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Analysis of Agricultural Policies on Rice production In Nigeria (1991-2024): An Autoregressive Distributed Lag (ARDL) Model

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Abstract

This study examines the effects of agricultural policies on rice production in Nigeria from 1991 to 2024, a period characterized by significant shifts in food security strategies and import regulations. Utilizing the Autoregressive Distributed Lag (ARDL) modeling approach, the research investigates the short- and long-run relationships between rice output and major policy-driven variables, including credit to agriculture, annual budgetary allocations, agrochemical utilization, and a policy dummy representing periods of rice import bans. Data were sourced from the Food and Agriculture Organization (FAO), the Central Bank of Nigeria (CBN) and the National Bureau of Statistics (NBS). The empirical results reveal a policy paradox within the sector. In the short run, rice production is highly responsive to government interventions, with the Error Correction Model (ECM**)** indicating a rapid adjustment rate of 65% toward equilibrium following economic shocks. Specifically, government expenditure and import restrictions provided significant immediate boosts to domestic output. However, the long-run estimates present a different narrative: agricultural credit and annual budgetary allocations were found to have a negative correlation with production over time. This suggests that while financial injections spark initial growth, their long-term impact is undermined by systemic inefficiencies, such as credit misallocation, leakages in budget implementation, and structural bottlenecks. Conversely, the consistent use of agrochemicals and inputs emerged as a stable driver of long-term yield growth. The study concludes that Nigeria's reliance on protectionist measures like import bans has effectively incentivized local farming but has not yet addressed the underlying productivity gaps. Policy recommendations focus on shifting from cash-based lending to input-based credit systems, enhancing budgetary transparency through digital tracking and transitioning from total market protection toward input subsidies that lower production costs.

Keywords: Agricultural policy; Rice production; Nigeria; ARDL

1. Introduction

Agriculture is defined broadly as the set of activities that use land and other natural resources to produce food, fibre, and animal products for direct consumption (self-consumption) or for sale, either as food or as input to the manufacturing industry (Ahmed *et al.*, 2021). Agriculture encompasses the activities that utilise land and other natural resources to produce food, fibre, and animal products for direct consumption or for sale, either as food or as raw material for manufacturing (Ahmed *et al.*, 2021). Agricultural policy refers to the framework of laws, regulations, and programmes instituted by governments to regulate domestic agricultural production and imports of foreign agricultural products, with the aim of achieving desired outcomes in the agricultural sector. In Nigeria, agricultural policies are primarily designed to increase productivity and competitiveness, enhance food security and safety, and foster long-term economic development (Owolabi *et al*., 2016; Pawlak & Kołodziejczak, 2020). These policies are particularly significant for staple cereals such as rice and maize, which are critical for national food security and contribute substantially to farmers' incomes and the overall economy.

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A key example of Nigeria's agricultural policy is the ban on rice and other food imports, implemented as part of a broader strategy to encourage domestic production, reduce reliance on foreign supplies, and promote self-sufficiency in staple food crops (Akande *et al*., 2019; Onwuka *et al*., 2021). The policy was designed to stimulate crop production by creating incentives for farmers, such as access to improved seeds, subsidised inputs, and better credit facilities, thereby generating employment, increasing rural incomes, and contributing to national food security (Ike & Eze, 2020). Rice is one of the most widely consumed cereals in Nigeria, forming the backbone of household food consumption and dietary energy supply (FAO, 2020). They are closely linked in terms of food demand because they serve as complementary staples in Nigerian diets; for instance, rice remains a primary staple for many households (Olajide *et al.*, 2021). Consequently, fluctuations in the production or availability of one cereal can directly affect the consumption patterns, market prices, and demand for the other, highlighting the interdependence of these crops in both production and consumption spheres.

Understanding how agricultural policies particularly import bans affect the production of rice is critical for assessing policy effectiveness, ensuring food security, and guiding future interventions in Nigeria's cereal sector. Cereal crops, particularly rice and maize constitute the major source of food for Nigeria's large and growing population, playing a critical role in ensuring national food security (FAO, 2020). Despite their importance, cereal production in Nigeria remains highly dependent on climatic conditions, availability of inputs, access to markets, and the presence of enabling government policies (Olayemi & Adegboye, 2018). Historical evidence from the period following Nigeria's independence to the present indicates that numerous agricultural policies have been formulated with the aim of boosting food production, including cereal crops; however, production trends have remained volatile due to inconsistent policy implementation, resource constraints, and other structural challenges (Akande *et al.*, 2019).

More recently, the advent of the Buhari administration brought significant policy interventions, including the ban on rice and other food imports, aimed at stimulating domestic production and reducing reliance on foreign supplies. While this policy has created incentives for local production, it has also influenced production dynamics across other cereals, affecting farmers' allocation of resources and the overall supply of staple foods (Ike & Eze, 2020). In response, the federal government has introduced measures such as the Anchor Borrower Programme, alongside substantial financial injections and the creation of an enabling environment, to further boost rice production and support to farmers (Onwuka *et al*., 2021).

