GUSAU JOURNAL OF BUSINESS ADMINISTRATION (GUJOBA)

Vol. 5 Issue 1, June, 2026; Pp 001 - 012

ISSN: 2811-1702. https://doi.org/10.57233/gujoba.v5i1.01

A Publication of the Department of Business Administration, Federal University Gusau, Nigeria

IMPACT OF FINANCIAL ACCESSIBILITY ON AGRICULTURAL OUTPUT IN WEST AFRICA

***Sani Muhammad and Abdullahi Shehu**

Department of Economics, Usmanu Danfodiyo University, Sokoto
Department of Economics, Federal University, Birnin-Kebbi

*Correspondence: *sani.muhammad1@udusok.edu.ng*

ABSTRACT

This study investigates the critical relationship between financial accessibility and agricultural output in 15 developing countries in West Africa over the period from 2010 to 2020. The study applies the Generalized Method of Moments (GMM) and panel causality tests to analyze the dynamics among the relevant variables. Specifically, the focus is on how financial accessibility-measured through domestic credit provided by the private sector (CPS) and the domestic credit extended by the banking sector-affects agricultural output in the region. The findings of this study underscore that financial accessibility has a significant positive influence on agricultural output. This relationship suggests that when farmers and agricultural businesses can access credit and financial services, they are more likely to invest in better technologies, improve productivity, and ultimately increase their yields. Moreover, the study's results reveal a unidirectional causal relationship running from financial accessibility to agricultural output. By improving access to credit, farmers can invest in essential resources such as seeds, fertilizers, and equipment, thereby boosting productivity. This approach would not only enhance financial accessibility but also create more employment opportunities, thereby contributing to poverty alleviation in the region. The implications of this research are significant. Policymakers should recognize the vital role of financial services in supporting agricultural development. By fostering an environment that encourages the growth of financial institutions, particularly in underserved rural areas, there is potential for transformative changes in agricultural productivity.

Keywords: Financial inclusion, financial accessibility, agriculture, West Africa, GMM.

1. INTRODUCTION

Financial inclusion is one of the most generally recognised areas of international development engagement. It was discovered that over 1.7 billion individuals worldwide are "unbanked," meaning they do not have an account with a financial institution or a mobile money provider, and 515 million persons worldwide opened an account between 2014 and 2017 (Demirgüç-Kunt, Klapper, & Singer, 2015). The majority of people in West African countries are "unbanked" due to the high cost and inaccessibility of financial services, as well as their poor quality (Duvendack & Mader, 2019). According to recent estimates, around 2 billion individuals worldwide lack access to formal financial services sectors. Thus, South Asia, East Asia and the Pacific, and Sub-Saharan Africa make for the majority of the world's unbanked individuals, accounting for around 31%, 24%, and 17% of adults, respectively. High-income countries, on the other hand, account for just 3% of

the unbanked, including the Middle East (4%), Europe and Central Asia (5%), Latin America and the Caribbean (10%), and other countries (4%). This demonstrates that the great majority of persons with no bank account (about 46%) live in countries that are developing (Seck, Naiya, & Muhammad, 2017).

Financial deprivation is one of the primary reasons why poverty persists in most developing countries. Deprivation is caused by high transaction costs and a lack of access to technology that is tailored to the needs of rural communities. Another form of financial exclusion is the distance between nearby bank branches. The expense of transportation from clients' homes to bank branches where transactions take place is an often mentioned obstacle to basic financial inclusion. Financing gaps develop as a result of inequalities in bank proximity between urban and rural locations, and this is especially apparent in rural areas among women, who benefit from just 10% of total credit to small farmers and less than 1% of overall credit to agriculture (Hansen, 2019).

In most low-income nations, agricultural producers face many hurdles such as poor output, limited access to commercial sectors for marketing their products, and limited access to financial services through financial institutions. Agriculture is also an important economic activity in Africa, employing over 55% of the population, while receiving just about 1% of bank loans. Furthermore, only 4.7 percent of persons in rural areas of developing nations worldwide have credit from a formal financial provider and around 5.9 percent have a bank account. It is also said that the majority of smallholder farmers do not have bank accounts and conduct most of their transactions in cash (Agbenyo, Jiang, & Antony, 2019; Chandio, Gessesse, & Dunya, 2017).

Agriculture remains the backbone of economic growth for any economy, regardless of its degree of development. In actuality, agriculture has long been recognised as the cornerstone of all economies, and its importance is obvious. The job combines product contribution, market contribution, factor contribution, and foreign exchange contribution. Without a doubt, agriculture is the most important sector and a significant source of income for people. This is due to the fact that, in addition to providing food to the economy's flooded masses, it is the primary source of raw materials that many sectors require before their output may appear. With agriculture employing over 70% of the West African population (MeheRette, 2009), empirical research assessing whether a range of financial services serve largely impoverished and financially disadvantaged farmers is limited.

