MICROFINANCE INSTITUTIONS AND THE PERFORMANCE OF AGRICULTURAL SECTOR IN NIGERIA

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Abstract
Microfinancing emerged to support low-income earners and small businesses, including farmers in the agricultural sector. Despite the critical role of agriculture in food production and raw material supply, Nigeria's economy remains dominated by the oil sector, leaving the agro-industry inadequately supported. This imbalance has spurred studies exploring the relationship between micro financing and agricultural performance, yet empirical findings remain inconclusive, necessitating further investigation. This study examines how microfinance institutions impact agricultural performance, focusing on microfinance credit, deposits, and investments. Guided by the neoclassical production theory and supply-leading theory, the research employs a model incorporating microfinance variables alongside factors such as capital, labor, inflation, rainfall, and fertilizer supply. Using time-series data from 1992 to 2023, sourced from the World Bank and the Central Bank of Nigeria, the study applied the Auto-Regressive Distributive Lag model. The findings reveal that microfinance credit and investments positively influenced agricultural productivity, growth, and output, implying that operation of microfinance institutions in Nigeria positively impacts the performance of the agricultural sector. Therefore, sustainability of microfinance institutions and increased access of farmers to their services should be encouraged through formulation of appropriate policies.

Key words: *Microfinance Institutions, Agriculture, Agricultural Sector, Bank Credits, Bank Deposits, Bank Investment, Nigeria*

Introduction

Every country has a segment of self-employed individuals and low-income entrepreneurs who demonstrate significant potential to establish businesses that could enable them to rise above poverty. However, a common obstacle that limits the growth of small and medium-scale enterprises globally is inadequate access to capital. Many economically disadvantaged individuals lack the resources necessary to finance their business ventures, leaving them unable to create wealth, escape poverty, or effectively respond to external economic shocks (Murad & Idewele, 2017). Microfinance institutions (MFIs) address this issue by providing financial services tailored to underserved populations. These institutions integrate social and economic development principles while operating within financial and commercial market frameworks. Their primary goal is to offer essential financial services, including credit, savings, and insurance, to small-scale and micro-entrepreneurs. Through these services, microfinance aims to alleviate poverty and promote financial inclusion, particularly in low-income communities (Al-Amin & Mamun, 2022). The global economic challenges, especially those experienced in developing nations, highlight the critical role of microfinance in poverty reduction. Emerging economies, such as those in Africa, often face declining economic performance and severe fiscal austerity, which exacerbate poverty levels. Recognizing the potential of microfinance, the 1990s witnessed increased interest and investment in this sector. In Nigeria, the establishment of a comprehensive microfinance regulatory framework in 2005 marked a significant step in formalizing and scaling the industry. This policy provided clear guidelines for licensing, governance, and oversight of privately-owned microfinance institutions. Beyond offering financial stability, microfinance has demonstrated a capacity to drive economic and social progress. For example, access to microfinance services often leads to higher per capita incomes, better access to basic amenities, improved healthcare, and enhanced professional training. These outcomes underscore the widespread belief that microfinance is instrumental in reducing poverty, prompting governments, NGOs, and private entities to support its growth and development (Friday & Cyril, 2021).

The Nigerian agricultural sector, a cornerstone of Nigeria's economy, benefits significantly from microfinance. Over the years, microfinance institutions have provided substantial credit to farmers to improve production practices, with more than 800 million microcredits disbursed to over 13,000 farmers (Ketu, 2008). By extending loans, microfinance banks help entrepreneurs expand existing businesses or establish new ones. Agriculture remains a vital economic driver, contributing significantly to Nigeria's GDP. For instance, agriculture accounted for 23.78% of GDP in the second quarter of 2021, slightly lower than 24.65% in the same period of 2020 but higher than the 22.35% recorded in the first quarter of 2021 (National Bureau of Statistics, 2021). Despite the potential of agriculture to foster economic growth, Nigeria's dependence on crude oil has overshadowed the agricultural sector. Recognizing the need to diversify the economy, the Nigerian government has increasingly focused on agriculture as a key driver of development. Policies encouraging financial inclusion, particularly within agriculture, have been introduced. In 2005, for example, the Central Bank of Nigeria established microfinance banks to serve unbanked segments of the economy, with an emphasis on agriculture. However, challenges persist. Despite substantial funding and favorable policies, agricultural output has not consistently improved. Empirical research suggests that microfinance services sometimes fall short of meeting the sector's financial demands, hindering the achievement of intended objectives. Poor performance by MFIs in credit delivery raises questions about their efficacy in supporting agricultural growth (Obadeyi, 2015). These gaps necessitate further research to explore how various policies impact agriculture and the economy at large.

Research on the relationship between microfinance institutions and agricultural productivity reveals mixed findings. Some studies, such as those by Ajayi and Olalekan (2018) and Divine (2021), highlight positive effects of agricultural credit on productivity. Conversely, others, like Abdulraheem and Adeola (2015) and Lawal et al. (2019), report negative impacts. These discrepancies may stem from differing methodologies, variables, and economic contexts across studies. Most prior research has focused narrowly on microfinance credit without considering the combined effects of microfinance deposits and investments. To address these gaps, this present study adopts a more comprehensive approach, examining how credit, deposits, and investments influence agricultural performance. Addressing these issues through rigorous research and targeted policies will ensure that microfinance fulfills its potential as a transformative force in Nigeria's economic landscape.

