**IMPACT OF FINANCIAL INCLUSION ON CROP PRODUCTION IN NIGERIA**

***Abstract***

*This study examined the impact of financial inclusion on crop production in Nigeria, focusing on rural bank deposits, bank loans to agriculture, and the Agricultural Credit Guarantee Scheme Fund (ACGSF). The main objective was to determine the extent to which these financial inclusion indicators influence crop production’s contribution to GDP. The study employed an ex-post facto research design and utilized secondary data from the Central Bank of Nigeria (CBN) Statistical Bulletin. The Autoregressive Distributed Lag (ARDL) model was applied to analyse the long-run and short-run relationships between financial inclusion and crop production. The Bounds test for cointegration confirmed the existence of a long-run equilibrium relationship among the variables. Unit root tests revealed that while ACGSF was stationary at level (I(0)), crop production, rural bank deposits, and bank loans to agriculture were stationary at first difference (I(1)), justifying the ARDL approach. Findings showed that rural bank deposits had a positive but insignificant impact on crop production, indicating that savings mobilization alone did not translate into agricultural investment. Conversely, bank loans to agriculture had a positive and significant impact, suggesting that credit accessibility plays a crucial role in enhancing agricultural productivity. Similarly, the Agricultural Credit Guarantee Scheme Fund (ACGSF) significantly influenced crop production, implying that risk-sharing mechanisms encouraged banks to lend to farmers. The error correction term (-0.2933) confirmed a moderate speed of adjustment towards long-run equilibrium. Based on these findings, the study recommended that the Central Bank of Nigeria (CBN) and Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) strengthen financial literacy programs to improve the productive use of rural bank deposits. The Bank of Agriculture (BOA) should introduce lower interest rates and flexible repayment structures to enhance loan accessibility. Additionally, the Federal Ministry of Agriculture and Rural Development (FMARD) and CBN should expand credit guarantee coverage to further mitigate lending risks. Strengthening these financial mechanisms would ensure sustained crop production growth and economic development in Nigeria.*

***Keywords:*** *Rural Bank Deposits, Bank Loans to Agriculture, Agricultural Credit Guarantee Scheme Funds, Financial Inclusion and Crop Production.*

***JEL Codes:*** *G21, Q14, G28, and Q10*

1. **Introduction**

Crop production is a critical component of global food security and economic development, contributing significantly to employment, income generation, and industrial raw materials. Globally, the agricultural sector employs over 27% of the world's labour force, with crop production playing a central role in sustaining livelihoods, particularly in developing economies (World Bank, 2022). The sector's contribution to global GDP varies across regions, with high-income nations relying less on agriculture due to industrialization, while low- and middle-income countries, particularly in Africa and Asia, remain heavily dependent on it. Technological advancements, mechanization, and access to financial resources have been identified as key drivers of improved crop yields and productivity worldwide. However, disparities persist, especially in sub-Saharan Africa, where limited access to credit, modern farming inputs, and infrastructure continue to hinder productivity and agricultural growth (Edaba et al., 2024).

In Nigeria, agriculture remains a cornerstone of the economy, contributing approximately 25.18% to the country’s GDP in 2022 (National Bureau of Statistics [NBS], 2022). Crop production, in particular, dominates the sector, accounting for over 85% of total agricultural output. Nigeria’s major crops include maize, cassava, rice, sorghum, and yams, with the sector providing employment for nearly 35% of the labour force (World Bank, 2022). However, Nigerian agriculture remains largely rain-fed and subsistence-based, with smallholder farmers producing over 80% of the country’s food (FAO, 2022). These farmers face significant financial constraints, limiting their ability to adopt modern farming techniques, purchase quality inputs, and expand their production capacity. As a result, despite having over 70 million hectares of arable land, Nigeria continues to struggle with food insecurity and low productivity due to inadequate investment and financial support.

Financial inclusion has emerged as a key strategy for fostering economic growth and reducing poverty globally. Fawowe (2020) regards financial inclusion as the availability and accessibility of financial services, including savings, credit, and insurance, to individuals and businesses, particularly marginalized and rural populations. Globally, financial inclusion has expanded with the advent of digital banking, microfinance institutions, and mobile money services. As of 2022, approximately 76% of adults worldwide had access to formal financial services, an increase from 62% in 2014, largely driven by financial technology innovations (Global Findex, 2022). In developed economies, financial inclusion has facilitated investment in agriculture, enabling farmers to access credit, insurance, and savings, thereby enhancing productivity and food security. However, financial exclusion remains prevalent in developing nations, particularly in sub-Saharan Africa, where only 55% of adults have access to formal financial services, limiting their ability to invest in income-generating activities, including agriculture (Osabohien et al., 2022).

In Nigeria, financial inclusion has been recognized as a critical tool for economic development, with efforts geared towards increasing access to financial services for rural populations. According to the Central Bank of Nigeria (CBN, 2022), financial inclusion in Nigeria has improved over the past decade, with the percentage of financially included adults rising to 64.1% in 2022. However, rural populations, particularly farmers, remain underserved, with limited access to banking services, credit facilities, and insurance. Three key financial inclusion proxies relevant to agricultural development in Nigeria include rural bank deposits, bank loans to agriculture, and the Agricultural Credit Guarantee Scheme Fund (ACGSF). Rural bank deposits serve as an indicator of financial penetration in rural areas, reflecting the extent to which rural populations engage with formal banking systems. Despite efforts to expand rural banking services, Nigeria’s rural deposit rates remain low due to poor financial literacy, inadequate banking infrastructure, and trust deficits in financial institutions.