Given these developments, there is a need to empirically assess the impact of government policies and interventions on cereal production in Nigeria. Specifically, modelling rice production using the Autoregressive Distributed Lag (ARDL) approach can provide insights into both short- and long-term relationships between policy measures, input availability, climatic factors, and production outcomes. Such an analysis is critical for guiding future policy decisions, ensuring sustainable cereal production, and strengthening food security in Nigeria. The autoregressive distributed lag (ARDL) model, proposed by Pesaran *et al*. (2001), allows the determination of long-run relationships among economic time series irrespective of whether the variables are I(0) or I(1). This flexibility has made ARDL a widely used tool in agricultural production research. Recent applications include studies on crop production and climate impacts, such as the ARDL analysis of climate and productivity factors on cassava yields in Nigeria (Ibrahim & Adeyemi, 2025), which found significant short- and long-run effects of climatic variables and inputs on cassava output. Empirical evidence from Nigeria also shows that agricultural financing mechanisms significantly influence agricultural output dynamics using ARDL models (Aigbovo & Edohen, 2025; Gana *et al*., 2024). Therefore, this study was organized to find the short and long-run effects of agricultural policies on rice production in Nigeria using the ARDL model.

2. Data collection and methodology

2.1. Sources of Data

This study uses important policy factors that are responsible for affecting the cereal crops in Nigeria specifically rice and maize. Previous studies by Gana *et al.* (2024), Aigbovo & Edohen (2025) and Ibrahim & Adeyemi (2025) Stated that policy tools such as annual budget, agricultural credit, input utilization and food import/export affects cereal crop production in Nigeria. Hence the study jointly used credit to agriculture, agrochemical usage (Nitrogen fertilizer used and pesticides) and annual budget as explanatory variables and rice production is used as explained variables. The annual data covering the period between 1991 to 2024 were gathered from Food and Agriculture Organization (FAO) database, Central Bank of Nigeria (CBN) and National Bureau for Statistics (NBS). The study emphasizes of Agricultural Policy on Nigeria in the model which hugely affects domestic rice crop production. The data were converted into log form before applying the ARDL test

Table 1 Variable Description and Data Sources

Variables	Description	Measurement units	Source
Rpro	Rice production in Nigeria	Tonnes	FAOSTAT (2025)
Cagric	Credit to agriculture in Nigeria	Naira	FAOSTAT (2025)
Agro	Nitrogen fertilizer and pesticides used for crop production activities in Nigeria	Tonnes	FAOSTAT (2025)
Abud	Nigeria annual budget	Naira	CBN (2025)
D	Dummy variables for agricultural policy	D=1, during ban of rice crop importation, otherwise 0	

3. Methodology

This study applied the well-established autoregressive distributed lag (ARDL) model developed by Pesaran *et al.* (2001). The ARDL model is considered superior to other econometric techniques when the variables are either stationary at level I(0) or integrated of order I(1). In line with the objectives of the study, the ARDL approach is more appropriate than alternative models for capturing both the short-run and long-run effects of the explanatory variables on rice production. To find the relationship between dependent and independent variables, the following model was constructed as:

$$Rpro_t=\alpha_0+\alpha_1 Cagric_t+\alpha_2 Abud_t+\alpha_3 Agro_t+\alpha_4 D+\varepsilon_t \quad (1)$$

By converting all variable of equation (1) into the natural log, the model is designed below:

$$lnRpro_t=\alpha_0+\alpha_1 lnCagric_t+\alpha_2 lnAbud_t+\alpha_3 lnAgro_t+\alpha_4 D+\varepsilon_t \quad (2)$$

Where:

Rpro represents rice production, t represents the time period from 1991-2024, α_0 represent the constant time while α_1-α_4 are the coefficient of the variables credit to agriculture (Cagric), Annual budget (Abud), Agrochemical used (Agro) and policy dummy variable (D) (dummy =1 represents years of ban of rice importation in Nigeria during the study year while dummy=0 represents period of intense rice importation) while ε_t represents the error term. Equation (2) can be written in ARDL form as follows:

$$\Delta lnRprot_t=\alpha_0+\sum_{i=1}^{p}\alpha_1 \Delta lnRpro_{t-i}+\sum_{j=0}^{q1}\beta j\Delta lnCagric_{t-j}+\sum_{k=0}^{q2}\gamma k\Delta lnAbud_{t-k}+\sum_{l=0}^{q3}\delta l\Delta lnAgro_{t-l}+\theta D_{t-1}+\varepsilon_t \quad (3)$$

Where α0 represents drift component while Δ shows the first difference, εt shows the white noise. After optimal lag length selection criteria, the long-run association existing between variables were determined and the study uses the error correction model (ECM) to find the short-run dynamics. The ECM general from of equation (3) is formulated in equation (4):

$$\Delta lnRprot_t=\alpha_0+\sum_{i=1}^{p}\alpha_1 \Delta lnRpro_{t-i}+\sum_{j=0}^{q1}\beta j\Delta lnCagric_{t-j}+\sum_{k=0}^{q2}\gamma k\Delta lnAbud_{t-k}+\sum_{l=0}^{q3}\delta l\Delta lnAgro_{t-l}+\theta D_{t-1}+\Theta ECM_{t-1}+\varepsilon_t \quad (4)$$

