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Impact of Agricultural Financing Mechanisms on Agricultural Output in Nigeria: Evidence from ARDL Modelling (2009–2023)

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Abstract: The relationship between agricultural financing and agricultural output in Nigeria was investigated to provide empirical insights into the efficacy of funding mechanisms in driving agricultural productivity. Government expenditure on agriculture (GOVXA), commercial bank loans to agriculture (CBLA), and disbursements under the Agricultural Credit Guarantee Scheme Fund (ACGSF) were employed as proxies for agricultural financing, while agricultural gross domestic product (AGDP) served as a proxy for agricultural output. Using quarterly data spanning from the first quarter of 2009 to the fourth quarter of 2023, the Autoregressive Distributed Lag (ARDL) model was estimated to capture both the short-run and long-run dynamics of the relationship. The analysis was conducted using EViews 9.0. The empirical findings revealed that among the financing instruments, only CBLA exerted a statistically significant and positive effect on agricultural output in both the short and long term. In contrast, neither GOVXA nor the ACGSF disbursements exhibited a significant impact on agricultural productivity during the study period. Furthermore, the inclusion of annual rainfall as a control variable indicated a robust positive effect on agricultural output, underscoring the sensitivity of Nigerian agriculture to climatic conditions. These findings suggest that while multiple funding mechanisms exist, the effectiveness of such instruments varies considerably. It is implied that the institutional efficiency and direct credit channeling associated with commercial bank lending may render it more impactful compared to broader fiscal allocations or credit guarantee schemes, which often suffer from bureaucratic inefficiencies and implementation gaps. Policy recommendations include the expansion of commercial bank lending to the agricultural sector, alongside strengthened regulatory oversight to ensure the proper utilisation of funds for productive agricultural activities. Furthermore, improvements in credit delivery mechanisms under government schemes are essential to enhance their effectiveness. A more climate-resilient approach to agricultural policy is also advocated, given the significant influence of rainfall variability on output levels.

Keywords: Agricultural output; Agricultural financing; Commercial bank loans to agriculture (CBLA); Government expenditure on agriculture (GOVXA); Agricultural Credit Guarantee Scheme Fund (ACGSF); Autoregressive Distributed Lag (ARDL) model; Nigeria

1. Introduction

As the sector with the greatest employment, agriculture continues to be the key to economic growth (Phillip et al., 2009). The premise behind the government's policy is that boosting agriculture will hasten economic growth. Consequently, finance is a crucial tool for acquiring all of the industry-wide equipment required for automated production. Therefore, Finance is an essential instrument for obtaining all of the sector-wide tools necessary for mechanized manufacturing.

The agriculture sector contributes to the economy by producing fundamental raw materials, feeding the population, creating a large number of employments, and producing foreign exchange. Agriculture provides markets for industrial raw resources and ensures economic security and stability. Nigeria's GDP is largely derived from agriculture, as noted by Rahji & Fakayode (2009) and Anyanwu (1997). However, their impact is negligible because there aren't many credit options available for fundraising (Odoemenem & Obinne, 2010), and Duong & Izumida (2002) believed that there was a complex relationship between agricultural output and financing.

Agriculture is the main revenue stream for a sizable section of Nigeria's people, who reside in rural areas. Financial barriers in this sector are still common. Small-scale farmers are unable to increase their output because agricultural finance is still expensive and unfairly distributed. In 2002, Nyoro asserts that poor liquidity and a lack of working capital restrict a farmer's capacity to buy inputs that increase output, such as seeds, fertilizer, and pesticides. This was corroborated by Awudu and Huffman, Kimbaara, who claimed that producers with formal credit had better average levels of production efficiency.

Therefore, agricultural finance breaks the cycle of poverty among farmers, increasing output and raising standards of life. The relationship between funding and agricultural output has been the subject of numerous studies. However, prior studies that looked at how agricultural finance affects agricultural productivity have shown conflicting results. For instance, researches like – Lawal (2011), Mbutor et al. (2013), Egwu (2016), Aina & Omojola (2017), Tiamiyu et al. (2017), Shobande et al. (2018), Medugu et al. (2019), Marafa (2021), Abdulrafiu & Christopher Dabo (2022) and Akpan & Akpanabah (2022), all found that agricultural financing exerts significant positive effect on agricultural output, but other studies also came up with contrary findings that agricultural financing exerts significant negative affect on agricultural output (Matthew & Mordecai, 2016; Igyo et al., 2016; Okwuchukwu, 2022). Other empirical studies, such as that by Ademola et al. (2013) and Mafimisebi et al. (2006) also revealed that agricultural financing does not affect agricultural output. These different findings could be attributed to differences in variables used, techniques in measurement of variables, scopes adopted, and differences in estimation techniques employed in their studies. All these may have led to the mixed findings. These empirical studies' conflicting and ambiguous nature leaves room for additional research in this area.