Objectives

The objective of this study was to investigate the effect of operation of microfinance institutions on the performance of agricultural sector in Nigeria, using three key indicators of performance of agricultural sector—agricultural productivity, growth, and output. These metrics provide a holistic view of how microfinance interventions contribute to efficiency, sectoral expansion, and tangible production outcomes. By using these indicators, researchers can offer actionable insights for policymakers. For instance, identifying which microfinance variables most significantly impact agricultural output can help refine policies to promote growth.

This study is organized into five major sections. Section 1 has covered the general introduction. Section 2 contains the literature review while Section 3 consists of theoretical framework and the methodology adopted for the study. Presentation and discussion of results, and conclusion are contained in Sections 4 and 5, respectively.

Literature Review

The existing empirical literature on the impact of microfinance institutions on agricultural output in Nigeria reveals diverse findings across different regions and timeframes. This review summarizes key studies conducted between 2015 and the time the present study was being conducted.

Starting from 2015, Abdulraheem and Adeola (2015) explored the effect of microcredit financing on agricultural production using structured questionnaires and personal interviews with farmers. Their analysis, based on correlation coefficients, revealed that while rural farmers benefit from microfinance services, the impact on farming operations remains below expectations. Access to microcredit is often limited to cooperative societies due to the lack of collateral assets such as machinery, which are required by commercial financial institutions. High-interest rates further constrain farmers' ability to secure credit. The study emphasized the need for appropriate policies and regulatory frameworks to enhance the effectiveness of microfinance in achieving agricultural objectives.

Conducting a study on the topic, Ajayi and Olalekan (2018) focused on the impact of agricultural credit accessed by farmers in Oyo State, employing descriptive statistics, probit models, and regression analyses. Their findings highlighted that factors such as farm size, labor costs, seed costs, and the amount of credit obtained positively influence productivity. The Chow test revealed significant differences in outputs between beneficiaries and non-beneficiaries of microfinance bank credit, underscoring the role of microfinance in enhancing agricultural productivity.

Lawal et al. (2019) examined the causal relationship between bank credit and agricultural productivity in Nigeria using secondary data from the Central Bank of Nigeria (CBN). Employing the Toda-Yamamoto Granger causality test and Vector Autoregression (VAR) models, the study found unidirectional causality from the Agricultural Credit Guarantee Scheme Fund (ACGSF) to agricultural GDP. This finding emphasizes the critical role of ACGSF in driving agricultural performance in Nigeria.

Simon-Oke and Jegede (2020) investigated the spatial distribution of microfinance institutions in Ekiti State and their effect on agricultural development. Using data collected from 300 farmers across three senatorial districts, the study identified issues such as collateral security and inadequate facilities as major impediments to agricultural growth. The authors recommended relaxed collateral requirements to improve access to credit facilities.

Further, Kofarmata and Danlami (2020) modeled the determinants of credit supplied to farmers by microfinance banks, analyzing data from 835 households and 45 microfinance banks. The Tobit model revealed that factors such as entrepreneurial ability, having a bank account, and profits from loans positively influenced loan supply. Conversely, the distance of farmers from banks negatively impacted credit availability.

In the same vein, Ezhar (2020) evaluated microfinance's role in agricultural production and identified challenges such as inadequate collateral, small loan amounts, and delays in loan disbursement. Recommendations included forming farmer-based organizations, educating farmers on credit processes, and encouraging MFIs to increase agricultural financing to reduce income inequality and poverty.

Ngong et al. (2021) assessed the impact of bank credit on agricultural productivity in the Central African Economic and Monetary Community (CEMAC) from 1990 to 2019. Using autoregressive distributed lag models, the study revealed that domestic credit, land, and physical capital positively influence agricultural value-added, while factors like inflation and labor availability had negative effects.

Fadeyi et al. (2021) systematically reviewed literature from 2007 to 2019, concluding that MFIs positively influence smallholder agriculture development in Nigeria. However, challenges such as farmers' location, limited awareness, high interest rates, credit rationing, and corruption among MFI officials hinder credit accessibility. The study recommended stricter regulations by the CBN to address these constraints.

Divine (2021) investigated microfinance credit’s impact on agricultural productivity in Bayelsa State. Using a survey design and statistical analyses, the study found a significant positive relationship between microfinance credit and productivity. Farmers with access to microfinance achieved higher productivity levels than those without.

Similarly, Okoroji et al. (2022) analyzed the effect of microfinance services on smallholder rice productivity in Anambra State. Data from 300 farmers showed that services such as micro-savings and remittances significantly improved productivity. Socioeconomic factors like age, marital status, and education influenced farmers' access to microfinance services, while challenges included management and institutional constraints.

Comparative studies on other countries provide additional perspectives. Shuaibu and Nchake (2021) analyzed credit market conditions in Sub-Saharan Africa, finding that improved credit infrastructure and agricultural input availability enhance productivity. Anderson and Wallgren (2022) conducted a macro-level analysis of microfinance effects on agricultural productivity across income categories, concluding that credit disbursements positively influence cereal yields.

In Nepal, Sapkota et al. (2022) observed higher agricultural productivity and gross margins among farmers participating in microfinance programs, although associated costs were also higher. This highlights the nuanced impact of microfinance on agricultural outcomes.

Summarily, these studies demonstrate that microfinance institutions play a vital role in enhancing agricultural productivity, particularly among smallholder farmers. However, challenges such as high interest rates, inadequate collateral, and infrastructural limitations persist. Addressing these barriers through targeted policies and improved financial frameworks is crucial for maximizing the benefits of microfinance in agriculture.

