relationship between commercial loan to agriculture and rice yield in the long run in Nigeria is rejected following its significance at 5%. It was therefore recommended that government should increase the amount of loan and encourage farmers by constantly and consistently providing high yielding variety that will increase yield. In addition, government should enact policy that will ensure that the input is highly subsidized and should be made available to the farmers at the right time and required quantity.

References

1. Longtau SR (2003) Multi-Agency Partnerships for Technical Change in West African Agriculture: Nigerian Case Study Report on Rice Production. National Bureau of Statistics (NBS).

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2. Bello A (2004) Nigeria Imported $US700 million rice in 2003: Federal Minister of Agric. And Rural Development, Tribune Newspaper.

3. Ben-Chendo GN, Lawal N, Osuji MN (2017) Cost and Returns of Paddy Rice Production in Kaduna State. European Journal of Agriculture and forestry Research 5(3): 41-48.

4. Price Waterhouse Coopers (PWC) (2017) Boosting rice production through increased mechanization.

5. Idachaba FS (2013) Agricultural Economist as a Preacher. Essay in Policy Advocacy on Nigerian Agriculture, Rural Development and Food Security 2: 2013.

6. Food and Agriculture Organization statistics (FAOSTAT) (2012) Towards 2030/2050 for Food, Nutrition, Agriculture and Major Commodity Group.

7. Central Bank of Nigeria (2005) Central Bank of Nigeria Statistical Bulletin. 16.

8. Olayide SO, Heady EO (1982) Introduction to Agricultural Production Economics. Ibadan University Press, Ibadan, Nigeria, 89. Third National Fadama Development Project (Fadama III) 9(3): 567-574.

9. Diao X, Hazell P, Thurlow J (2010) The role of agriculture in African development. World Development 38(10): 1375-1383.

10. Brooks J, Secretariat OECD (2010) Agricultural Policy Choices in Developing Countries: A Synthesis. Working Party on Agricultural Policy and Markets, Reference: TAD/CA/APM/WP, p. 41.

11. Sarris A (2001) The role of agriculture in economic development and poverty reduction: an empirical and conceptual foundation. The rural development department The World Bank.

12. Rao JM (1989) Agricultural supply response: A survey. Agricultural Economics 3(1): 1-22.

13. Pesaran MH, Shin Y (1998) An autoregressive distributed-lag modelling approach to cointegration analysis. Econometric Society Monographs 31: 371-413.

14. Boansi D (2013) Output supply and yield response of rice in Nigeria: implications for future rice policy. Corvinus University of Budapest, Hungary.

15. Tanko M, Iddrisu A, Alidu AF (2015) Determinants of Rice Yield in Northern Region of Ghana, the Role of Policy. Asian Journal of Agricultural Extension, Economics & Sociology 9(2): 1-11.

16. Haile MG, Kalkuhl M, Von Braun J (2015) Worldwide Acreage and Yield Response to International Price Change and Volatility: A Dynamic Panel Data Analysis for Wheat, Rice, Corn, and Soybeans. American Journal of Agricultural Economics pp. 139-165.

17. Rahji M, Adewunmi MO (2008) Market Supply response and Demand for local rice in Nigeria: Implications for self-sufficiency Policy. J Cent Eur Agric World Bank, Third National Fadama Development Project (Fadama III) 9(3): 567-574.

18. National Population Commission (NPC) (2016) Nigerian Population now 182 million. Vanguard Media Limited, Nigeria.

19. Aregheore EM (2005) Country pasture/forage resource profiles: Nigeria. Food and Agriculture Organization of the United Nations.

20. Food, and Agriculture Organization (FAO) (1996) The world sorghum and millet economies: fact, trends and outlook (W1808/E). FAO Document Repository.

21. Pesaran MH, Shin Y, Smith RJ (2001) Bounds testing approaches to the analysis of level relationship. Journal of Applied Economics 16: 289-326.

22. Ogazi CG (2009) Rice output supply response to the changes in real prices in Nigeria: An autoregressive distributed lag model approach. Journal of Sustainable Development in Africa 11(4): 83-100.

23. Boansi D (2014) Yield response of rice in Nigeria: A co-integration analysis. American Journal of Agriculture and Forestry, 2(2): 15-24.

24. Ahmed M (2007) The effects of AKRSP's micro-credit programme on agriculture and enterprise development in district Astore Northen areas implication for poverty alleviation. M.sc (Hons) Thesis, Depat of Agric Econ Agric Univ Peshawar, Pakistan.

25. Adesina A (2013) Rice consumption and importation in Nigeria, no solution in sight. Vanguard Media Limited, Nigeria.

26. Borrero A, Ramos M, Arsenal A, Lopez, K, Hettel G (2007) Linking users to public goods via open access. First Monday, Scholarly Publishing Initiatives at the International Rice Research Institute 12(10).

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