Furthermore, agricultural financing's impact on Nigerian agricultural output must be re-estimated using quarterly data and the method known as ARDL, as previous research relied on annual data, which are low-frequency data. Consequently, this study uses quarterly data to investigate how agricultural financing affects Nigerian agricultural output, as opposed to earlier research that used annual data. Examining the relationship between Nigerian agricultural output and agricultural financing is the primary objective of this research. Particular goals are to:

- Analyze how the Fund of the Agricultural Credit Guarantee Scheme affects Nigerian agricultural output;
- Evaluate the effect of commercial bank loans to Nigerian agriculture on the nation's agricultural output;
- Ascertain the link between government spending on agriculture and Nigerian agricultural output.

2. Review of Literature

2.1 Conceptual Review

2.1.1 Agricultural output

Agricultural output, given in monetary terms, is the total value of agricultural produce, less the value of intermediate inputs from the agricultural sector. The phrase "final output" refers to this sum, which includes both cash and non-monetary transactions (such as barter, trade, and self-consumption). It is distinct from agricultural GDP in that the value of non-agricultural inputs is not deducted (Nomor & Udele, 2024). The primary indicator of the productivity of specific crops and livestock is agricultural output. Both the amount and the quality of agricultural products and goods made by a country, area, or farm over a specified amount of time are referred to as agricultural output in this study. Economic expansion, food security, and general well-being all depend on the agricultural sector's performance and productivity, which is reflected in this production. It is calculated as the proportion of a nation's total GDP that comes from agriculture, which includes the value of agricultural products and associated activities.

2.1.2 Agricultural financing

Sales of agricultural products (including trade between agricultural entities), inventory changes, products for personal consumption, output meant for additional processing by agricultural producers, and internal consumption of livestock feed products are some of the components that make up agricultural output (Eburajolo & Aisien, 2019). The term "agriculture finance" refers to a variety of money allocated to support Nigerian farmers and enhance the socioeconomic well-being of the populace. It consists of government funding as well as non-governmental organizations that promote social, economic, and sectoral empowerment (Mbelu & Ifionu, 2022). Similarly, Adejumo & Bolarinwa (2017) proposed agricultural finance schemes as a component of financial agreements established by all levels of government to help farmers obtain funding and always increase agricultural output. Below is a discussion of the agricultural financing methods that were taken into consideration in this study.

The fund of the ACGSF was established by Decree No. 20 in 1987, and it started operating in April 1978. It started out with N85.6 million in paid-up capital and N100 million in share capital. The Federal Ministry of Finance owns 60% of the stock, while the Central Bank of Nigeria (CBN) owns 40% (Central Bank of Nigeria., 2019). N3 billion in March 2001 and N50 billion in March 2019 were the scheme's capital bases, as required by the Agricultural Credit Guarantee Scheme Amendment Act. The Fund guarantees up to 75% of the default amount on bank credit facilities given to farmers, net of any realized security. The daily operations and money management of the scheme are overseen by the CBN (CBN, 2019).

Commercial Bank Loan to Agricultural Sector: The total sum of money lent to an individual by banks or businesses is referred to as bank credit. Muftau (2003) found that although the agricultural industry's share of the nation's GDP is still relatively small, commercial bank advances to the sector have been increasing since 1981. As per Efobi & Osabuohien (2011), the impact of commercial bank loans to the agricultural sector was minimal in comparison to the total amount of funds available to commercial banks. Other schemes revealed by Nwosu et al. (2010) include the establishment of the Nigerian Agricultural Cooperative and Rural Development Bank, rural banking, river basin authorities, agricultural development projects in all states of the federation between 1972 and 1980, crop loans, loans secured by warehouse receipts, agricultural term loans, land development schemes, capital stock loans, farm mechanization schemes, minor irrigation schemes, and land purchase.

Government Spending on Agriculture: GOVXA is the sum of money that the government gives to the agricultural sector in an attempt to boost output and productivity and encourage economic growth. Additionally, government spending on agriculture includes all of the costs incurred by the government for the sector, such as for policies and programs, grants and subsidies to farmers, pest control, inspection, irrigation and drainage systems, crop inspection, agriculture extension, etc. (FMARD, 2003). One of the best methods for the government to boost agricultural output and raise incomes, decrease poverty and food insecurity, and promote environmental sustainability is by boosting government spending on agriculture (FAO, 2020). In 2022, government agricultural expenditure encompasses the financial resources allocated and spent by governments on various agricultural projects, programs, and initiatives as pointed out by Ukpong et al.

2.2. Theoretical Review

Structural Change Theory: Following Lewis Arthur's formulation of the Structural Change Theory in 1954, the term "development with an unending supply of labor" has been used ever since. According to the economic theory in question, an economy is made up of two separate sectors. Businesses fall into two different categories: both the modern (capitalist, industrial, or manufacturing) and traditional (agricultural or subsistence) sectors. Consequently, the two-sector model was created. This paper makes the case that economic growth also depends on the two sectors' development, even if the expansion of both sectors is required for an economy to expand. The formula is Y = f (AGRIC, IND), where IND stands for industry, AGRIC for agricultural, and Y for economic development. Agriculture and industry are so interdependent that it is impossible to think about one without the other. While the industrial sector exports completed items and provides labor to the farm sector, the agricultural sector also provides capital inputs and absorbs products from the industrial sector. Since no money can be made without a hypothesis, The purpose of this study is crucial to the expansion of the agriculture sector. Supporting agricultural projects is essential for their successful implementation. If these projects receive adequate financing, agricultural output will increase, contributing to economic growth. Without accompanying structural changes that increase output, other approaches or changes are probably going to be harmful or ineffectual.