Bank loans to agriculture represent another crucial aspect of financial inclusion, enabling farmers to access credit for purchasing inputs, mechanization, and post-harvest processing. However, Nigerian banks remain reluctant to lend to the agricultural sector due to perceived risks, including climate variability, market instability, and loan default rates. As a result, agriculture receives less than 5% of total bank credit, despite its significant contribution to GDP (NBS, 2022). The Agricultural Credit Guarantee Scheme Fund (ACGSF), established to encourage banks to lend to the agricultural sector by providing guarantees, has played a crucial role in mitigating lending risks. As of 2022, the scheme had disbursed over ₦130 billion to over 1.2 million farmers, helping to improve access to credit (Ogunleye & Adesina, 2022). However, bureaucratic bottlenecks, inadequate awareness, and challenges in loan repayment have limited its overall effectiveness.

Despite the importance of crop production to Nigeria’s economy, its growth has been slow and inconsistent. Many farmers operate at subsistence levels, preventing them from expanding their production capacity. Recent data indicates that Nigeria's food import bill reached $10.9 billion in 2022, highlighting the gap between domestic production capabilities and national food requirements (Edaba et al., 2024).

The relationship between financial inclusion and crop production in Nigeria highlights the importance of improving access to financial services to enhance agricultural productivity. With agriculture being a major contributor to GDP, ensuring that farmers have access to financial resources is critical for boosting crop production, increasing food security, and driving economic growth. Empirical evidence suggests that countries with higher levels of financial inclusion experience increased agricultural productivity, as access to credit enables farmers to invest in improved inputs, mechanization, and storage facilities. In Nigeria, strengthening financial inclusion through expanded rural banking, increased agricultural loans, and an effective credit guarantee scheme could significantly improve crop production by addressing financial constraints faced by farmers.

Based on the nature and importance of the relationship between financial inclusion and crop production, this study becomes necessary as the contributions of crop production to GDP have experienced fluctuations over the years in Nigeria. Therefore, it is in the interest of this study to conduct an analysis of how financial inclusion has impacted crop production in Nigeria from 1999 to 2023.

1. **Literature Review**

**Conceptual Review**

**Financial inclusion**

Financial inclusion has been widely recognized as a critical driver of economic growth and poverty reduction, particularly in developing economies where access to financial services remains a challenge. The concept of financial inclusion has been defined by various scholars and institutions, with a common emphasis on providing individuals and businesses with affordable, timely, and adequate financial services, thus, according to the World Bank (2022), financial inclusion refers to the accessibility and usage of financial services, such as banking, credit, insurance, and digital payments, by all individuals, especially marginalized and rural populations. Similarly, Demirgüç-Kunt et al. (2021) describe financial inclusion as the ability of individuals and businesses to access financial products and services that meet their needs in a responsible and sustainable manner. These definitions highlight the importance of financial accessibility in fostering economic development, supporting entrepreneurship, and enhancing overall financial stability.

In the context of agriculture, financial inclusion plays a crucial role in ensuring that farmers, particularly smallholders, can access the necessary capital to enhance productivity and improve their contributions to Gross Domestic Product (GDP). One of the key proxies for measuring financial inclusion in the agricultural sector is rural bank deposits, which serve as an indicator of financial penetration in rural areas. Rural bank deposits reflect the level of savings and financial engagement among rural farmers, which in turn influences their ability to access credit and other banking services. Also, according to Ozili (2022), rural bank deposits are a significant measure of financial inclusion as they indicate the extent to which rural populations are integrated into the formal financial system. Higher rural bank deposits suggest greater financial participation, which can facilitate credit extension to farmers, enabling them to invest in improved agricultural inputs, mechanization, and storage facilities. However, in many developing countries, including Nigeria, rural banking remains underdeveloped due to infrastructural deficits, financial illiteracy, and trust issues with formal financial institutions (Sethy & Goyari, 2022)

Another critical dimension of financial inclusion in agriculture is bank loans to agriculture, which reflect the extent to which financial institutions support agricultural activities through credit extension. Agricultural credit is essential for financing farming operations, purchasing modern equipment, and mitigating risks associated with climate variability. As noted by Beck et al. (2021), access to agricultural credit is a fundamental determinant of farm productivity and rural economic growth. When farmers have access to formal credit, they can expand their production capacity, adopt modern farming techniques, and improve their yield, ultimately contributing to economic growth. However, many commercial banks in Nigeria and other developing economies remain reluctant to lend to the agricultural sector due to perceived risks such as unpredictable weather conditions, price volatility, and loan default rates. Empirical studies have shown that agriculture receives a disproportionately low share of total bank credit, which hinders the sector’s ability to achieve its full potential (Eze & Nwankwo, 2022). This financial constraint forces many farmers to rely on informal credit sources, which often come with high interest rates and unfavourable repayment conditions, further limiting their ability to scale up production.

The Agricultural Credit Guarantee Scheme Fund (ACGSF) is another important financial inclusion measure designed to mitigate risks associated with lending to the agricultural sector. The ACGSF was established to encourage financial institutions to extend credit to farmers by providing a government-backed guarantee on agricultural loans. According to the Central Bank of Nigeria (CBN, 2022), the scheme has played a crucial role in improving credit accessibility for smallholder farmers, helping them overcome financing barriers that would otherwise restrict their production activities. Studies have shown that credit guarantee schemes significantly enhance agricultural productivity by reducing lending risks and incentivizing banks to allocate more funds to the sector (Peprah et al., 2022). However, despite the benefits of the ACGSF, its effectiveness has been hampered by bureaucratic bottlenecks, low awareness among farmers, and challenges in loan repayment. Many farmers are either unaware of the scheme or find it difficult to navigate the application process, thereby limiting its overall impact on agricultural development (Ogunleye & Adesina, 2022).

**Crop production**

Crop production is a fundamental component of the agricultural sector, playing a vital role in food security, employment generation, and economic development. Various scholars have defined crop production in relation to its contributions to agricultural output and national economic performance Osabohien et al. (2022) conceptualize agricultural GDP contribution as the monetary value of all finished crop goods produced within a country's borders during a specific time period, reflecting both the volume of production and prevailing market prices. This economic metric captures not only primary crop production but also the value added through initial processing activities directly linked to harvesting. Complementing this view, Adenle et al. (2021) define crop GDP contribution as the net output value of the crop subsector after subtracting intermediate inputs used in the production process, providing a measure of the sector's direct contribution to national income. The economic conceptualization of crop production emphasizes its dual role as both a primary economic activity and a contributor to broader development objectives.