Methodology

This study is anchored on the neoclassical theory of production and supply-lending hypothesis. These two theories jointly provide a relevant framework for understanding the effect of microfinance operation on agricultural performance. Going by supply-lending hypothesis, financial development or supply of financial resources precede and foster output growth. It posits that supply of financial resources has a positive effect on agricultural output and productivity.

According to neoclassical theory of production, agricultural firms (or farmers) aim to maximize profits by optimizing their use of inputs (such as labour, capital, and land) to produce output. The theory posits that access to capital, which includes financial capital, determines agricultural output. Financial capital such as credit, deposits, and investment, can affect the performance of agricultural sector in several ways. One, credit from MFIs can enable farmers to invest in inputs such as seeds, fertilizers, and equipment, which can lead to an increase in agricultural output. Two, access to deposits and investment services from MFIs can help farmers smooth consumption and manage risks. By having a safe place to save their earnings and access to investment opportunities, farmers can better plan for the future and make long-term investments in their farms, which can improve productivity and output over time. Three, through access to credit, deposits, and investment, farmers can adopt new technologies, improve their farming practices, and increase their efficiency, leading to higher levels of agricultural growth.

The mathematical form of the neoclassical theory of production is

$$Y = f\ (K, L),$$

where Y = Output, K = Capital, L = Labour

Capital can further be divided into physical capital and financial capital. Therefore, the equation can be rewritten as

$$Y = f(PK, FK, L),$$

where Y = Output, PK = Physical Capital, FK = Financial Capital, L = Labour

Physical capital refers to tangible assets that are used in the production of goods and services. This includes machinery, buildings, vehicles, equipment, and infrastructure such as roads and bridges. Physical capital enhances the efficiency and capacity of labour, enabling workers to produce more output with the same amount of effort.

Financial capital, on the other hand, represents the financial resources made available for investment in business operations, expansion, and other economic activities. Financial capital includes credit (loans and advances), equity investments, savings, and other financial instruments.

Model Specification

The econometric models specified from the theoretical expositions above are as follows:

Model 1

$$\Delta AGOt = \alpha_0 + \sum_{t=0}^{n} \alpha_1 \,\Delta MFIC_{t-1} + \sum_{t=0}^{n} \alpha_2 \,\Delta MFID_{t-1} + \sum_{t=0}^{n} \alpha_3 \,\Delta MFII_{t-1} + \sum_{t=0}^{n} \alpha_4 \,\Delta LAB_{t-1} + \sum_{t=0}^{n} \alpha_5 \,\Delta CAP_{t-1} + \sum_{t=0}^{n} \alpha_6 \,\Delta INF_{t-1} + \sum_{t=0}^{n} \alpha_7 \,\Delta SOF_{t-1} + \sum_{t=0}^{n} \alpha_8 \,\Delta RAF_{t-1} + \mu_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3)$$

Model 2

$$\Delta AGPt = \alpha_0 + \sum_{t=0}^{n} \alpha_1 \,\Delta MFIC_{t-1} + \sum_{t=0}^{n} \alpha_2 \,\Delta MFID_{t-1} + \sum_{t=0}^{n} \alpha_3 \,\Delta MFII_{t-1} + \sum_{t=0}^{n} \alpha_4 \,\Delta LAB_{t-1} + \sum_{t=0}^{n} \alpha_5 \,\Delta CAP_{t-1} + \sum_{t=0}^{n} \alpha_6 \,\Delta INF_{t-1} + \sum_{t=0}^{n} \alpha_7 \,\Delta SOF_{t-1} + \sum_{t=0}^{n} \alpha_8 \,\Delta RAF_{t-1} + \mu_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Model 3

$$\Delta AGGRt = \alpha_0 + \sum_{t=0}^{n} \alpha_1 \,\Delta MFIC_{t-1} + \sum_{t=0}^{n} \alpha_2 \,\Delta MFID_{t-1} + \sum_{t=0}^{n} \alpha_3 \,\Delta MFII_{t-1} + \sum_{t=0}^{n} \alpha_4 \,\Delta LAB_{t-1} + \sum_{t=0}^{n} \alpha_5 \,\Delta CAP_{t-1} + \sum_{t=0}^{n} \alpha_6 \,\Delta INF_{t-1} + \sum_{t=0}^{n} \alpha_7 \,\Delta SOF_{t-1} + \sum_{t=0}^{n} \alpha_8 \,\Delta RAF_{t-1} + \mu_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

AGO represents agricultural output, AGP agricultural productivity, AGR agricultural growth rate, MFIC microfinance credit to agricultural sector, MFID microfinance deposits as total deposits of microfinance banks, MFII microfinance investment as total investment made by microfinance institutions, LAB labour force, CAP capital, INF inflation rate, RAF annual rainfall, SOF supply of fertilizer as total of quantity of fertilizer products, *t* time, and μ the error term used to capture other variables that were not included in the model. The a priori expectations of the parameter estimates are $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7, \alpha_8 > 0$.

In this study, *agriculture sector performance* is measured by agricultural output, agricultural productivity, and agricultural growth rate. *Agricultural output* is a measure of the quantity or volume of agricultural production. It is measured as currency. Agricultural output has been identified in empirical studies such as Abdulraheem and Adeola (2015) to be influenced by several indicators, inlcuding labour, capital, and credits. *Agricultural productivity* measures the volume of output (e.g., output per unit of land or per unit of labour) divided by volume of inputs (such as labor, land, capital, and technology) are used to produce agricultural output. *Agricultural growth rate* measures the rate of change in agricultural output over time. It is usually expressed as a percentage and indicates how quickly agricultural output is expanding or contracting.