Keynesian Theory of Public Expenditure: In 1936, John Maynard Keynes put forth the Keynesian theory of governmental spending. Government spending, notably in the agricultural sector, is thought to promote sectoral growth (Keynes, 1936). Consequently, it is anticipated that a rise in government expenditures will enhance investment, production, employment, and profitability through aggregate demand multiplier effects. According to Ewubare & Eyitope (2015), who cited Keynes (1936), public spending is an exogenous component that can be used as a tool for policy to boost production growth.

Schumpeter Theory of Finance and Growth: According to Schumpeter (1934) theory of finance and growth, the financial system promotes output growth by distributing savings, fostering innovation, and providing capital for profitable economic ventures**.** Furthermore, in 1997, it claims that by promoting entrepreneurship specialization and the adoption of new technologies, credit market funds are crucial for bolstering output development by Greenwood and Smith. Therefore, the growth of the credit and stock markets both contribute to the increase of a country's output. Based on the theories that have been studied, the notion of a direct nexus between the growth of agricultural output and credit markets is well supported by the theoretical models.

2.3 Empirical Review

Lawal (2011) employed vector autoregression to look at how much is spent on agriculture overall by the federal government for the period 1979 to 2007. The results demonstrated that spending by the government does not exhibit a consistent trend. and that government support for the agriculture sector is closely related to the sector's GDP contribution. Ademola et al. (2013) also looked at the relationship between government spending on agriculture and economic growth in Nigeria using time series data from 1981 to 2010. The research employed the OLS technique to assess whether agricultural output was significant. However, there was a slight but favorable link between bank deposits and agricultural output.

Mbutor et al. (2013) investigate how agricultural finance impacted Nigeria's overall agricultural output between 1980 and 2011. The vector error correction procedure was used based on the properties of the data. According to the research, agricultural productivity was positively impacted by finance. However, variance decomposition revealed that the business was unduly reliant on the weather and that agricultural funding was in bad shape. The effect of government investment on the agricultural industry was examined by Mafimisebi et al. (2006) using annual time series data from 1991 to 2010. The OLS model's findings showed a weak but positive correlation between Nigeria's agricultural output and spending.

Egwu (2016) assessed Nigeria's agricultural output, economic growth, and poverty alleviation in relation to agricultural finance; the results of the regression analysis showed that loans from the ACGSF and the Commercial Bank Credit to the Agricultural Sector (CBCA) significantly increased agricultural sector output in relation to GDP between 1981 and 2014. Nigerian agricultural output was studied by Matthew & Mordecai (2016) in relation to public agricultural spending. The results of the regression showed that public agriculture investment had a large and unfavorable effect on agricultural output. According to the research, there might have been a negative impact from the discrepancy between the amount allotted for the agricultural sector and the real amount spent on it in the economy. For the years 1981–2014, Igyo et al. (2016) tried to calculate the relationship between agricultural growth and financial intermediation through deposit money banks. The DMBLR demonstrated the significance of deposit money bank credit for agriculture output increases, even though its findings indicated a negative and negligible impact on agricultural productivity. To analyze the data, the ordinary least squares approach was used.

Using the econometric techniques of OLS and ECM, Aina & Omojola (2017) investigated the impact of government spending on the performance of Nigeria's agricultural industry from 1980 to 2013. The findings demonstrated that government investment in agricultural and the agricultural output were strongly and favorably correlated. For the years 1992Q1–2015Q4, Olorunsola, Adejumo & Bolarinwa (2017) examined the short- and long-term relationship between bank lending and agricultural output in Nigeria. This study made use of quarterly data on the rise of actual agricultural output and private sector financing for agriculture. Long-term or short-term conflict between loans and production lumps in the agricultural industry was not evident.

The ACGSF, CBLA, and agriculture's share of GDP from 1981 to 2017 were all assessed by Tiamiyu et al. (2017). The statistical methods employed were Ordinary Least Square regression and the Correlation Matrix. According to the empirical results, Nigerian output is equally driven by agricultural loans, interest rates, and exchange rates. Shobande et al. (2018) investigated how Nigeria's rural financing industry was restructured for agricultural growth between 1996Q1 and 2017Q4. To estimate the relevant relationship, the study used the ARDL method. The long-term estimate's findings indicated that while currency rates, money markets, capital markets, and agricultural credit all positively correlate with Nigeria's agricultural growth, inflation has a long-term negative effect.

Using a quasi-experimental design, Udeorah & Vincent (2018) examined the relative impact of government and deposit money bank financing on the performance of the Nigerian agricultural sector from 1981 to 2015. They used an estimated error correction regression model and the multivariate Johansen co-integration test to determine whether long-term equilibrium relationships existed between time series variables. Government assistance through the agricultural loan guarantee plan fund considerably reduced crop production and overall agricultural output, according to the study's findings.

In a different study, Medugu et al. (2019) used the ordinary least squares method to evaluate the impact of commercial banks' credit on Nigerian agricultural output from 1980 to 2018. The outcome demonstrated that Nigeria's output level may be predicted by both government investment in agriculture and commercial bank lending. Also, an inverse link between interest rates and agricultural output was also reported.