Where Δ represent the first difference while Θ is the coefficient of ECM for short-run dynamics after a shock in the short run

3.1. CUSUM and CUSUMSQ test

After confirming the existence of long-run relationships among the variables, the study employed the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests, as proposed by Brown *et al.* (1975), to examine the stability of the ARDL model. Previous studies (Pesaran & Shin, 1999; Pesaran *et al*., 2001) have shown that these tests are effective in assessing the goodness of fit and parameter stability of the ARDL framework. The tests were applied to the residuals of the error correction model (ECM). When the plotted statistics remain within the 5% critical bounds, the results indicate that the estimated coefficients of the ARDL model are stable over the study period

4. Results and discussions

4.1. Descriptive Statistics

Table 2 Descriptive Statistics of the Variables Used

Variables	Mean	Std. Dev	Min	Max	Skewness	Kurtosis	Jarque-Bera	Prob.	Obs
Rpro	5056527	2314104	242700	9129908	0.1130	0.0009	10.95	0.0042	34
Cagric	9468878	1.22e+07	31300	4.79e+07	0.0002	0.0098	15.47	0.004	34
Agro	241955.4	142757.2	79844.19	648896.9	0.0085	0.3195	7.06	0.0293	34
Abud	18.16471	12.78093	1.5	47.3	0.4335	0.1299	3.16	0.0522	34
D	0.4117647	0.4995542	0	1	0.3325	0.0000	-	0.000	34

Note: The results are taken before data transformation using logarithm, Rpro, Cagric, Agro, Abud & D represents rice production, credit to agriculture, agrochemical use and period of ban in rice importation from 1991-2020

The descriptive statistics in Table 2 for the variables used in this study show important characteristics of rice production and related agricultural policy variables in Nigeria from 1991 to 2024. The mean rice production (Rpro) was approximately 5,056,527 tonnes, with a standard deviation of 2,314,104 tonnes, indicating considerable variation in production levels over the study period. The minimum and maximum production were 242,700 and 9,129,908 tonnes, respectively, while the skewness (0.113) and kurtosis (0.0009) values suggest that the distribution of rice production is nearly symmetric and close to normal. However, the Jarque-Bera test (10.95, p = 0.0042) indicates that the series is statistically non-normal.

Credit to agriculture (Cagric) averaged about 9,468,878 billion naira, with a high standard deviation of 12,200,000 billion naira, reflecting substantial fluctuations in agricultural financing. The variable is approximately symmetric (skewness ≈ 0) but displays some deviation from normality (Jarque-Bera = 15.47, p = 0.004).

Agrochemical use (Agro) had a mean of 241,955 tonnes, with a minimum of 79,844 tonnes and a maximum of 648,897 tonnes. The low skewness (0.0085) suggests a roughly symmetric distribution, but the kurtosis (0.3195) and Jarque-Bera test (7.06, p = 0.0293) indicate a mild departure from normality.

The annual budget (Abud) averaged 18.16 billion naira, with a standard deviation of 12.78 billion, showing wide variation in government expenditure over time. Its distribution is moderately positively skewed (0.434) and slightly platykurtic (0.13), with the Jarque-Bera test (3.16, p = 0.0522) suggesting near-normality.

Finally, the dummy variable (D) representing the period of rice importation ban has a mean of 0.412, indicating that import bans occurred in approximately 41% of the observed years. Its distribution is slightly skewed (0.33), as expected for a binary variable.

4.2. Trend line for the Variables

The trend analysis of rice production in Nigeria from 1991 to 2024 in Figure 1 shows a clear long-run upward movement, as indicated by both the actual series (Rpro) and the fitted trend line. In the early 1990s, rice production remained relatively low and exhibited mild fluctuations, reflecting instability in output during this period. From the late 1990s to the mid-2000s, production increased gradually but with noticeable short-term variations, which may be associated with policy inconsistencies, climatic conditions, and changes in input availability. A more pronounced rise in rice production is observed from around 2010 onwards. This period is characterised by a sharp and sustained increase in output, indicating improved performance of the rice sector. The acceleration in production coincides with intensified agricultural policy interventions, including import restrictions, input subsidy programmes, and increased support for domestic rice production.