Nature, Measurement and Sources of Data

Time series data spanning from 1992 to 2023 in Nigeria were used in this study. The data were obtained from various issues of Central Bank of Nigeria (CBN) Statistical Bulletins, World Bank's World Development Indicators (WDI). Data on agricultural output, productivity and growth rate, MFI credit, deposits and investment as well as labour and capital were obtained the CBN Bulletin while data on inflation rate, annual rainfall and supply of fertilizer were obtained for the WDI. Table 1 presents the definition, measurement and sources of data used for the study

Table 1 Definition, Measurement and Sources of Data

Variables	**Definition**	**Measurement**	**Source**
Agricultural output	This is the total quantity or value of agricultural products produced in a given period of time, usually measured in terms of weight or value.	Currency (Billion Naira)	CBN Bulletin, 2023
Agricultural	This measures the volume of output	Currency	CBN Bulletin,

Variables	Definition	Measurement	Source
productivity	divided by volume of inputs are used to produce agricultural output.	(Billion Naira)	2023
Agricultural growth	This measures the rate of change in agricultural output over time. It is usually expressed as a percentage and indicates how quickly agricultural output is expanding or contracting.	Percentage (%)	CBN Bulletin, 2023
Microfinance institution credit	This are small loans granted to micro enterprises by financial intermediaries on the basis of the borrower's cash flow.	Currency (Billion Naira)	Olagunje & Ajiboye (2010)
Microfinance institution deposit	This are the money received from depositors by the microfinance institutions for the purpose of lending it out to needing customers.	Currency (Billion Naira)	Bangura (2020);
Microfinance Investment	This is measured by total investment made by the microfinance institutions and used	Currency (Billion Naira)	Rupali (2020)

Variables	Definition	Measurement	Source
	in agriculture.		
Labour	It comprises of people above 15 years that are contributing to production of goods and services during a particular period.	Currency (Billion Naira)	Unal & Semih (2020); Ochonogor (2020); Ngong et al. (2021)
Capital	This refers to the total amount of physical capital that is available for use in agricultural production within a specific region or country.	Currency (Billion Naira)	Divine (2021); Ajayi & Olalekan (2018), and Lawal et al, (2019).
Inflation rate	This is a continuous increase in the overall price level of goods and services in an economy over time.	Percentage (%)	Chukuemeka and Ibetewe (2020)
Annual rainfall	This is the total amount of precipitation (rain, snow, sleet, etc.) that falls in a specific area over the course of a year.	Inches	Amakor & Anyamaobi, 2022; Anderson & Wallgren, 2022.
Supply of fertilizer	This is the quantity of fertilizers (such as nitrogen, phosphorus, and potassium compounds) that is	Quantity (Volume)	Dossou et al. (2020)

Variables	Definition	Measurement	Source
	available for use in agriculture within a given period, usually a year.		

Results and Discussion

Descriptive Analysis

In order understand the pattern and trends in each of the variables included in the model specified, we carried out the descriptive analysis, presented in Table 2.

Table 2 Descriptive Statistics

Variables	Mean	Median	Std. Dev.	Coeff. of Var	Min	Max
AGO – Agricultural Output	11.10	11.30	5.68	51.17	3.67	18.70
AGP – Agricultural Productivity	16.40	16.80	8.09	49.33	5.70	29.60
AGG – Agricultural Growth as	5.87	4.01	9.22	157.07	1,87	55.57
MFIC – Microfinance Institution Credit	84890.68	35628.93	101416.2	119.47	135.8	308319.3
MFID – Microfinance Institution Deposit	85914.29	50949.80	91903.82	106.97	639.6	281896.6
MFII – Microfinance Institution Investment	3667.99	3653.15	2906.59	79.24	118.4	8959.8
LAB – Labour Force – Total number of workforces	51.00	50.80	11.30	22.16	33.70	70.60
CAP – Capital Stock -	25.83	25.51	10.32	39.95	14.16	44.47
INF – Inflation Rates	15.89	10.10	16.25	102.27	0.68	75.40
SOF – Supply of Fertilizer	9.99	8.44	5.58	55.86	4.14	20.96
RAF – Annual Rainfall	1385.72	1382.60	140.74	10.16	1145.18	1808.6

Source: Author’s Computation

From Table 2, agricultural output had a mean value of about 11.1 trillion naira, implying that on the average, agricultural output in Nigeria was 11.1 trillion naira within the period being investigated. The standard deviation of agricultural output was 5.68 trillion naira. The maximum value was 18.7 trillion naira, while the minimum value was 3.67 trillion. The average value for agricultural productivity in Nigeria was 16.4 million with a standard deviation of 8.09 million, which suggests a minimal difference in the values of agricultural productivity over the years within the period investigated. The minimum value of 5.70 million, while the maximum value of agricultural productivity was 29.6 million.

The average value of agricultural growth was 5.87% with a standard deviation of 9.22%, which indicates that the values of agricultural growth deviates widely from the mean value over the years for the period under consideration. The minimum value of agricultural growth was 1.87%, while the maximum value was 55.57%. Microfinance institutions' credit (MFIC) had an average value of ₦84,890.63 million, with a standard deviation of ₦101,416.2 million, which indicates a wide spread in the value of microfinance institution credit within the investigated timeframe. The minimum value of microfinance institutions' credit was ₦135.8 million, while the maximum value was ₦308,319.3 million.