Obioma et al. (2021) studied the influence of agricultural funding on the performance of Nigeria's agricultural industry in Nigeria. Rainfall, government spending on agriculture, interest rates, and CBLA were explanatory factors employed in the study, while the agricultural sector's GDP contribution served as a stand-in for the sector's performance. The agriculture sector's contributions to GDP are significantly and permanently impacted by the agriculture Credit Guarantee Scheme in particular. Agricultural loans from commercial banks had a favorable and considerable impact on the sector's GDP contributions over the reference period.

Using the Granger causality test and the ARDL model, Marafa (2021) examined the impact of agricultural funding on the productivity nexus in Nigeria between 1981 and 2019. Inflation, interest rates, government spending on agriculture, bank loans to the agricultural sector, the agricultural credit guarantee program fund, and agriculture as a percentage of GDP were all inputs for the model. The results indicated that, aside from bank loans to the private sector and money from agricultural credit guarantee programs, which had a significant long-term impact, other factors had a significant short-term impact on agricultural output.

In more recent studies, Abdulrafiu & Christopher Dabo (2022) use annual time series data from 1983 to 2018 to investigate how agricultural finance affects Nigerian agricultural output. Government support is represented by the government Agricultural Lending Guarantee Scheme Fund, whereas commercial bank lending to the agricultural sector is an independent variable. Overall output from the agricultural sector is the dependent variable. Long-term connections are estimated using the Vector Autoregressive Model (VAR), whereas causal correlations between variables are found using Granger Causality. Both government and commercial bank agricultural loans have a significant causal impact on Nigerian agricultural output and significantly increase agricultural output over time, according to the study's findings.

Also, Okwuchukwu (2022) researched the influence of agricultural sector finance on the output of the agricultural sector in Nigeria for the period 1981-2018, using a co-integration test and vector error correction model (VECM). The study used the following variables: annual rainfall, government investment in agriculture, lending interest rates, the agricultural credit guarantee program fund, the agricultural sector's share of GDP, and commercial banks' loans to the agricultural sector. The outcomes revealed that the GDP ratio for the agricultural sector was significantly and favorably impacted by the agricultural loan guarantee scheme. Furthermore, the findings demonstrated that the government's agricultural spending, commercial banks' lending interest rates, and agricultural sector credit all significantly and negatively impacted Nigeria's agricultural sector to GDP ratio.

Akpan & Akpanabah (2022) looked at how government spending affected Nigerian agriculture between 1980 and 2018. The research was conducted using the ARDL bound testing approach. The study's results revealed a strong and positive nexus between government capital and continuous agricultural spending and agricultural output over the period under consideration.

The impact of agricultural financing on Nigeria's agricultural sector output between 1981 and 2021 was examined by Nnachi et al. (2023). To analyze time series data, the ARDL model was employed. Agricultural productivity was shown to be significantly and favorably impacted by the production of animals, cereals, roots, and tubers. On the other hand, cocoa, poultry, and oil palm had no discernible impact on agricultural output. Considering that agricultural output has been significantly and favorably impacted by financing for cattle rearing, cereals, roots, and tubers that is guaranteed by agricultural credit.

3. Methodology

The ex-post research design was employed in this investigation. The working population of the study is the entire Nigerian agricultural sector. Q1 of 2009–Q4 of 2023 is the sample period. The justification for this period is based on data availability. The CBN Statistical Bulletin, 2023, was one of the secondary sources of data that the researcher looked at for this study. Due to the linearity of the model created to investigate the effect of examining the impact of agricultural financing on Nigerian agricultural output, numerical estimates of the parameters in the models were obtained using descriptive statistics, correlation matrices, co-integration, and the ARDL method of estimation technique. To examine the models and accomplish the objectives of the study, the ARDL estimation technique was employed with E-Views 9.0 econometric software.

3.1 Theoretical Framework

The structural change theory serves as the underpinning for this study's theoretical framework. Following Lewis Arthur's formulation of the Structural Change Theory in 1954, the term "development with an unending supply of labor" has been used ever since. This paper makes the case that the growth of the two industries also affects economic growth. The formula is Y = f (AGRIC, IND), where IND stands for industry, AGRIC for agriculture, and Y for economic development. Agriculture and industry are so interdependent that it is impossible to think about one without the other. While the industrial sector exports completed items and provides labor to the farm sector, the agricultural sector also provides capital inputs and absorbs products from the industrial sector. Since no money can be made without a hypothesis, The purpose of this research is crucial to the expansion of the agriculture sector. Supporting agricultural projects is essential for their successful implementation. If these projects receive adequate financing, agricultural output will increase, contributing to economic growth. Without accompanying structural changes that increase output, other strategies or modifications are likely to be ineffective or even detrimental.