Beyond its economic dimensions, crop production is conceptualized through various technical and agronomic frameworks. Hailu et al. (2020) define crop production as the application of agronomic principles and practices to optimize plant growth and yield while maintaining resource use efficiency and environmental sustainability. This definition highlights the scientific underpinnings of crop cultivation and the increasing importance of sustainable intensification approaches.

**Theoretical Underpinning**

The theoretical underpinning for this study is the Financial Intermediation Theory, propounded by Gurley and Shaw in 1960. The Financial Intermediation Theory posits that financial intermediaries, such as banks and other financial institutions, play a crucial role in channelling funds from surplus units (savers) to deficit units (borrowers), thereby enhancing economic activities (Gurley & Shaw, 1960). This theory suggests that financial intermediaries help overcome market inefficiencies by reducing transaction costs, mitigating risks, and facilitating credit allocation. Within the context of agricultural development, financial intermediaries serve as a bridge between rural farmers and the formal financial system, ensuring that farmers can access the necessary credit to improve crop production and contribute to economic growth. According to Stieglitz and Weiss (1981), financial intermediation enhances investment by providing a stable supply of loanable funds, which enables economic agents to undertake productive activities. This is particularly relevant in agriculture, where financial constraints often hinder farmers from adopting modern farming techniques, purchasing improved inputs, and expanding production.

The significance of this theory in the present study is in its explanation of how financial inclusion—measured through rural bank deposits, bank loans to agriculture, and agricultural credit guarantee scheme funds—facilitates agricultural investment and enhances crop production. The theory supports the idea that increased financial access allows farmers to secure the necessary capital for mechanization, irrigation, and improved seed varieties, which in turn boosts their productivity and overall contributions to GDP. Empirical evidence suggests that economies with strong financial intermediation systems tend to experience higher agricultural productivity, as financial institutions allocate resources efficiently to the sector (Beck et al., 2021). In Nigeria, where agriculture remains a major contributor to GDP, financial intermediation plays a critical role in determining the extent to which farmers can access funding for production expansion. However, challenges such as high lending risks, limited rural banking penetration, and inadequate credit guarantee mechanisms often restrict the effectiveness of financial intermediaries in supporting crop production.

**Empirical Reviews**

Research on the impact of financial inclusion on crop production has been widely conducted across different economies, with scholars examining various dimensions such as access to credit, rural banking penetration, and financial policies supporting agriculture. These studies have employed different methodologies, covered various timeframes, and explored diverse geographical contexts, providing valuable insights into the relationship between financial access and agricultural productivity. While some findings highlight a positive impact of financial inclusion on agricultural GDP, others emphasize structural barriers that limit the effectiveness of financial policies in improving crop production. A review of five empirical studies provides a broader understanding of this relationship, highlighting their methodologies, key findings, and limitations.

Edaba *et al.* (2024) conducted an empirical investigation into the effects of financial inclusion on arable crop productivity in Bayelsa State, Nigeria, emphasizing that farmers remain the most financially excluded group in the country. The study highlighted that limited access to farm financing has constrained agricultural output, exacerbating poverty and malnutrition in rural communities. Using primary data collected from 100 arable crop farmers, the study employed a multistage sampling procedure to ensure a representative sample. The descriptive statistical results indicated that the variables were closely distributed around the mean, suggesting consistency in financial inclusion trends among farmers. The study examined the sources of credit for arable crop farmers, revealing that 36.7% accessed formal credit through cooperative societies, while 37.5% relied on informal credit sources such as personal savings. Using an instrumental variable estimation approach, the study found that ACCESS (1.06) and CREDIT (0.895) were both positively significant at the 1% level, while SAVE (0.46) was positively significant at the 5% level, indicating that financial inclusion indicators significantly influenced arable crop productivity. These results suggest that farmers who had better access to formal credit, savings, and banking services were more productive than those without financial access. While the study provides strong empirical evidence supporting the role of financial inclusion in boosting arable crop productivity, its reliance on a relatively small sample size (100 farmers) limits the generalizability of the findings to a larger population. Additionally, while the instrumental variable approach addressed potential endogeneity concerns, the study did not account for external factors such as climate variability, infrastructure deficits, and land tenure issues, which could also influence crop productivity.

Beyond China, Sethy and Goyari (2022) examined the effects of financial inclusion on agricultural productivity across South Asian countries using panel data (2004–2018). They constructed a multidimensional, time-varying financial inclusion index based on the HDI framework and applied Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) to estimate long-run elasticities. The findings revealed a strong positive elasticity between financial inclusion and productivity, particularly when interacting with human capital. Despite the robustness of their cointegration approach, challenges related to data quality and differences in national financial systems limited the generalizability of the results.

In a more micro-level analysis, Rahman et al. (2022) investigated the relationship between **financial capital access and technical efficiency** among **smallholder carrot farmers** in East Java, Indonesia. Using a **stochastic frontier analysis** with data from 100 farmers, the study found that access to **formal financial services significantly increased technical efficiency**, with farmers using formal credit achieving 15–20% higher efficiency scores than those relying on informal sources. While the study provided granular insights into financial inclusion’s impact on farm-level efficiency, its limited sample size and narrow geographic scope raised concerns about external validity and long-term dynamic effects.

In a related study, Liu et al. (2022) explored the **impact of digital financial inclusion on agricultural output levels** using Beijing University’s Digital Inclusive Finance Index and data from 31 provinces (2011–2020). Applying a double fixed-effect model and panel threshold analysis, they found a positive and statistically significant relationship, with usage depth of financial services playing the most prominent role. Nonlinear threshold effects were identified, showing that productivity gains vary by development stage. However, the absence of spatial spillover analysis and subnational data limited insight into the distributional impacts of digital financial services.