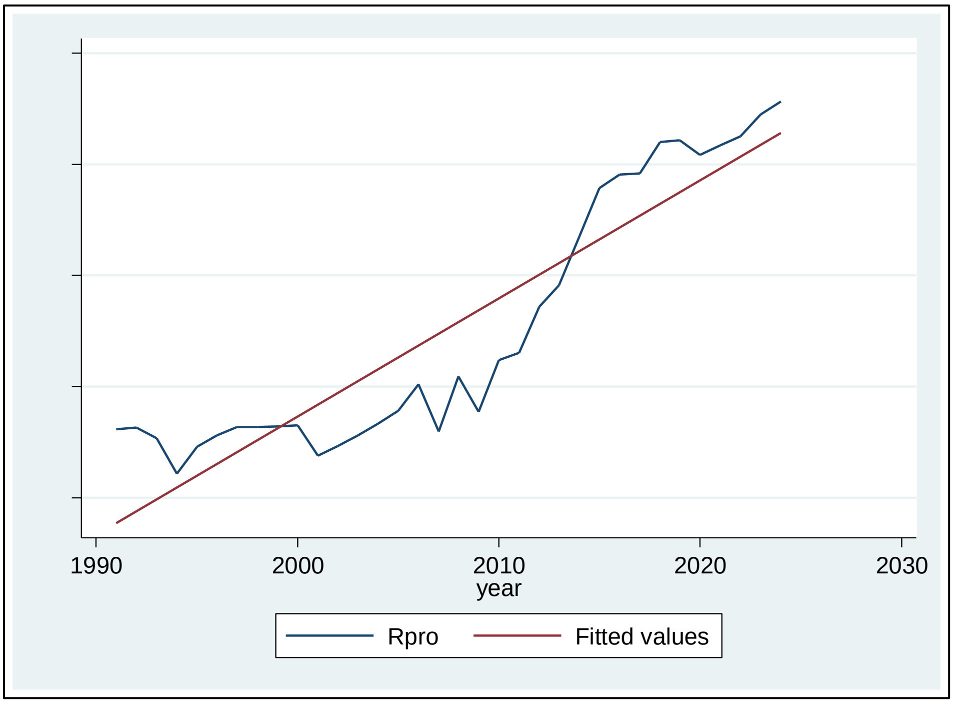


Figure 1 Trend of rice production of Nigeria (1991-2024)

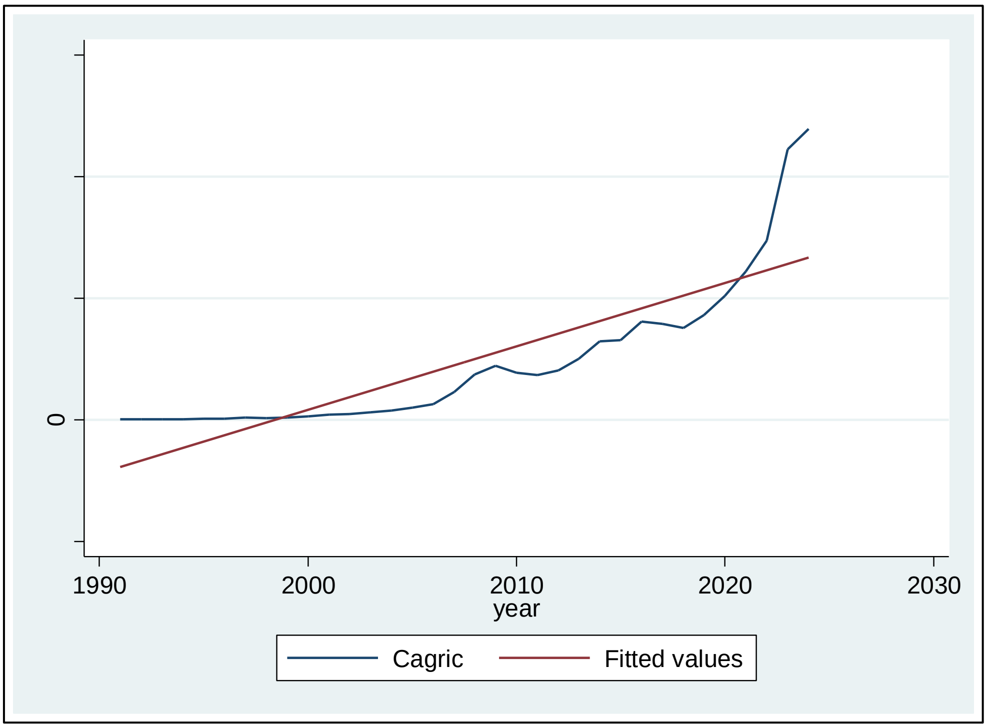


Figure 2 Trend of Credit to Agriculture of Nigeria (1991-2024)

The trend of credit to agriculture in Nigeria from 1991 to 2024 in Figure 2 reveals a strong positive long-run movement, as shown by the upward-sloping fitted trend line. This indicates a sustained expansion in the volume of financial resources channelled to the agricultural sector over the period under review. In the early 1990s, credit to agriculture remained very low and almost stagnant, reflecting limited access to formal financing and weak institutional support for the sector. From the late 1990s to the mid-2000s, a gradual increase is observed, although the growth was modest and accompanied by slight fluctuations, suggesting cautious lending behaviour by financial institutions. A more noticeable rise in agricultural credit occurs from around 2008 onwards, with intermittent short-run variations. This improvement may be linked to policy initiatives aimed at boosting agricultural financing, such as specialised credit schemes, interest rate interventions, and increased involvement of deposit money banks in agricultural lending. From about 2020 to 2024, the graph shows a sharp and accelerated increase in credit to agriculture, indicating a significant scale-up of funding to the sector. This period coincides with heightened government efforts to stimulate domestic food production, address food insecurity, and reduce import dependence.