Microfinance institutions' deposits (MFID) had an average value of ₦85,914.29 million with a standard deviation of ₦91,903.82 million, which shows that microfinance deposit deviates widely from the mean value with the considered period. The minimum value of microfinance institutions' deposit was ₦639.6 million, while the maximum value of microfinance institutions' deposit was ₦281,896.6 million. Microfinance institutions' investment (MFII) had an average value of ₦3,667.99 million with a standard deviation of ₦2,906.59 million, which indicate a wide spread in the value of microfinance institution investment. The minim value of microfinance institutions' investment was ₦118.4 million, while the maximum value was ₦8,959.8 million.

Labour (LAB) had an average value of 5.1 million individual, with a standard deviation of 1.13 million individuals, which suggests that minimal difference in labor force over the years for the period under consideration. The minimum value of labour was 3.37 million, while the maximum value of labor was 7.06 million individuals. Capital (CAP) had an average value of ₦28.83 million with a standard deviation of ₦10.32 million, which indicates a wide difference in capital formation over the years for the period under consideration. The minimum value of capital was ₦14.17 million, while the maximum value of capital was ₦44.48 million. Inflation rate (INF) had an average value of 15.89 percent with a standard deviation of 16.25 percent, which indicates that there has been wide spread of inflation rate over the years. The minimum value of inflation rate was 0.68 percent, while the maximum value of inflation rate was 75.40 percent.

The coefficient of variation in Table 2 is the only statistic that can be used for cross-variable comparison, unlike standard deviation and the others as the unit of measurement does not affect it. Hence, this is the reason for its being singled out in this paragraph for discussion. The coefficient of variation of annual rainfall and labour force, which are 10.16 and 22.16 respectively are relatively low compared to others. This was followed by capital stock with coefficient of variation of 39.95. It was also recorded in Table 4.1 that agricultural output and agricultural productivity have relatively low coefficient of variation of 51.17 and 49.33. On the other hand, agricultural growth, microfinance institution credit, microfinance institution deposit, inflation rates, and microfinance institution investment recorded the highest dispersion with coefficient of variations of 157.07, 119.47, 106.97, 102.27, and 79.24 respectively. This deviation shows a relatively lower variation in labor force and annual rainfall. However, the deviation is relatively higher for agricultural growth, microfinance institution credit and microfinance institution investment.

Correlation Analysis

Correlation analysis was conducted to ascertain the level of multicollinearity between the explanatory variable include in the models. The results of the correlation analysis are presented in Table 3. The p-values of the correlation coefficient in Table 3 indicate the statistical significance of the correlation between each pair of the variables. The magnitude of the correlation coefficients (the highest being 0.591) and their corresponding p-values show that the explanatory variables are correlated but not perfectly correlated. Hence, the results obtained in this study were not affected by perfect multicollinearity problem.

	AGO	AGP	AGGR	MFIC	MFID	MFII	LAB	CAP	INF	SOF	RAF
AGO	1.000										
AGP	0.514 (0.000)	1.000									
AGGR	-0.107 (0.571)	-0.102 (0.5903)	1.000								
MFIC	0.479 (0.000)	0.471 (0.000)	-0.209 (0.265)	1.000							
MFID	0.511 (0.000)	0.505 (0.000)	-0.207 (0.270)	0.590 (0.000)	1.000						
MFII	0.401 (0.000)	0.406 (0.000)	-0.139 (0.462)	0.565 (0.001)	0.230 (0.000)	1.000					
LAB	0.578 (0.000)	0.575 (0.000)	-0.121 (0.522)	0.513 (0.000)	0.540 (0.000)	0.383 (0.000)	1.000				
CAP	-0.388 (0.000)	-0.396 (0.000)	-0.055 (0.771)	-0.441 (0.014)	-0.493 (0.005)	-0.333 (0.000)	-0.304 (0.000)	1.000			
INF	-0.568 (0.001)	-0.571 (0.001)	0.007 (0.970)	-0.397 (0.029)	-0.428 (0.018)	-0.498 (0.005)	-0.585 (0.000)	0.588 (0.000)	1.000		
SOF	0.591	0.581	-0.271	0.376	0.376	0.352	0.222	-0.100	-0.017	1.000	

	(0.000)	(0.001)	(0.147)	(0.000)	(0.000)	(0.055)	(0.000)	(0.595)	(0.925)		
RAF	-0.256 (0.171)	-0.254 (0.175)	0.071 (0.705)	-0.294 (0.114)	-0.297 (0.110)	-0.193 (0.305)	-0.284 (0.128)	0.076 (0.687)	0.207 (0.271)	-0.339 (0.066)	1.000

p-values are in parentheses below the coefficient. A coefficient is statistically significant if the associated p-value is not greater than 0.05.

Source: Author's Computation

Diagnostic Results

The results of the general tests on the explanatory powers of the equation as well as the specific tests carried out to check the validity of the models' assumption on the normality of the distribution of residuals, autocorrelation, multicollinearity, and heteroscedasticity are described in this section.

(The R-squared values were 0.814, 0.812, and 0.889 in the equations respectively, and their respective F-statistic's p-values were 0.000 in each case. Thus, these F-statistic values are statistically significant at the 5% critical level. This means that the models were good fits.