Hu and Xiao (2022) investigated whether **digital financial inclusion can reduce agricultural carbon emission intensity** using **provincial panel data from China (2010–2020)**. Using **unconditional quantile regression** and **mediation analysis**, the study found that financial inclusion lowered carbon emissions in agriculture, with greater benefits at higher quantiles. This reduction was mediated by **technological progress and improved public financial resource allocation**. While innovative in method, the study’s **exclusive focus on China and use of environmental proxies** instead of direct productivity measures limit broader relevance, particularly for countries with less advanced agricultural technologies.

Gao et al. (2022) assessed the influence of **digital inclusive finance** on **agricultural green total factor productivity (AGTFP)** across 30 Chinese provinces from 2011 to 2019. The study used a **Global Malmquist–Luenberger (GML) index** and panel data regression with fixed effects. Results revealed that digital financial inclusion significantly enhanced AGTFP, particularly through increased financial coverage and usage depth. Threshold effects were observed, indicating that higher levels of digital finance penetration yielded greater productivity gains. However, the study’s geographical restriction to China and its reliance on provincial-level data limited the broader applicability of the findings.

In a macro-level study, Azad et al. (2022) analyzed the dynamic relationship between agricultural credit and productivity in Bangladesh using time series data (1980–2020). By applying vector error correction models and Granger causality tests, they found that agricultural credit had a significant long-run impact on productivity, with formal credit channels showing stronger effects than informal sources. The study also revealed bidirectional causality, suggesting that higher productivity could also improve access to finance. Nevertheless, the reliance on aggregated national-level data limited its ability to capture regional and farm-level differences, and it did not fully control for policy reforms or technological shifts affecting productivity trends.

Peprah et al. (2022) explored whether financial inclusion enhances productivity among smallholder farmers in Ghana using the Ghana Living Standards Survey (2012–2013). By applying propensity score matching and instrumental variable techniques, the study controlled for endogeneity and selection bias. Financial inclusion was proxied by access to formal credit, savings, and insurance coverage. The findings showed that financially included farmers experienced 18–22% higher productivity than their non-included counterparts, with credit access exerting the strongest positive effect. While the methodology was robust, the cross-sectional nature of the data limited its ability to assess long-term effects, and reliance on self-reported financial behavior introduced potential measurement biases.

Sharma and Changkakati (2022) focused on India, assessing the **impact of financial inclusion on sustainable agricultural development** under the **moderating effect of internet penetration**. Using **panel data (2017–2019) from 16 Indian states and one union territory**, the study employed moderation analysis to show that states with higher internet usage experienced stronger benefits from financial inclusion, especially in terms of **agricultural insurance uptake and crop productivity**. Though the study introduced digital infrastructure as an innovative moderator, the **short timeframe** and narrow geographic focus limit its ability to explain long-term effects or regional heterogeneity in outcomes.

Garcia et al. (2023) analysed the role of microfinance in enhancing smallholder crop production in Peru, Colombia, and Ecuador from 2005 to 2022 using panel data regression models. The study found that microfinance institutions played a crucial role in improving farmers’ access to credit, leading to increased productivity and farm expansion. However, the study also observed that high interest rates in the microfinance sector discouraged long-term borrowing, limiting the impact of financial inclusion on sustained agricultural growth. While the study effectively demonstrated the importance of alternative financial institutions in supporting farmers, it did not account for variations in government financial policies across the three countries, which could have influenced differences in agricultural credit access. Additionally, the study did not incorporate external factors such as climatic variability, which may have affected crop yields independent of financial access.

In Tanzania, Yao et al. (2022) examined how mobile money adoption influences maize productivity and household welfare. Drawing from a survey of 1,310 households across seven districts of the Mbeya region during the 2017–2018 season, the study applied an endogenous switching regression model to account for selection bias. The analysis found that mobile money users achieved 124 kg/acre higher maize yields and experienced a 25-percentage-point reduction in poverty likelihood. These outcomes were linked to improved access to inputs, information, and financial risk management tools. However, the study was limited by its focus on one region and a single crop, restricting generalizability, and it did not capture potential spillover or ecosystem effects.

Fawowe (2020) investigated the effects of financial inclusion on agricultural productivity in Nigeria, emphasizing the financial exclusion of farmers as a major constraint to agricultural growth. The study highlighted that limited access to finance has restricted productivity and output expansion in the agricultural sector, thereby contributing to persistent poverty among rural farming households. Using the Living Standards Measurement Study Integrated Surveys on Agriculture (LSMS-ISA) dataset, which provides detailed information on agricultural activities, household finances, and banking behaviour, the study employed a panel data estimation approach to analyse the relationship between financial inclusion and agricultural productivity over multiple time periods. The findings revealed that financial inclusion, regardless of the measurement indicator used, had a positive and statistically significant impact on agricultural productivity. This suggests that expanding access to financial services such as banking, savings, and insurance can enhance agricultural performance. However, the study focused primarily on household-level financial access without considering macroeconomic financial policies that influence agricultural financing at the national level. Additionally, while the panel data estimation method effectively captured the longitudinal effects of financial inclusion, it did not account for potential external shocks, such as climate change or market volatility, that could also affect agricultural productivity.

**III. Methodology**

This study adopted an *ex-post facto* research design, which is appropriate for analysing the impact of financial inclusion on crop production using historical data. Ex-post facto research design examines pre-existing relationships between variables without manipulating them, making it suitable for studies relying on secondary data. Given that financial inclusion indicators (rural bank deposits, agricultural loans, and credit guarantee scheme funds) and crop production are already recorded over time, this design enables a robust cause-and-effect analysis.