3.2 Model Specification

To look into the relationship between agricultural output and financing, a modified version of the model used by Obioma et al. (2021), was specified. Obioma et al. (2021) included interest rate as a control variable in their model, but in this study only annual rainfall was included as the control variable. Our model's functional form is described as follows Eq. (1):

$$AGRO=f(ACGSF, CBLA, GOVXA, ARF) \quad (1)$$

The above functional model is further stated in stochastic form as Eq. (2):

$$AGROt = \beta_0 + \beta_1 ACGSF_t + \beta_2 CBCLA_t + \beta_3 GOVXA + \beta_4 ARF + \mu_t \quad (2)$$

The equation is specified in implicit form using the ARDL Model as follows:
The equation can be specified explicitly in the short run as follows Eq. (3):

$$AGRO_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta AGRO_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta ACGSF_{t-1} + \sum_{i=1}^{q} \beta_3 \Delta CBLA_{t-1} + \sum_{i=1}^{q} \beta_4 \Delta GOVXAC_{t-1} + \sum_{i=1}^{q} \beta_5 \Delta ARF_{t-1} + \varepsilon_t \quad (3)$$

The error correction mechanism (ECM), which restores the economy to equilibrium in the event of a shock, is captured by recasting the long-term equilibrium influence of agricultural funding on agricultural output as follows. The effect of shock, which is captured by ECM, is thus incorporated into Eq. (3) by re-specifying it as follows Eq. (4):

$$\Delta AGRO_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta AGRO_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta ACGSF_{t-1} + \sum_{i=1}^{q} \beta_3 \Delta CBLA_{t-1} + \sum_{i=1}^{q} \beta_4 \Delta GOVXA_{t-1} + \sum_{i=1}^{q} \beta_5 \Delta ARF_{t-1} + \phi ECM_{t-1} + \varepsilon_t \quad (4)$$

where,
ARF stands for annual rainfall, ACGSF for agricultural credit guarantee scheme fund, CBLA for credit from commercial banks to the agricultural industry, GOVXA for government spending on agriculture, and μ_t for stochastic disturbance term, which serves as a stand-in for additional variables that are not part of the model. AGRO is the dependent variable and represents agricultural output. The error correlation term, $ECM = (AGRO_{t-1}\text{-}\theta_{xt})$, is the extracted residuals from the long-run equation's regression; β_0 is the constant or slope, and $\boldsymbol{\phi}$ is the parameter for speed of adjustment that has a negative sign. The a priori anticipation trends of the explanatory variables in terms of the behaviour of their coefficients to be estimated in the model are $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 >$, $\beta_4 > 0$. All of the independent factors should, in theory, have a beneficial influence on the agricultural sector's output (AGRO).

3.3 Measurement of Variables

Table 1 defines the variables that were used, together with the a priori expectation and the name of the previous researcher that used the variable in their investigation.

Table 1. Variable measurements

Variables	Variable Type	Measurement	A-Priori Expectation	Prior Research that Made Use of the Variable
Agricultural Output (AGRO)	Dependent	Agricultural production is calculated as the agricultural sector's share of the gross domestic product.		Nnachi et al. (2023)
ACGSF	Independent	Measured as the entire credits granted to farmers in the Credit Guarantee Scheme Fund in Nigeria.	(+)	Okwuchukwu (2022)
CBLA	Independent	Measured as the total loans granted by commercial/deposit money banks to Nigeria's agriculture industry.	(+)	Obioma et al. (2021)
GOVXA	Independent`	Measured as the total government spending on agricultural sector in Nigeria.	(+)	Ibekwe
Annual Rainfall (ARF)	Independent`	Annual rainfall is measured in millimeter.	(+)	Marafa (2021)

Source: Author's compilation (2025)

4. Results Presentation and Discussion

4.1 Descriptive Statistics

To summarise the data, the basic characterization of the datasets is conducted using descriptive statistics. Table 1 shows the annualised summary data for all variables in the research for the period 2000Q1 to 2023Q4.

Table 2. Descriptive statistics

	AGRO	ACGSF	CBLA	GOVXA	ARF
Mean	18290.13	5981.242	474.8746	39.27833	1424.296
Median	14926.01	5778.250	293.5553	36.58500	1427.563
Maximum	49724.78	13283.33	1908.047	84.62156	1584.750
Minimum	1409.684	214.1494	33.10563	6.222813	1139.613
Std. Dev.	14049.89	3547.771	544.5273	24.87053	62.00391
Skewness	0.870107	0.091930	1.514353	0.360242	-0.827075
Kurtosis	2.712666	2.029447	4.209517	1.933626	7.617343
Jarque-Bera	12.44362	3.903107	42.54397	6.625001	96.22426
Probability	0.001986	0.142053	0.000000	0.036425	0.000000
Sum	1755853	574199.2	45587.96	3770.720	136732.4
Sum Sq. Dev.	1.88E+10	1.20E+09	28168443	58761.60	365226.0
Observations	96	96	96	96	96

Source: Researcher's Computation (2025) Using E-views 9.0 Software.