With respect to the test for non-normality of the distribution of the residuals, the Jarque-Bera test statistic's p-values of 0.725, 0.718, and 0.845 in each of the models implies that the test statistics were not statistically significant at 5% level of significance. So, the study failed to reject the null hypothesis of normally distributed error terms, which leads to the conclusion that the residuals were normally distributed.

Using the tolerance and variance inflator factor (VIF) test, the hypothesis of multicollinearity among the explanatory variables was rejected, for VIF < 10 and tolerance > 0.01 in all cases (mean VIF = 1.87). This implies that the model was devoid of severe multicollinearity. Hence, multicollinearity was not a problem in estimating the model.

As reported in Table 4.6, the Breusch-Pagan-Godfrey methodology was applied to test for the existence of heteroscedasticity across the three equations. The test statistics for agricultural output, agricultural productivity, and agricultural growth were 1.26, 1.24, and 1.29 respectively, with their corresponding p-values of 0.263, 0.265, and 0.256. Thus, according to this decision rule, this means that none of the equations suffered from the problem of heteroscedasticity or unequal variance of error terms, since the p-values are greater than the 0.05 significance level.

Breusch-Godfrey methodology was employed to test for the existence of autocorrelation problem. As revealed in Table 7, the F-statistic for agricultural output, agricultural productivity, and agricultural growth models were 1.29, 1.30, and 2.29 respectively, with their corresponding p-values of 0.255, 0.253, and 0.135. This implies that none of the models suffered the serial correlation problem, as all the p-values exceed 0.05.

Unit Root Test of Variables

The results of Augmented Dickey-Fuller unit root test conducted to verify their stationarity and order of integration are presented in Table 4. The results indicate that the data were mix of I(0) and I(1) series, which is a valid condition for the Auto-Regressive Distributive Lag (ARDL) estimation. More specifically, agricultural output, agricultural growth, and annual rainfall follow I(0) series, indicating that they are stationary at levels, while agricultural productivity, microfinance credit, microfinance deposit, microfinance investment, labour force, capital stock, inflation rates, and supply of fertilizer were stationary at first difference.

Table 4 Results of Augmented Dickey Fuller Unit Root Test

	At Level Series		At First Difference Series		Order of Integration
Variables	Statistic	p-value	Statistic	p-value	
AGO	-2.190	0.042	-	-	I(0)
AGP	0.057	0.963	-3.391	0.011	I(1)
AGGR	-3.530	0.007	-	-	I(0)
MFIC	2.378	0.999	-3.514	0.007	I(1)
MFID	3.487	1.000	-3.010	0.034	I(1)
MFII	-1.357	0.602	-3.650	0.004	I(1)
LAB	1.027	0.994	-3.117	0.025	I(1)
CAP	-1.806	0.377	-6.782	0.000	I(1)
INF	-2.544	0.105	-4639	0.000	I(1)
SOF	-0.800	0.819	-3.898	0.002	I(1)
RAF	-5.108	0.000	-	-	I(0)

Source: Author's Computation, 2024

Optimal Lag Length Selection

Having established that the series were mix of I(0) and I(1), we proceeded to employ ARDL model estimation and determine the optimal lag length suitable for the ARDL estimation. Vector Autoregressive, VAR, was used to determine the optimal lag length for the ARDL cointegration test which was based on the AIC criterion as shown in Table 5.

Table 5 Lag Selection Results

Agricultural Output Model							
Lag	LL	LR	P	FPE	AIC	HQIC	SBIC
0	-796.53			2.60E+25	61.3484	61.3624	61.3968
1	-736.844	119.37*	0	2.8e+23*	56.8342*	56.862*	56.9309*
2	-736.841	0.00589	0.939	3.00E+23	56.9109	56.9527	57.056
3	-736.835	0.01284	0.91	3.30E+23	56.9873	57.043	57.1808
4	-736.747	0.17558	0.675	3.50E+23	57.0575	57.1271	57.2994
Agricultural Productivity Model							
Lag	LL	LR	P	FPE	AIC	HQIC	SBIC
0	-446.451			5.20E+13	34.4193	34.4333	34.4677
1	-388.211	116.48*	0	6.4e+11*	30.0163*	30.0441*	30.113*
2	-388.208	0.00693	0.934	6.90E+11	30.0929	30.1347	30.2381
3	-388.202	0.0124	0.911	7.40E+11	30.1694	30.2251	30.3629
4	-388.109	0.18541	0.667	8.00E+11	30.2392	30.3088	30.4811
Agricultural Growth Model							
Lag	LL	LR	P	FPE	AIC	HQIC	SBIC
0	-96.658			107.159*	7.51216*	7.52609*	7.56055*
1	-96.6565	0.00317	0.955	115.745	7.58896	7.61683	7.68574
2	-96.6513	0.01023	0.919	125.041	7.66549	7.70729	7.81065
3	-96.6367	0.02919	0.864	135.081	7.74129	7.79702	7.93484
4	-96.6347	0.00402	0.949	146.208	7.81806	7.88773	8.06000

Source: Author's calculation, 2024

As shown in Table 5, the optimal lag length for agricultural output, agricultural productivity, and agricultural growth models are 1, 1 and 0, respectively, according to the AIC, which is consistent with most of the other criteria. Using this optimal lag length, the likelihood ratio test which depends on the Maximum Eigen values of the stochastic matrix of the Johansen (1991) procedure for exploring the number of cointegrating vectors was employed as shown in Table 5.