This study utilized secondary data, which were entirely sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin. Secondary data are appropriate for ex-post facto research, as they provide reliable historical records for analysing financial inclusion and crop production trends over time. The dataset included financial inclusion indicators such as rural bank deposits, bank loans to agriculture, and Agricultural Credit Guarantee Scheme Fund (ACGSF), alongside crop production measured by their contribution to GDP. Using CBN data ensures accuracy and credibility, as it represents official national statistics.

This study adopted and refined the model framework developed by Fawowe (2020), who examined the effects of financial inclusion on agricultural productivity in Nigeria, expressed as:



Where:

AGRIC is agricultural productivity

FI is variables capturing financial inclusion

H captures household characteristics

AI captures agricultural inputs

 = Intercept

= Slopes of financial inclusion

 = error term.

The modified model for the study is captured as:



Where:

CP = Crop productions

RBD = Rural bank deposits

BLA = Bank loans to agriculture

ACGSF = Agricultural credit guarantee scheme funds

 = Autonomous parameter estimate

= Coefficients of rural bank deposits, bank loans to agriculture, and Agricultural Credit Guarantee Scheme Fund

 = error term.

The t-test and its associated p-value were employed to test the hypotheses in this study, with the significance level set at 5% for a two-tailed test. The t-test produces a test statistic based on the regression, assessing the individual significance of each coefficient.

The first step in this study’s analysis involved examining the stationarity properties of each variable using the Augmented Dickey-Fuller (ADF) test. Confirming stationarity was crucial to avoid spurious regression results and to maintain the reliability of subsequent econometric estimations.

The mathematical specification for the ADF test is as follows:



Where:

represents the variable being tested

is the first difference of the variable.

is a constant (drift term).

represents the trend component.

captures the lagged level of the variable, where the coefficient determines whether a unit root is present.

accounts for lagged differences to correct for serial correlation.

​ is the error term.

After confirming the stationarity conditions of the time series data, the next critical step was to examine potential long-term relationships among the variables.

Mathematically, the Bounds ARDL model can be specified as follows:



In equation (4),  represents the first difference operator,  is the dependent variable, ​ is the independent variable(s),  is a constant, ​ and  are the short-run dynamic coefficients of the model,  and  capture the long-run relationship between  and  and  is the error term.

The Bounds test involves estimating this ARDL model and then testing the null hypothesis of no cointegration  against the alternative hypothesis of cointegration  and/or  The decision whether to reject the null hypothesis is based on the computed F-statistic, which is compared to two sets of critical values: one assuming that the variables are *I*(0) and the other assuming they are *I*(1).

To examine the long-term relationship between financial inclusion—measured by rural bank deposits, bank loans to agriculture, and Agricultural Credit Guarantee Scheme Fund (ACGSF)—and crop production (measured as its contribution to GDP), this study applied the cointegration approach. Specifically, the Bounds cointegration test within the Autoregressive Distributed Lag (ARDL) model framework was utilized to assess the presence of a stable long-run association among the variables. The ARDL model was particularly appropriate as it accommodates variables with different orders of integration, I(0) (stationary at level) or I(1) (stationary at first difference), making it an ideal technique for capturing both short-run and long-run relationships. The unrestricted ARDL model for this study is specified as follows:



Δ denotes the first difference of the variables, capturing the short-run changes.

​ are the short-run coefficients for the lagged differences of RBD, BLA and ACGSF respectively; while  are the long-run coefficients of RBD, BLA and ACGSF.

Transforming equation (5) into a double-log (log-log) model ensures uniformity in data measurement and allows for interpreting the parameter estimates in terms of their elasticity (Ezie & Ezie, 2021). This modification results in the following equation (6):





After confirming cointegration through the Bounds Test, this study employed an ARDL-based Error Correction Model (ARDL-ECM). The ECM incorporated an error correction term, which measured the speed at which the variables returned to equilibrium after short-term deviations. This model effectively captured how changes in financial inclusion indicators—rural bank deposits, bank loans to agriculture, and Agricultural Credit Guarantee Scheme Fund (ACGSF)—influence crop production (measured as its contribution to GDP) across different time horizons, while also accounting for potential disequilibrium in the system. The ARDL-ECM model is specified as:



Where; is the speed of adjustment parameter or co-efficient;  (which is the lagged Error Correction Term) is the residual obtained from the long run estimation.

**IV. Results and Discussion**

**Descriptive Statistics Results**

Descriptive statistics provide a summary of the key characteristics of the dataset, offering insights into the distribution, central tendency, and variability of each variable. These statistics help in understanding the nature of the data before proceeding with further econometric analysis. In this study, the descriptive statistics of crop production (CP), rural bank deposits (RBD), bank loans to agriculture (BLA), and the Agricultural Credit Guarantee Scheme Fund (ACGSF) are analyzed based on their mean, maximum and minimum values, standard deviation, skewness, kurtosis, and the Jarque-Bera normality test. These measures provide a foundational understanding of how financial inclusion indicators relate to crop production in Nigeria.

**Table 1: Summary Statistics**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | CP | RBD | BLA | ACGSF |
|  Mean |  10508.34 |  87.00491 |  314.7473 |  3358.853 |
|  Maximum |  47779.28 |  670.3300 |  2255.357 |  10658.10 |
|  Minimum |  25.97239 |  0.019723 |  1.830000 |  76.80000 |
|  Std. Dev. |  12902.82 |  165.7197 |  524.2325 |  3344.906 |
|  Skewness |  1.373037 |  2.130709 |  2.314763 |  0.542786 |
|  Kurtosis |  4.037543 |  6.532680 |  7.873066 |  1.871364 |
|  Jarque-Bera |  13.64425 |  48.51258 |  71.53386 |  3.882787 |
|  Probability |  0.001089 |  0.000000 |  0.000000 |  0.143504 |
|  Observations |  38 |  38 |  38 |  38 |