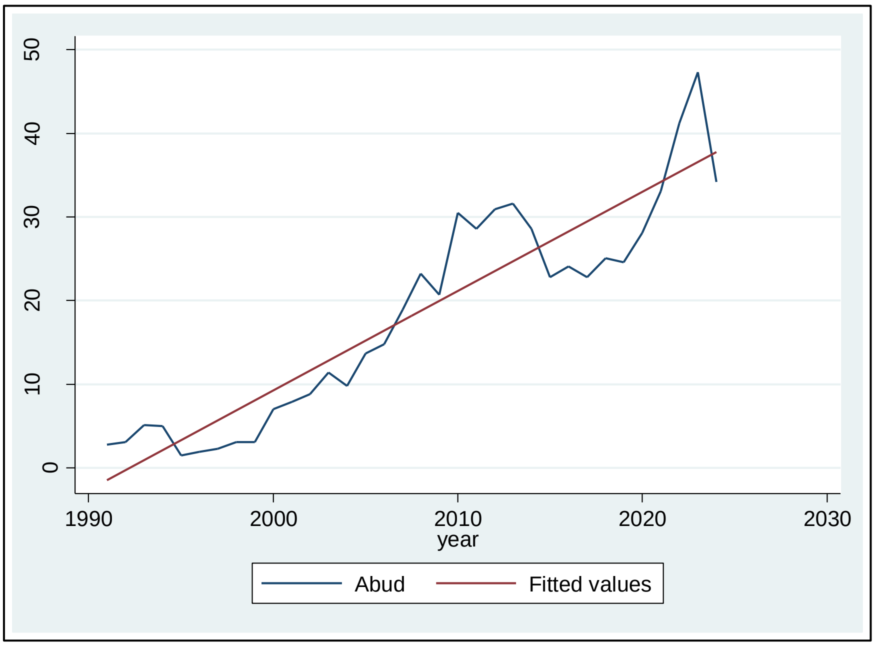


Figure 3 Trend of Annual budget of Nigeria (1991-2024)

The trend of Nigeria's annual budget from 1991 to 2024 in Figure 3 shows a clear and sustained upward movement, as indicated by the positively sloped fitted trend line, reflecting a long-term expansion in government expenditure. In the early 1990s, the annual budget was relatively low, averaging about ₦2-₦5 trillion, indicating limited fiscal space and modest government spending. By the late 1990s and early 2000s, the budget increased gradually to about ₦7–₦10 trillion, suggesting improved revenue mobilisation and expanding public sector activities. From around 2008 to 2012, the budget rose more sharply, reaching approximately ₦28–₦32 trillion. However, this period was characterised by noticeable fluctuations, with the budget declining to about ₦23–₦25 trillion between 2014 and 2016, possibly due to revenue shocks and macroeconomic challenges. A renewed upward trend is observed from 2017 onwards. The annual budget increased steadily, surpassing ₦30 trillion by 2020 and rising sharply to a peak of about ₦45–₦47 trillion around 2023. In 2024, a slight decline is observed, with the budget estimated at about ₦35–₦38 trillion, though it remains significantly higher than earlier periods.

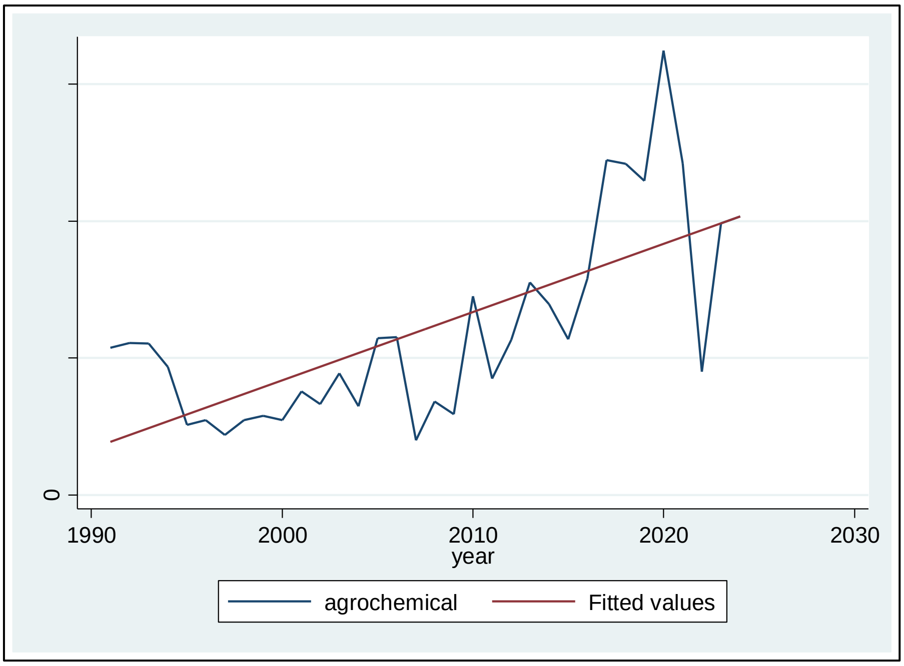


Figure 4 Trend of agrochemical used of Nigeria (1991-2024)

Based on the fitted trend line in the figure 4, agrochemical use in Nigeria shows a steady increase from about 80,000 tonnes in 1991 to roughly 100,000–120,000 tonnes by 1995, rising further to around 150,000 tonnes in 2000. The trend line indicates continued growth to approximately 200,000 tonnes in 2005, about 250,000–270,000 tonnes in 2010, and close to 300,000 tonnes by 2012. From this point, the upward trend becomes steeper, reaching about 330,000 tonnes in 2015, around 360,000–380,000 tonnes in 2018, and approximately 400,000 tonnes by 2020. Despite short-term shocks visible in the actual series, the fitted values continue to rise, reaching about 420,000 tonnes in 2022 and approximately 440,000–450,000 tonnes by 2024.