ARDL Bound Test for Cointegration

The results of the test carried out for the ARDL Co-integration Approach are presented Table 6

Table 6 ARDL Cointegration Approach

	Model 1 for AGO (Agricultural Output)		**Model II for AGP (Agricultural Productivity)**		**Model III for AGG (Agricultural Growth)**	
K	7		7		7	
Computed F-statistic	5.491		4.471		9.097	
Upper and lower bound of the F-statistics at 5% significance level	I (0) Bound	I (1) Bound	I (0) Bound	I (1) Bound	I (0) Bound	I (1) Bound
.	2.32	3.50	2.32	3.50	2.32	3.50

K is the number of independent variables. There is long run relationship if the F-statistic value is greater than the upper critical bound of I_1 and an absence of a long-run relationship if it is lower than the lower critical bound of I_0 while the test is inconclusive if it falls between the two bounds.

Source: Author's Computation, 2024.

As shown in Table 6 in respects of agricultural output, agricultural productivity, and agricultural growth models, the F-statistics are 5.491, 4.471, and 9.097 respectively, which in each case, is greater than the 3.61 upper bound critical value at 5% significance level. Given these results, it is concluded that the models were all cointegrated, meaning that there exists a long-run relationship between each of the dependent variables and its regressors.

Results of the Long-Run ARDL Estimation of the Regression Equations

Following the evidence that each dependent variable and its independent variables exhibited long-term relationship, the long- and short-run parameters are applicable and estimated through the ARDL technique. However, for the reason of brevity and the concern of the study with only the long run effects of the explanatory variables on the dependent variables, it is only the long run estimates of the models that are reported here.

Presentation of the Estimates

Four regression equations were estimated—AGO, AGP, AGG equations—through the ARDL approach. The estimates from these equations are presented in Table 4.6.

Evaluation of Performance of Explanatory Variables

After the evaluation of the results of the overall robustness and diagnostic tests of the equations, we proceeded to examine the performance of each explanatory variable based on the size, sign, and the statistical significance. All results contained in Table 4.6 were evaluated at the 0.05 level of significance, except the evaluation of the effect of microfinance institutions' operation on performances of agricultural sector, which was evaluated at the 0.05 level of significance.

(a) Microfinance Institution Credit (*MFIC*): As shown in Table 4.6, the coefficients of MFIC in the three equations are 4.579, 0.663, and 10.824 respectively, with respective p-values of 0.012, 0.007, and 0.169, implying that the positive coefficients are statistically significant in the AGO and AGP equations, but not statistically significant in the AGG equation at the chosen level of significance of 0.05. In view of the fact that all coefficients were positive, it was concluded that microfinance institution credits influenced agricultural sector performance positively. This result is in line with the *a priori* expectation of positive effect. This is in conformity with the findings of Nwele et al (2015) and Lubna and Nabil (2019).

Table 7: ARDL Long-Run Estimates of the Models for the Three Categories of Agricultural Sector Performance

	Agricultural Output (or AGO) Model			Agricultural Productivity (or AGP) Model			Agricultural Growth (or AGGR) Model		
Variable	**Coeff**	**t-**	**P-**	**Coeff**	**t-Stat**	**P-**	**Coeff**	**t-**	**P-**
lnMFIC	4.579	2.87	0.012	0.663	3.14	0.007	10.824	1.46	0.169
lnMFID	0.376	0.91	0.379	0.05	0.85	0.412	14.599	2.37	0.034
lnMFII	-	-	0.852	0.032	2.53	0.025	9.652	3.70	0.000
lnLAB	3.039	2.58	0.023	0.426	2.54	0.025	395.76	2.29	0.039
lnCAP	0.048	2.99	0.010	-0.007	-2.94	0.012	-4.37	-	0.118
INF	0.002	1.40	0.184	0.0003	1.40	0.185	0.376	1.75	0.104
lnSOF	0.049	2.57	0.023	-0.001	-1.27	0.228	-0.842	-	0.225
lnRAF	-	-	0.096	0.003	2.44	0.035	-0.041	-	0.009
ECT_{t-1}	-	-	0.032	-0.479	-2.77	0.010	-	-	0.000
R-Squared	0.814	-	-	0.812	-	-	0.889	-	-
Adjusted R-Squared	0.571	-	-	0.567	-	-	0.744	-	-
F-statistic for the R^2	23.51	-	0.000	19.236	-	0.000	5.104	-	0.031
Heteroskedasticity (F-	1.26	-	0.263	1.24	-	0.265	1.29	-	0.256
Serial Correlation (f-	1.29	-	0.255	1.30	-	0.253	2.29	-	0.135
Jarque-Bera Test	0.64	-	0.725	0.67	-	0.718	0.34	-	0.845
Average VIF	1.87	-	-	1.87	-	-	1.87	-	-
Observation	31	-	-	31	-	-	31	-	-

Source: Authors' Computation

(b) Microfinance Institution Deposit (*MFID*): The coefficients of MFID in the models are 0.376, 0.050, and 14.599 respectively, with respective p-values of 0.379, 0.412, 0.034, implying that the positive coefficients is statistically significant in the AGG equation, but not statistically significant in the AGO and AGP equations at the 0.05 level of significance. Thus, it was concluded that microfinance institution deposits influenced agricultural sector performance positively. This result is also in line with the *a priori* expectation of positive effect. The outcome corroborates with what past studies conducted by Kofarmata and Danlami (2020), and Kanu and Isu (2015).