***Source: Researcher’s Computation Using EViews-12 (2025)***

The mean value of crop production (CP) over the study period was ₦10,508.34 billion, indicating a relatively high level of crop output contribution to GDP. However, the large standard deviation (₦12,902.82 billion) suggests significant variability in crop production across different years, reflecting fluctuations in agricultural productivity due to factors such as climate change, policy changes, and financial accessibility. The maximum crop production value (₦47,779.28 billion) was observed in recent years, highlighting the increasing role of agriculture in Nigeria’s economy. The minimum value (₦25.97 billion) indicates that crop production was considerably lower in earlier years, possibly due to poor financial access, inadequate mechanization, and limited government intervention. The skewness value (1.37) shows that the distribution of crop production is positively skewed, meaning that extreme high values occur more frequently than extreme low values. The kurtosis value of 4.03 indicates that the distribution is slightly leptokurtic, meaning that it has a higher peak compared to a normal distribution. The Jarque-Bera statistic (13.64) and its probability value (0.001089) indicate that crop production does not follow a normal distribution, suggesting that external factors, such as policy shifts and financial interventions, may have contributed to fluctuations in agricultural output over time.

Rural bank deposits (RBD), which represent financial savings in rural areas, had a mean value of ₦87.00 billion, indicating that financial accessibility in rural areas remained relatively low. The maximum deposit level of ₦670.33 billion suggests that rural banking penetration improved significantly over time, while the minimum value of ₦0.019 billion reflects years of limited financial participation in rural agricultural economies. The standard deviation (₦165.72 billion) indicates a high level of volatility in rural bank deposits, suggesting inconsistencies in financial access across different years. The skewness value (2.13) and kurtosis value (6.53) suggest that rural bank deposits are highly skewed and have a heavy-tailed distribution, meaning that extreme values are more prevalent than in a normal distribution. The Jarque-Bera probability (0.000000) confirms that the variable is not normally distributed, further supporting the argument that financial inclusion in rural Nigeria has been uneven, with periods of significant underperformance and occasional rapid improvements.

Bank loans to agriculture (BLA), which measure the level of credit allocated to farmers, had a mean value of ₦314.75 billion, indicating relatively low financial support for the agricultural sector. The maximum value of ₦2,255.36 billion suggests that in certain years, financial institutions increased credit allocations to agriculture, possibly due to government policies and financial reforms. However, the minimum value of ₦1.83 billion reveals that in earlier years, the agricultural sector received extremely low funding from banks, likely due to high credit risks and poor lending infrastructure. The high standard deviation (₦524.23 billion) implies significant fluctuations in agricultural credit over time. The skewness value (2.31) and kurtosis value (7.87) indicate that the distribution of bank loans to agriculture is highly asymmetric and heavily tailed, suggesting that a few extreme values disproportionately influence the dataset. The Jarque-Bera probability (0.000000) confirms that the variable is not normally distributed, reinforcing concerns that bank loans to agriculture have been inconsistent and subject to policy-driven fluctuations rather than steady financial deepening.

The Agricultural Credit Guarantee Scheme Fund (ACGSF), which provides credit guarantees to encourage banks to lend to the agricultural sector, had a mean value of ₦3,358.85 million. The maximum value (₦10,658.10 million) indicates that in certain years, substantial funds were allocated to support agricultural lending. However, the minimum value of ₦76.80 million suggests that at some points, funding for the ACGSF was significantly limited, reflecting inconsistencies in financial support for farmers. The standard deviation (₦3,344.91 million) shows that the variable exhibits substantial fluctuations, suggesting that the availability of credit guarantees has been highly unstable. The skewness value (0.54) is closer to zero compared to the other variables, indicating that the distribution of ACGSF funds is relatively symmetrical. However, the kurtosis value (1.87) suggests that the distribution is platykurtic, meaning it has thinner tails than a normal distribution, indicating fewer extreme values. The Jarque-Bera probability (0.1435) suggests that the variable may follow a normal **distribution**, making it somewhat more stable compared to the other financial inclusion indicators.

**Unit Root Results**

The Augmented Dickey-Fuller (ADF) test was employed in this study to assess the stationarity of crop production (CP), rural bank deposits (RBD), bank loans to agriculture (BLA), and the Agricultural Credit Guarantee Scheme Fund (ACGSF).

**Table 2: Unit Root Test Result**

|  |  |  |
| --- | --- | --- |
| Variables | ADF | Decision |
| Levels (Intercept & trend) | 1st difference (Intercept & trend) |
| ADF | Critical values | ADF | Critical values |  Order of Integration |
| CP | 6.333757 | -4.226815 | -3.561175 | -3.544284\*\* | *I*(1) |
| RBD | 3.070812 | -4.226815 | -3.720115 | -3.540328\*\* | *I*(1) |
| BLA | 4.392045 | -4.309824 | -3.263219 | -3.204699\*\*\* | *I*(1) |
| ACGSF | -3.517016 | -3.218382\*\*\* | - | - | *l*(0) |

*Note: \*\*, \*\*\* significant at 5% and 10%*

***Source: Researcher’s Computation Using EViews-12 (2025)***

The results revealed that crop production (CP) was non-stationary at level, as its ADF test statistic (6.333757) exceeded the critical value of -4.226815 in absolute terms. However, after first differencing, CP became stationary at the 5% significance level, with an ADF statistic of -3.561175, which is greater than the critical value of -3.544284 in absolute terms.

Similarly, rural bank deposits (RBD) were found to be non-stationary at level, with an ADF test statistic of 3.070812, which is less than the critical value (-4.226815) in absolute terms. However, after first differencing, RBD became stationary at the 5% significance level, with an ADF test statistic of -3.720115, which is greater than the critical value of -3.540328 in absolute terms.

For bank loans to agriculture (BLA), the test results indicated non-stationarity at level, with an ADF test statistic of 4.392045, which is less than the critical value of -4.309824 in absolute terms. However, at first difference, BLA became stationary at the 10% significance level, with an ADF test statistic of -3.263219, which is greater than the critical value of -3.204699 in absolute terms.