4.3. Unit Root Test

To check the integration order of each variable, the study incorporates the Augumented Dickey Fuller (ADF) and Phillips-Perron (PP) Unit root test.

Table 3 Unit root test

	ADF					**PP**			
	Level		1st difference		Level		1st difference		Order of integration
Variable	Test statistic	p-value	Test statistic	p-value	Test statistic	P-value	Test statistic	p-value	I(1)
LnRpro	0.428	0.9825NS	-3.555	0.0067***	0.221	0.9734NS	-8.040	0.000***	I(1)
LnCagric	-2.356	0.1545NS	-3.567	0.0064***	-2.462	0.1251NS	-5.273	0.000***	I(1)
Lnagro	-1.573	0.5151NS	-6.344	0.000***	-1.923	0.3213NS	-7.093	0.000***	I(1)
LnAbud	-1.161	0.6901NS	-4.415	0.0003***	-1.216	0.6665NS	-5.783	0.000***	I(1)
D	-2.180	0.2137NS	-4.059	0.0011***	-2.437	0.1316NS	-6.767	0.000***	I(1)

Note: NS=not significant, ***=significant at 1% level

The results of the unit root tests in Table 3 based on the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) procedures indicate that all the variables are non-stationary at levels but become stationary after first differencing. Specifically, the ADF and PP test statistics at levels for LnRpro, LnCagric, lnagro, LnAbud, and D are statistically insignificant, as their p-values exceed the 5 per cent level, implying the presence of unit roots. However, at first difference, both tests produce statistically significant test statistics for all variables, with p-values less than 0.05, leading to the rejection of the null hypothesis of a unit root. This confirms that all the series are integrated of order one, I(1). The mixture of non-stationarity at levels and stationarity at first difference justifies the application of the Autoregressive Distributed Lag (ARDL) modelling approach for analysing the long-run and short-run relationships among the variables.

4.4. Lag Selection Criteria

Table 4 Lag selection criteria using

Lag	LL	LR	DF	P	FPE	AIC	HOIC	SBIC
0	-80.0952	NA	NA	NA	0.0001677	5.49001	5.56541	5.7213
1	29.0471	218.28	25	0.000	7.5E-07	0.061476	0.513841	1.44921*
2	51.9235	45.753	25	0.007	9.9E-07	0.198481	1.02782	2.74265
3	99.4346	95.022*	25	0.000	3.4E-07*	-1.25384*	-0.047537*	2.44677

*=Represents the criterion selecting the lag order. LL, LR, DF, P, FPE, AIC, HOIC and SBIC represents log-likelihood, likelihood ratio, Final Prediction Error, Akaike Information Criterion, Hannan–Quinn Information Criterion, Hannan–Quinn Information Criterion and Schwarz Bayesian Information Criterion.

Table 4 presents the results of the lag length selection criteria for the model. The log-likelihood (LL) values increase as the lag length rises, indicating improved model fit with additional lags. The sequential likelihood ratio (LR) test suggests that lag 3 is optimal, as it is statistically significant at the 5 per cent level. This is further supported by the Final Prediction Error (FPE), Akaike Information Criterion (AIC), and Hannan–Quinn Information Criterion (HQIC), all of which attain their minimum values at lag 3, as indicated by the asterisks. Although the Schwarz Bayesian Information Criterion (SBIC) selects lag 1 as the optimal lag, the majority of the criteria favour lag 3. Therefore, lag 3 is selected as the optimal lag length for the ARDL model, ensuring a better balance between goodness of fit and model efficiency.

Table 5 ARDL bound test for Cointegration

Equation	Lag	F-statistic	P-value
Logrpro= f(logcagric logabud logagro d)	(3 1 1 1 1)	54.13	0.000***
Critical value	10%	5%	1%
Lower bound I(0)	2.723	3.376	5.028
Upper bound I(10	4.126	5.010	7.229

***= significant at 1% level

Table 5 shows the results of the ARDL bounds test for cointegration for the estimated model. The computed F-statistic of 54.13 is statistically significant at the 1 per cent level and is far greater than the upper bound critical values at the 10 per cent (4.126), 5 per cent (5.010), and 1 per cent (7.229) significance levels. This leads to the rejection of the null hypothesis of no long-run relationship among the variables. Consequently, the results confirm the existence of a stable long-run cointegrating relationship between rice production (Logrpro) and the explanatory variables, namely credit to agriculture (logcagric), annual budget (logabud), agricultural output (logagro), and the policy dummy (d).