(c) Microfinance Institution Investment (MFII): The coefficients of MFII in the three equations are 0.017, 0.032, and 9.652 respectively, with respective p-values of 0.852, 0.025, and 0.000, implying that the positive coefficient is not statistically significant in the AGO equation, but statistically significant in the AGP and AGG equations at the 0.05 level of significance. Thus, it can be concluded that microfinance institution investments influenced agricultural sector performance positively. This result is in line with the *a priori* expectation. It is also in agreement with the findings of Nwele et al (2015) and Kofarmata and Danlami (2020).

(d) Labour Force (LAB): The coefficients of LAB in the equations are 3.039, 0.426, and 395.762 respectively, with respective p-values of 0.023, 0.025, and 0.039, indicating that the positive coefficients are statistically significant at the chosen 5% level of significance in all the Equations. Thus, it can be concluded that labour force has notable influence on agricultural sector performance. The result aligns with the *a priori* expectation. It also corresponds with the empirical findings of Dossou et al. (2020), Kofarmata and Danlami (2020), and Boateng et al. (2015).

(e) Capital Stock (CAP): The coefficients of CAP in the AGO, AGP, and AGG models are 0.048, 0.007, and -4.370 respectively, with corresponding p-values of 0.010, 0.012, and 0.118, indicating that the positive coefficient is statistically significant at the chosen 5% level of significance in the AGO and AGP models, but not in the AGG model. This suggests that capital stock has a notable influence on agricultural output and productivity, but not on agricultural growth. The result is consistent with our a priori expectation. It also corresponds with the empirical findings of Dossou et al (2020), Kofarmata and Danlami (2020), and Boateng et al. (2015).

(f) Inflation Rates (INF): The coefficients of inflation rates in the AGO, AGP, and AGG equations are 0.002, 0.0003, and 0.376 respectively, with corresponding p-values of 0.184, 0.185, and 0.104, indicating that the coefficient is not statistically significant at the 5% level of significance in any of the models. This suggests that inflation rates do not have influence on agricultural sector performance. This results supports our a priori expectation. This is because higher inflation rates reduces purchasing power, which tends to reduce production. However, the result indicates that increase in inflation brought about higher agricultural sector performance. However, this finding is not in tandem with the empirical findings of Dossou et al. (2020), Kofarmata and Danlami (2020), and Boateng et al. (2015), who found significant effects of inflation on agricultural performance.

(g) Supply of Fertilizer (SOF): The coefficients of SOF in the equations are 0.049, -0.001, -0.842 respectively, with respective p-values of 0.023, 0.228, and 0.225, indicating that the coefficient is statistically significant in the agricultural output model, but not statistically significant in the agricultural productivity and agricultural growth model at the chosen 5% level of significance in the models. This suggests that supply of fertilizer only has influence on agricultural output. The positive result is consistent with our a priori expectation of positive relationship. The result conforms to the findings of Boateng et al. (2015), Akpaeti et al. (2019), and Ajayi and Olalekan (2018).

(h) Annual Rainfall (RAF): The coefficients of RAF in the AGO equation, AGP model, and AGG model are -0.019, 0.003, and -0.041 respectively, with corresponding p-values of 0.096, 0.035, and 0.009, indicating that the coefficient is statistically significant at the chosen 5% level of significance in the AGP and AGG equations, but not in the AGO equation. This suggests that Annual Rainfall has a notable influence on agricultural productivity and growth, but not on agricultural output. The result is inconsistent with our a priori expectation. However, it corresponds with the empirical findings of Dossou et al (2020) and Kofarmata and Danlami (2020), who found significant effects of rainfall on agricultural performance.

Conclusion

A general and overall conclusion that emerges is that operation of microfinance institutions in Nigeria contributes positively and significantly to the performance of the agricultural sector. Specifically, microfinance institutions' credits and investment enhance agricultural productivity. Higher investment commitment by the microfinance institutions' allows the agricultural sector and key stakeholders boost productivity. Furthermore, inflation rates contributes significantly to agricultural sector in Nigeria.

This study therefore recommends that policymakers implement supportive measures to enhance the positive influence of microfinance institutions on agricultural performance in Nigeria. These include improving access to microfinance services in rural areas through mobile and agent banking, developing tailored financial products for farmers, and promoting financial literacy. Creating a regulatory framework to ensure sustainability of microfinance institutions and facilitating partnerships with agricultural extension services can further optimize outcomes. Investments in agricultural education, vocational training, and gender empowerment are essential to strengthening the labor force and productivity. Additionally, expanding credit facilities and investing in agricultural infrastructure, such as irrigation and storage, are critical for leveraging the positive effects of capital stock on agriculture.

The study notes limitations, including potential endogeneity issues and restricted applicability to other contexts. Thus, future research should incorporate broader economic and policy factors to better understand the dynamics between microfinance and agricultural performance. Further research on microfinancing and agricultural productivity should adopt longitudinal studies to assess the long-term effects of microfinance on agricultural borrowers, tracking metrics such as yields, incomes, and loan repayments over time. Exploring the role of digital financial services and fintech in enhancing agricultural microfinance, particularly in rural areas with increasing digital penetration, is also essential. Additionally, comparative studies across Nigeria's regions could reveal how factors like climate, soil quality, and market access influence the effectiveness of microfinance, providing insights for tailoring strategies to regional needs and improving overall agricultural productivity.

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