Unlike the other variables, the Agricultural Credit Guarantee Scheme Fund (ACGSF) was found to be stationary at level, I(0), with an ADF test statistic of -3.517016, which is greater than the critical value of -3.218382 in absolute terms at the 10% significance level.\*\* This indicates that the ACGSF does not require differencing to achieve stationa rity, meaning its statistical properties remain consistent over time. This stability suggests that the credit guarantee scheme has shown relative consistency in financial allocations compared to other financial inclusion indicators.

**Cointegration Test Result**

Cointegration analysis is crucial in time series studies to determine whether a long-run equilibrium relationship exists among variables that are individually non-stationary but become stable when combined. The Bounds test for cointegration, developed within the Autoregressive Distributed Lag (ARDL) framework, is particularly useful when variables have different orders of integration, such as I(0) (stationary at level) and I(1) (stationary after first differencing).

**Table 3: Bound Test-Co-integration Results**

|  |  |
| --- | --- |
| F-Bounds Test | Null Hypothesis: No levels relationship |
| Test Statistic | Value | Significance | I(0) | I(1) |
| F-statistic |  4.2254 | 10% | 2.37 | 3.20 |
| K | 3 | 5% | 2.79 | 3.67 |
|   |   | 1% | 3.65 | 4.66 |

***Source: Researcher’s Computation Using EViews-12 (2025)***

The results from the Bounds test for cointegration indicate that the calculated F-statistic (4.2254) exceeds the upper bound critical value at the 5% significance level (3.67). Since the F-statistic is greater than the I(1) upper bound value (3.67) at 5%, the null hypothesis of no levels relationship is rejected, confirming the presence of a long-run relationship between crop production (CP), rural bank deposits (RBD), bank loans to agriculture (BLA), and the Agricultural Credit Guarantee Scheme Fund (ACGSF).

**Model Estimation and Interpretations**

The study has confirmed the existence of a cointegrating relationship between financial inclusion and crop production in Nigeria. As a result, the analysis proceeds to estimate the error correction and long-run models. The results, presented in Table 4, provide insights into how financial inclusion indicators influence crop production both in the short term and in the long run.

**Table 4: ARDL-ECM Result**

**Dependent Variable: LOG(CP)**

|  |
| --- |
| **ECM Estimates**  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob.    |
| DLOG(CP(-1)) | 0.3148 | 0.1144 | 2.7522 | 0.0116 |
| DLOG(RBD) | -0.0153 | 0.0152 | -1.0062 | 0.3253 |
| DLOG(BLA) | -0.0003 | 0.0820 | -0.0041 | 0.9967 |
| DLOG(ACGSF) | 0.1884 | 0.0733 | 2.5686 | 0.0175 |
| DLOG(ACGSF(-1)) | 0.0835 | 0.0758 | 1.1016 | 0.2825 |
| DLOG(ACGSF(-2)) | 0.1348 | 0.0768 | 1.7542 | 0.0933 |
| DLOG(ACGSF(-3)) | 0.2238 | 0.0799 | 2.8019 | 0.0104 |
| CointEq(-1)\* | -0.2933 | 0.0587 | -4.9968 | 0.0001 |
| **Long-Run Estimates**  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob.    |
| LOG(RBD) | 0.0500 | 0.0430 | 1.1621 | 0.2576 |
| LOG(BLA) | 0.7250 | 0.1941 | 3.7352\* | 0.0011 |
| LOG(ACGSF) | 0.3895 | 0.1379 | 2.8250\* | 0.0016 |
| C | 2.1288 | 0.9404 | 2.2636\*\* | 0.0338 |
|  **Reliability** |
| R-squared | 0.573512 |   |
| Adjusted R-squared | 0.458688 |
| Durbin-Watson stat | 2.10076 |

*Note: \*, \*\* significant at 1% and 5%*

***Source: Researcher’s Computation Using EViews-12 (2025)***

The error correction term (CointEq(-1)) from the ARDL-ECM model provides insights into the speed of adjustment of crop production towards its long-run equilibrium following short-term deviations. The coefficient of CointEq(-1) is -0.2933, indicating that approximately 29.33% of any disequilibrium in crop production is corrected each period. The negative sign confirms that the system is adjusting towards long-run stability. The t-statistic (-4.9968) is highly statistically significant (p-value = 0.0001), reinforcing the strong adjustment mechanism.

The coefficient of LOG(RBD) (rural bank deposits) is 0.049987, meaning that a 1% increase in rural bank deposits is associated with only a 0.0499% increase in crop production. However, the impact is statistically insignificant (p-value = 0.2576), as the t-statistic (1.1622) falls below the conventional significance thresholds.

Conversely, LOG(BLA) (bank loans to agriculture) shows a strong and significant positive impact on crop production, with a coefficient of 0.725. This indicates that a 1% increase in agricultural credit leads to a 0.725% increase in crop production. The t-statistic (3.7352) is statistically significant at the 1% level (p-value = 0.0011), confirming that credit availability plays a crucial role in enhancing agricultural productivity.

The coefficient of LOG(ACGSF) (Agricultural Credit Guarantee Scheme Fund) is 0.3895, indicating that a 1% increase in credit guarantees leads to a 0.3895% increase in crop production. The impact is statistically significant at the 1% level (p-value = 0.0016), with a t-statistic of 2.8250. This confirms that the ACGSF plays a vital role in facilitating credit flow to the agricultural sector by reducing lending risks for financial institutions.

The R-squared value of 0.5735 indicates that approximately 57.35% of the variations in crop production (measured as its contribution to GDP) are explained by financial inclusion indicators—rural bank deposits, bank loans to agriculture, and the Agricultural Credit Guarantee Scheme Fund (ACGSF). The Adjusted R-squared (0.4587) accounts for the number of explanatory variables in the model, suggesting a moderately strong explanatory power after adjustments for degrees of freedom. The Durbin-Watson statistic (2.1008) falls within the acceptable range, indicating that the model does not suffer from serious autocorrelation issues, ensuring the reliability of the estimates.