Table 6 Johanson cointegration estimation

Hypothesis	Test statistics	5% critical value
Trace Statistics		
r≤0	140.4606	68.52
r≤1	65.3033	47.21
r≤2	36.9696	29.68
r≤3	18.5823	15.41
r≤4	5.4536	3.76

r≤5	NA	NA
Maximum statistics		
r≤0	75.1571	33.46
r≤1	28.3337	27.07
r≤2	18.3872	20.98
r≤3	13.1287	14.07
r≤4	5.4536	3.76
r≤5	NA	NA

Table 6 reports the Johansen cointegration test results based on the trace and maximum eigenvalue statistics. The trace statistics indicate that the null hypotheses of no cointegration (r ≤ 0), at most one (r ≤ 1), two (r ≤ 2), three (r ≤ 3), and four (r ≤ 4) cointegrating relationships are all rejected at the 5 per cent significance level, as the corresponding test statistics exceed their critical values. Similarly, the maximum eigenvalue statistics reject the null hypotheses of r ≤ 0, r ≤ 1, and r ≤ 4, since the test statistics are greater than the 5 per cent critical values, while the null hypotheses of r ≤ 2 and r ≤ 3 are not rejected. Overall, the results provide strong evidence of the existence of multiple cointegrating relationships among the variables, confirming a stable long-run equilibrium relationship between rice production and the explanatory variables in the model.

4.5. Short and Long-Run Estimation of Parameters

Table 7 Long-run estimation of parameters from ARDL model

Variable	Coefficient	Std. Error	Z-stat	Prob.
Lncagric	-0.22	0.08	-2.75	0.0121**
Lnabud	-0.25	0.09	-2.78	0.0131**
Lnagro	0.52	0.12	4.33	0.0010***
D	-0.02	0.01	-2.00	0.0500**

*** & ** represent significance at 1% & 5% levels.

The long-run ARDL estimates in Table 7 indicate that agricultural credit, annual budget, agricultural output, and the policy dummy have statistically significant effects on rice production in Nigeria. Credit to agriculture (Lncagric) has a negative and significant coefficient (−0.22), implying that a 1% increase in agricultural credit is associated with a 0.22 per cent decrease in rice production in the long run, possibly reflecting inefficiencies, misallocation, or delays in the effective utilisation of credit. Similarly, the annual budget (Lnabud) exerts a negative and significant effect (−0.25), suggesting that increases in government budgetary allocations do not automatically translate into higher rice output, which may be due to weak implementation, leakages, or spending priorities not directly targeted at rice production. In contrast, agricultural output (Lnagro) shows a positive and highly significant relationship with rice production, as a 1 per cent increase in overall agricultural output leads to a 0.52% increase in rice production, highlighting the importance of broader agricultural sector performance. The policy dummy (D) is negative and weakly significant, indicating that the policy period is associated with a slight reduction in rice production in the long run.

Table 8 Short Run Estimation

Variable	Coefficient	Std. Error	Z-stat	Prob.
Lncagric	4.1651	1.4700	2.83	0.045**
Lnabud	-10.4561	3.1164	-3.36	0.001***
Lnagro	-10.4271	4.9504	-2.11	0.012**
D	40.7022	4.4809	9.08	0.000***

ECM(-1)	-0.6521	0.1892	-3.4466	0.000***

*** & ** represents significance at 1% and 5% levels.

The short-run ARDL results in Table 8 show that rice production in Nigeria responds positively to government agricultural expenditure but negatively to increases in agricultural labour/input costs and agrochemical use. Specifically, a 1% increase in government expenditure raises rice output by about 4.17%, while higher labour or input costs and agrochemical use reduce production by roughly 10% each in the short run. The dummy variable has a significant positive effect, suggesting that certain policy interventions or favourable conditions boost rice production. The error correction term is negative and significant, indicating that about 65% of any deviation from the long-run equilibrium is corrected within the next period, showing a relatively fast adjustment towards stability.

4.6. Diagnostic Testing

Table 9 Diagnostic Testing

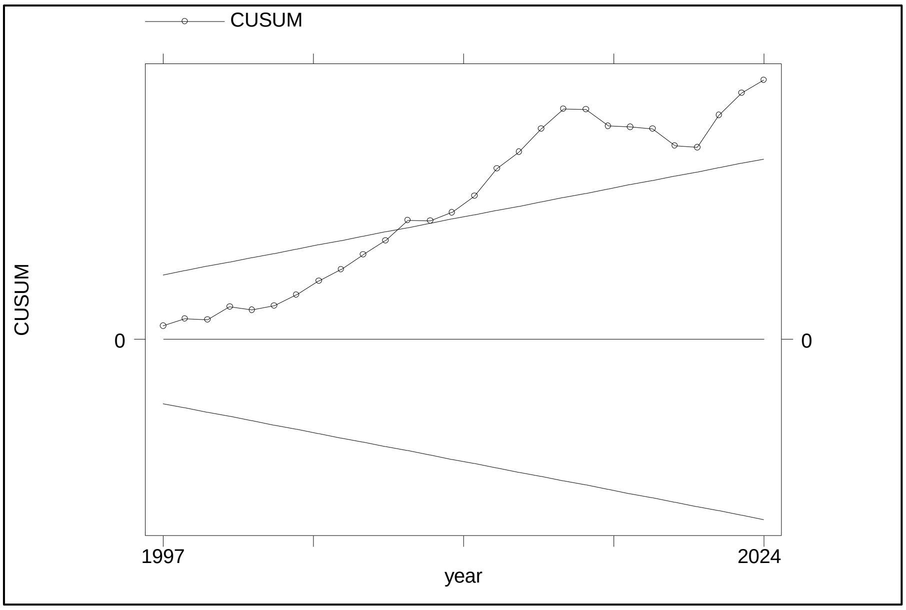
R-square	**0.736**
Adjusted R-square	0.698
Durbin-Watson Statistic	1.851
Chi2 Ramsey Reset	1.241(0.548)
Chi2 ARCH	0.921(0.486)
Chi2 B-G	0.421(0.626)
Chi2 Normality	2.212(0.201)
Chi2 SC	0.365(0.745)