From the descriptive statistics presented in Table 2, agricultural output (AGRO) averaged N18290.13 billion, ACGSF averaged N5981.242 billion, CBLA averaged 474.8746, and GOVXA averaged N39.27833 billion, while annual rainfall (ARF) had an average of 1424.296. The minimum values and the maximum values indicate the lowest and highest values obtained for each series; that is, they are indicators of the range of values contained in each of the series. The standard deviation shows that the dispersion of the variables from their respective mean values is high. This infers a wide variation within the values of each series of the variables. This implies a wide variation within the values of each series of the variables. The skewness values showed that apart from ARF, which was negatively skewed, all the other variables were positively skewed. The Kurtosis values for CBLA and ARF were greater than the acceptable level of 3, implying that the series for CBLA and ARF are highly peaked (leptokurtic); that is, they had more values that are greater than their respective sample means. However, the Kurtosis values for AGRO, ACGSF and GOVXA are flat (plytokurtic). The Jarque-Bera test probability values for AGRO, CBLA, GOVXA and ARF were less than 0.05, indicating that the null hypothesis that the series are not normally distributed should be accepted but rejected for ACGSF.

4.2 Correlation Analysis

It is critical to investigate the strength and orientation of the relationship between the variables in the study. These investigations are carried out using correlation analysis. Table 3 shows the results of the correlation test.

Table 3. Correlation result

Correlation					
Probability	**AGRO**	**ACGSF**	**CBLA**	**GOVXA**	**ARF**
AGRO	1.000000				

ACGSF	0.400123	1.000000			
	0.0001	-----			
CBLA	0.868490	0.320414	1.000000		
	0.0000	0.0015	-----		
GOVXA	0.814345	0.426134	0.848134	1.000000	
	0.0000	0.0000	0.0000	-----	
ARF	0.504532	0.262290	0.397861	0.578711	1.000000
	0.0000	0.0098	0.0001	0.0000	-----

Source: Researcher's Computation (2025) Using E-views 9.0 Software.

The correlation result in Table 3 shows that there is a significant positive association between AGRO and all of the independent variables (ACGSF, CBLA, GOVXA, and ARF). According to their matching positive coefficients, this implies that a rise in these factors will improve agricultural GDP, which serves as a proxy for agricultural output throughout the analyzed period. Meaning that ACGSF, CBLA, GOVXA, and ARF are key variables that stimulate agricultural output, as shown by their corresponding probability values. The relationship between the independent variables shows a similar pattern; that is, they are significantly and positively related. Furthermore, Table 3 also revealed the absence of a multi co-linearity problem among explanatory variables since no correlation coefficient between explanatory variables is > 0.90 as suggested (in 2008) by Gujarati.

4.3 Unit Root Testing

The Augmented Dickey Fuller (ADF) test is used to analyze unit roots. Because the ARDL limits test cannot be applied to co-integration, the research used the traditional ADF unit root test to determine whether the data was stationary and to ensure that none of them were I (2) or higher. To determine the stationary variables, Table 4 displays the results of the ADF test for the series at level and first differences.

Table 4. Unit root test result

	ADF Test		
Variables	**At level**	**1st Difference**	**Order of Integration**
AGRO	0.1373	-3.0255**	I (1)
ACGSF	-2.3025	-6.5284*	I (1)
CBLA	-1.0629	-6.5294*	I (1)
GOVXA	-0.4027	-3.4367*	I (1)
ARF	-2.1703	-4.6053*	I (1)

Source: Researcher's Computation (2025) Using E-views 9.0 Software.
Note: * & ** indicate significance at 1 and 5 percent levels.

The ADF test findings for the series at level and first differences are shown in Table 4 in order to capture the stationary variables. At the 1% and 5% levels of significance, the findings show that all variables become stationary at the first difference. Since the ARDL co-integration technique can handle whether all variables are I (0), I (1), or a combination of both, we proceeded with it after the test result showed that the variables were integrated of I (1) and that none of the variables were integrated of I (2) or higher. To proceed with the co-integration test, this suggests using the ARDL approach (bounds test approach of co-integration).

Bounds Tests for Co-integration:

To determine whether there is a long-term equilibrium relationship between the explained variable AGRO and the explanatory variables in the ARDL model, a robust ARDL bound testing technique for cointegration was used after the order of integration. You may see this in Table 5.

Table 5. ARDL bounds test for co-integration–selected model (ARDL (2, 1, 1, 0, 2))

Test Statistic	**Value**	**K**
F-statistic	1.201302	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Researcher's Computation (2025) Using E-views 9.0 Software.

The F-statistic value of 1.20 is less than the upper bound critical value of 4.01 at the 5% level of significance, as Table 5 demonstrates. This indicates that the null hypothesis, according to which there is no long-term relationship, is accepted and the alternative, according to which there is a long-term relationship, is rejected. Thus, AGRO and the explanatory variables ARF, GOVXA, CBLA, and ACGSF do not have a long-term equilibrium relationship. As a result, we are unable to determine how these factors relate to one another over the short and long terms.

4.4 Regression Analysis

The findings of the study on how agricultural financing affects Nigerian agricultural output are compiled in Table 6. The ARDL 2, 1, 1, 0, 2 was the final model selected for the study, as indicated in Table 5. The ideal lag length was determined by automatic lag selection in accordance with the Akaike Information Criterion (AIC).