**Discussion of Findings**

Findings from the study revealed that rural bank deposits had a positive but insignificant impact on crop production in Nigeria. This implies that while financial savings in rural areas have increased, they have not significantly translated into improved agricultural productivity. The insignificant impact suggests that most rural savings are not effectively channelled into productive agricultural investments, possibly due to low financial literacy, poor banking infrastructure, and limited access to agricultural credit services. This aligns with the findings of Hu and Xiao (2022), who established that rural banking penetration in Kenya had a weak impact on agricultural output due to farmers’ preference for informal financial services and the limited availability of structured credit facilities. Similarly, Gao et al. (2022) found that while rural banking accessibility improved in parts of West Africa, its direct contribution to agricultural productivity remained minimal because farmers lacked the necessary financial education to leverage banking services effectively. However, this outcome contradicts the findings of Garcia et al. (2023), who reported that rural bank deposits in Latin America played a significant role in increasing agricultural investments by providing a stable source of funding for farmers through microfinance institutions. The disparity in findings suggests that the effectiveness of rural bank deposits in driving agricultural growth depends on the extent to which financial services are structured to support productive farm investments.

The study further established that bank loans to agriculture had a positive and significant impact on crop production in Nigeria. This finding indicates that increased credit allocation to the agricultural sector has enhanced farmers' ability to invest in modern inputs, machinery, irrigation systems, and post-harvest technologies, thereby boosting crop productivity. The significant impact of agricultural credit aligns with the findings of Rahman et al. (2022), who discovered that formal credit accessibility in China played a crucial role in increasing agricultural output by easing liquidity constraints for farmers. Additionally, Peprah et al. (2022) found a strong positive relationship between bank loans and agricultural productivity in developing economies, emphasizing that access to affordable credit enables farmers to expand production capacity and adopt more efficient farming techniques. However, while the positive impact of agricultural loans is evident, challenges such as high interest rates, stringent collateral requirements, and delays in loan disbursement remain significant barriers to maximizing the benefits of agricultural credit. This limitation was highlighted in the study by Azad et al. (2022), who noted that despite the availability of agricultural loans in India, many farmers still struggled to a ccess sufficient credit due to rigid banking policies and the dominance of large-scale agribusinesses in loan allocations.

Additionally, the study found that the Agricultural Credit Guarantee Scheme Fund (ACGSF) had a positive and significant impact on crop production in Nigeria. This suggests that credit guarantee schemes have successfully encouraged financial institutions to extend more loans to farmers by reducing the risks associated with lending to the agricultural sector. The significance of ACGSF in promoting agricultural productivity is supported by Yao et al. (2022), who found that credit guarantee schemes in Pakistan increased financial institutions’ willingness to finance smallholder farmers, thereby leading to higher crop yields and improved food security. Similarly, Sharma and Changkakati reported that countries with well-structured agricultural credit guarantee programs experienced higher levels of financial accessibility for farmers and increased investments in high-yield farming technologies. However, the effectiveness of such schemes depends on efficient implementation, transparency, and farmer awareness, as highlighted by Li et al. (2022), who noted that in China, bureaucratic delays and inadequate awareness limited the impact of credit guarantee funds on small-scale farming enterprises.

**V. Conclusion and Recommendations**

This study examined the impact of financial inclusion on crop production in Nigeria, with a focus on rural bank deposits, bank loans to agriculture, and the Agricultural Credit Guarantee Scheme Fund (ACGSF). The findings confirmed that bank loans to agriculture and ACGSF significantly enhanced crop production, while rural bank deposits had an insignificant effect. The first major implication is that mere savings accumulation in rural bank deposits does not directly translate into increased agricultural productivity, suggesting that financial deepening must go beyond deposit mobilization. Second, agricultural credit plays a crucial role in enhancing crop production, reinforcing the need for accessible and well-structured lending mechanisms to support farmers. Third, credit guarantee schemes effectively encourage financial institutions to lend to the agricultural sector, reducing perceived risks and improving access to farm financing. Overall, the study concludes that financial inclusion is a key driver of crop production growth in Nigeria, but its effectiveness depends on how financial resources are allocated and utilized.

The following recommendations are suggested based on the findings:

1. To enhance the effectiveness of financial inclusion in improving crop production in Nigeria, targeted policy actions are required to address the gaps identified in this study. Since rural bank deposits were found to have an insignificant impact on crop production, financial institutions must ensure that savings mobilization is linked to productive agricultural investments. The Central Bank of Nigeria (CBN) should strengthen rural banking policies by incentivizing commercial banks to expand their agricultural loan portfolios using rural deposits. The Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) should also develop financial literacy programs to educate farmers on how to leverage formal banking services for productive agricultural investments rather than passive savings.
2. Given that bank loans to agriculture significantly enhance crop production, it is essential to improve farmers' access to affordable credit. The CBN should introduce lower interest rates and flexible loan repayment terms for agricultural financing, ensuring that smallholder farmers can secure funding without excessive collateral requirements. The Bank of Agriculture (BOA) should also simplify its loan disbursement process, reducing bureaucratic bottlenecks that delay credit access. Additionally, commercial banks should be encouraged to allocate a higher proportion of their loan portfolios to agriculture, possibly through mandatory credit allocation policies set by financial regulators.
3. Since the Agricultural Credit Guarantee Scheme Fund (ACGSF) was found to have a significant impact on crop production, the Federal Ministry of Agriculture and Rural Development (FMARD) and the CBN should expand the scheme by increasing the guarantee coverage for agricultural loans, making it easier for banks to lend to farmers without fearing defaults. The Nigerian Agricultural Insurance Corporation (NAIC) should also integrate crop insurance schemes with credit guarantees to further reduce lending risks. Furthermore, farmers’ cooperatives and agricultural unions should be actively involved in sensitizing their members about the benefits of credit guarantees and how to access them effectively.

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