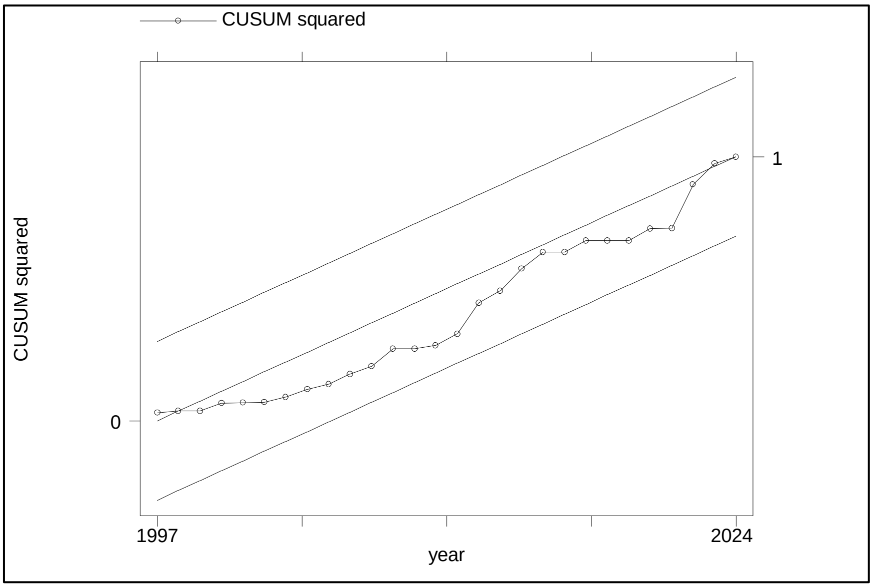
The diagnostic test results indicate that the model is statistically sound and well specified. The R-square of 0.736 and adjusted R-square of 0.698 suggest that about 70–74% of the variation in the dependent variable is explained by the model, indicating a good fit. The Durbin–Watson statistic of 1.851 is close to 2, implying the absence of serious autocorrelation in the residuals. The Ramsey RESET test (χ^2 = 1.241, p = 0.548) shows no evidence of model misspecification. The ARCH test (χ^2 = 0.921, p = 0.486) confirms the absence of heteroskedasticity, while the Breusch–Godfrey test (χ^2 = 0.421, p = 0.626) further supports the absence of serial correlation. In addition, the normality test (χ^2 = 2.212, p = 0.201) indicates that the residuals are normally distributed, and the stability condition (χ^2 = 0.365, p = 0.745) confirms parameter stability over the sample period.

4.7. Stability Check

The CUSUM of squares (CUSUMSQ) stability test indicates that the estimated model is stable over the sample period. As shown in the graph in Figure 5, the CUSUMSQ plot remains entirely within the 5% critical bounds throughout the period from 1997 to 2024. This implies that there is no evidence of sudden or systematic changes in the variance of the residuals, and hence no structural instability in the model parameters. Although the CUSUMSQ line shows a gradual upward movement, it does not cross the upper or lower critical limits, suggesting that any fluctuations in the model are within acceptable statistical limits.

CUSUM sq





Source: authors' estimates from data 1991–2024.

Figure 5 Plot of CUSUM and CUSUMSQ for coefficients' stability of ARDL model

5. Conclusion and Recommendations

The study concludes that Nigeria's journey toward rice self-sufficiency is characterized by a high level of responsiveness to immediate government action, yet it lacks a foundation for long-term sustainability. While agricultural policies and import restrictions have successfully shifted the country away from a reliance on foreign grain, the gains remain fragile. The findings reveal a significant disconnects: financial injections and budgetary allocations provide a strong initial spark for production, but they fail to maintain that momentum over time. This suggests that the current system is efficient at mobilizing farmers in the short term but is plagued by structural inefficiencies such as poor fund implementation and resource misallocation that erode progress in the long run. It was therefore recommended that:

- Government should transition from cash-based lending to an input-credit model that provides farmers with seeds and fertilizers directly to prevent fund diversion and ensure credit is used strictly for productivity;
- Federal and State authorities must implement digital tracking systems for agricultural spending to eliminate administrative leakages and ensure public funds effectively reach the farm level; and

- Policy focus should shift from permanent import bans toward utilizing tariff revenues to subsidize modern agrochemicals and equipment, allowing local rice to become naturally competitive through lower production costs and higher yields.

Compliance with ethical standards

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Disclosure of conflict of interest

The author declares no conflict of interest.

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