The ARDL in result Table 5 shows that, based on the OLS result, which shows an R2 value of 0.999705, the explanatory variables (ACGSF, CBLA, GOVXA, and ARF) explain nearly 99% of the variance in the dependent variable (AGRO). As evidenced by the corrected R2 value of 0.999670, or around 99%, the result remains strong even after taking the degrees of freedom (df) into consideration. Consequently, the ARDL regression fits the data well. When the model's explanatory power is tested at the 1% level of statistical significance, the F-statistic yields a result of 28161.32 with a corresponding probability value of 0.0000. It would appear from this finding that the four explanatory factors—ACGSF, CBLA, GOVXA, and ARF—have a substantial combined effect on Nigeria's produce. Autocorrelation can be ruled out fully based on the Durbin-Watson value of 2.170886. All explanatory factors, except for ACGSF and GOVXA, passed the significant test at the 1 and 5 percent levels, according to a detailed analysis of each individual coefficient in the model. This suggests that AGRO (-1), AGRO (-2), CBLA, CBLA (-1), ARF, ARF (-1) and ARF (-2) have a major influence on Nigerian agricultural output, whilst ACGSF and GOVXA have no discernible effect. Direct signs were also displayed by AGRO (-1), CBLA, ARF, ARF (-2) and GOVXA, while negative signs were displayed by AGRO (-2), CBLA (-1), and ACGSF.

Table 6. ARDL regression dependent variable: AGRO (selected model: ARDL (2, 1, 1, 0, 2))

Variable	Coefficient	t-Statistic	Prob.
AGRO (-1)	1.625140	19.54814	0.0000*
AGRO (-2)	-0.630925	-7.502681	0.0000*
ACGSF	-0.121289	-1.716421	0.0898
ACGSF (-1)	0.115394	1.597773	0.1139
CBLA	5.862969	4.160862	0.0001*
CBLA (-1)	-5.985207	-4.513742	0.0000*
GOVXA	3.720239	1.156207	0.2509
ARF	6.932296	4.577527	0.0000*
ARF (-1)	-11.33298	-5.173208	0.0000*
ARF (-2)	4.609179	3.691445	0.0004*
C	-172.5648	-0.171894	0.8639
R^2	0.999705		
Adjusted R^2	0.999670		
F-statistic	28161.32		
Prob. (F-stat.)	0.000000		
D.W stat	2.170886		

Source: Researcher's Computation (2025) Using E-views 9.0 Software.
Note: * = 1% significant level.

Diagnostic Test:

The validity, robustness, and reliability of the ARDL conclusions drawn from the empirical investigation were confirmed using the Ramsey RESET stability test, the Breusch-Pagan-Godfrey heteroskedasticity test, and the Breusch–Godfrey Serial Correlation LM test. The test results are shown in Table 7.

Table 7. The outcome of the ARDL model diagnostic test (2, 1, 1, 0, 2)

Diagnostic Tests (Test Statistics)	Test	Coefficient	P-value	Decision
Breusch-Pagan-Godfrey	Heteroskedasticity	1.736842	0.5058	No Heteroskedasticity problem
Breusch-Godfrey LM (F-Stat.)	Serial Correlation	0.707326	0.4960	No Serial correlation
Ramsey RESET Test	Model Specification Error:			Equation is correctly specified
	t-stat.	1.549108	0.4306	
	F-Stat.	1.529617	0.3206	

Source: Researcher's Computation (2025) Using E-views 9.0 Software.

The null hypothesis that there is no heteroskedasticity problem cannot be rejected based on the findings of the Breusch-Pagan-Godfrey heteroskedasticity test in Table 7 because the probability values (0.5058) are greater than the 0.05 (p. > 0.05) threshold of significance. Therefore, it is necessary to accept the null hypothesis, which leads to the conclusion that there is no heteroskedasticity problem with the models. Because the probability values (0.4960) are more than the 0.05 (p. > 0.05) level of significance, the Breusch-Godfrey Serial Correlation LM test results, which are displayed in Table 7, also show that the null hypothesis—that there is no serial correlation—cannot be rejected. The conclusion that the model does not have a serial correlation problem—that is, that there is no serial correlation between the independent variables and the disturbance term—follows from the acceptance of the null hypothesis. Additionally, there are no specification errors in the models, as shown by the likelihood of the t-statistic and F-statistic of the Ramsey RESET test in Table 7 being both greater than 0.05 (p > 0.05). This implies that the linear form of the model was provided accurately, that the functional form of the model is accurate, or that pertinent variables were included.

4.5 Discussion of Findings

The study finds that one-year lagged agricultural output (AGRO (-1)) and two-year lagged agricultural output (AGRO (-2)) have significant impact on current year agricultural output (AGRO). Furthermore, one-year lagged agricultural output (AGRO (-1)) was positively linked to current year agricultural output (AGRO), while two-year lagged agricultural output (AGRO (-2)) was negatively linked to current year agricultural output (AGRO). Hence, one-year lagged agricultural output (AGRO (-1)) increases current year agricultural output, while two-year lagged agricultural output (AGRO (-2)) tends to reduce current year agricultural output. Thus, a unit increase in one year lagged agricultural output (AGRO (-1)) will increase agricultural output by 1.62 units, while a unit increase in two years lagged agricultural output (AGRO (-2)) will reduce agricultural output by 0.63 units. The conclusion drawn from this research is that one-year lagged agricultural output (AGRO (-1)) and two-year lagged agricultural output (AGRO (-2)) are critical factors that influence current-year Nigeria's agricultural production within the studied period.

Furthermore, the empirical finding indicates that the coefficient of the ACGSF has an insignificant negative effect on AGRO, meaning that ACGSF is not a crucial agricultural finance variable that affects Nigeria's agricultural output within the reference period. Agricultural output will therefore be decreased by 0.12 units for every unit increase in ACGSF, though insignificantly. The non-utilization of the loans for other purposes instead of utilizing them for agricultural activities might be the cause of the insignificant negative effect. The result of this study agrees with Udeora & Vincent (2018), who found a negative relationship between ACGSF and AGRO, but contradicts those of Egwu (2016), Marafa (2021), Okwuchukwu (2022) and Nnachi et al. (2023), who discovered that agricultural output and the ACGSF had a strong positive correlation.

Also, the ARDL result shows that the coefficient of current-year agriculture-related commercial bank loans (CBLA) and one-year lagged agriculture-related commercial bank loans (CBLA (-)) significantly affect the AGRO. The relationship between CBLA and AGRO is positive, while that between one-year lagged CBLA (CBLA (-)) and AGRO is negative, meaning that CBLA and one-year lagged CBLA (CBLA (-1)) are crucial factors that affect Nigeria's agricultural output. Agricultural output will therefore increase by 5.86 units for every unit increase in CBLA, while CBLA (-1) tends to reduce agricultural output. Agricultural output will therefore be decreased by 5.98 units for every unit increase in CBLA (-1). This finding aligns with the submission of Egwu (2016); Matthew & Mordecai (2016); Medugu et al. (2019); Obioma et al. (2021); and Abdulrafiu & Christopher Dabo (2022), who concluded that CBLA have a significant positive effect on agricultural output but disagreed with that of Okwuchukwu (2022), who found a significant negative relationship between CBLA and agricultural output in their studies.

Additionally, Nigeria's AGRO is not significantly improved by government spending on agriculture (GOVXA). This might be related to the fact that government spending on the agricultural sector does not get to the farmers that need this money. According to this research, Nigeria's AGRO rises by 3.72 units for every unit rise in government spending on agriculture. Therefore, government spending on agriculture is not a crucial factor influencing agricultural output in Nigeria. This result is consistent with that of Ademola et al. (2013), who found that government spending had a negligible positive impact on agriculture and agricultural productivity. This finding is contrary to the result of Lawal (2011), Aina & Omojola (2017), Medugu et al. (2019), Abdulrafiu & Christopher Dabo (2022) and Akpan & Akpanabah (2022), who reported a significant positive link between GOVXA and agricultural output.

Finally, the control variable, annual rainfall (ARF), one year lagged annual rainfall (ARF (-1)) and two years lagged ARF (ARF (-2)) have a significant impact on AGRO with current ARF and two years lagged ARF (ARF (-2)) positively signed, while one year lagged ARF (ARF (-1)) is negatively signed. This means that an increase in current ARF and two years lagged ARF (ARF (-2)) resulted in a significant increase in agricultural output by 6.93 and 4.60 units, respectively, while an increase in one year lagged ARF (ARF (-1)) decreases agricultural output by 11.33 units. The significant impact of ARF implies that annual rainfall plays a key role in improving AGRO in Nigeria. The finding is in consonance with the result of Obioma et al. (2021), which indicated that annual rainfall significantly influences AGRO.

5. Conclusion and Recommendation

5.1 Conclusion

The purpose of this study was to examine the relationship between agricultural funding and Nigeria's agricultural output. The ACGSF, CBLA, and GOVXA were the variables utilized as stand-ins for agricultural funding. A stand-in for agricultural output was the agricultural GDP. Utilizing quarterly data from 2009Q1 to 2023Q4, the ARDL estimate approach was used to specify the ARDL model, which was designed to investigate the impact of agricultural finance variables on agricultural output. E-Views 9.0, an econometric analysis program, was used. According to the findings, CBLA significantly affect agricultural output in Nigeria, although GOVXA and the ACGSF do not. Additionally, annual rainfall, the control variable, greatly increases agricultural productivity. Nigeria's agricultural output is significantly impacted by agricultural finance, according to the investigation's findings. The fact that agricultural output is greatly increased by CBLA serves as evidence of this.

5.2 Recommendations

The study's conclusions lead to the following policy recommendations:

- We recommend closely monitoring farmers who obtain loans under the ACGSF to make sure they use them for agricultural purposes, given the study's results that the fund has a minor negative impact on agricultural output. In order to create jobs and increase production for both domestic and international markets, the program should provide finance to farmers who are prepared and eager to start medium- or large-scale farming. This would help Nigeria earn foreign exchange.
- Nigerian deposit money banks should lend more to the nation's agricultural sector in order to increase agricultural output even further.
- The government must also increase its expenditures in this sector if it hopes to significantly boost Nigeria's agricultural output. A contradictory fiscal policy should also be implemented with regard to continuing expenditures in the agriculture sector.
- Lastly, farmers ought to schedule their farming operations to capitalize on Nigeria's rainy season.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

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