Financial markets (including insurance and credit markets) in West Africa are frequently undeveloped, with over 80% of the population financially excluded. According to Adesina (2012), despite accounting for 44% of GDP, the agricultural sector receives just 2% of total commercial bank loans. The reasons for the agricultural sector's undercapitalization are high collateral demands by banks, a lack of capacity to develop appropriate credit instruments for agriculture, high perceived risks of lending to this sector, and a general aversion of banks to agriculture (Terfa, 2018). The overall performance of agriculture in West Africa in terms of output and productivity, as well as the degradation of competitiveness, are the result of a slew of structural issues, many of which have been exacerbated by ineffective policies. Aside from the disincentives created by inconsistent government policies and interventions, structural issues such as market access, risks and uncertainties, and access to inputs, services, and technologies reduce the incentives to invest in agricultural and related upstream and downstream segments. While many restrictions and potential solutions are value chain specific, there are significant general constraints that cut across the majority of agricultural value chains (Lashitew, VanTulder, & Liasse, 2018).

The quest for improvement in agricultural output has been a mirage since the emergence of agriculture and remains so even in the face of the technological advancement. While other sectors of the global economy such as mining, services, and manufacturing has witnessed tremendous advancement, most developing countries are still faced with low agricultural output. Despite recent financial sector expansion in West Africa, many individuals and businesses remain excluded from official financial services. An examination of adults' and businesses' use of (and access to) financial services reveals that West Africans Countries fall behind other developing economies in these dimensions, and cost, distance, and documentation requirements are significant impediments. Individual characteristics analysis allows us to discover demographic groups that are

disproportionately excluded from the financial system. Rural residents, the impoverished, women, less educated individuals, young and elderly people, for example, suffer additional difficulties in gaining financial inclusion. Barriers to entry for both people and businesses tend to decrease as per capita GDP grows, especially in countries with more competitive, open, market-oriented, and well-regulated financial systems, as well as better established contractual and informational infrastructures (World Bank, 2008).

Furthermore, the agricultural sector in African nations has enormous and untapped potential, with smallholders often confronted with limited market linkages, low yields, and unpredictable quality. In normal conditions, having access to cash can assist farmers in efficiently handling and managing these difficulties. The majority of smallholder farmers are having problems acquiring proper structured financial services to meet their goals (Adejumo & Omonona, 2017; Alen & Coulibaly, 2017) Availability, access, and usage of financial inclusion (also known as banking the unbanked) is a crucial instrument for agricultural expansion as well as an additional tool for enabling impoverished farmers to have more sustainable lives.

Given the scope of existing studies and the relevance of financial inclusion in agricultural output, it might be argued that this field of study has received less attention. As a result, there is a knowledge gap on the influence of financial inclusion on Agricultural Output in West African Countries. This study aims to fill this research gap by examining the Impact of financial accessibility on agricultural output. The study will look at whether access to financial services may lead to increased agricultural output in West Africa, as well as whether there is an interaction impact between the two elements. The rest of the paper proceeds according to the following structure. Section 2 highlights the existing literature; Section 3 describes data, source of data and estimation procedure to estimate the model and Section 5 and 6 reveal the conclusion and recommendations.

2. LITERATURE REVIEW

2.1 Theoretical Framework

Three related theoretical frameworks form the foundation of this thesis. First are the theories of financial intermediation under which theories of information asymmetry, transaction costs and regulation. The second set provides the theories of social exclusion. This theory is key to the understanding of the concepts of financial inclusion, especially within the context agricultural output. The third theory is the theory of inclusive growth. The choice of the three overlapping theoretical frames in this study is aimed at providing more comprehensive understanding of how separate, yet related factors are interrelated in terms of their influence on the analysis of financial accessibility on agricultural output. Therefore, the utility of the three theories as the underlying theoretical bases for explaining financial accessibility on agricultural output in the West Africa countries context is examined.

2.2 Empirical Review

Shen et al. (2024) utilized panel data from 2012 to 2018 across 26 cities in the Yangtze River Delta region of China to analyze agricultural green total factor productivity. Employing a nonparametric approach, the study assessed productivity growth with and without considering environmental constraints. By using the system generalized method of moments (system-GMM) and an instrumental variable (IV) model, the researchers conducted a dynamic panel regression to explore the impact of digital financial inclusion on agricultural green performance. Their findings indicate a general enhancement in agricultural green performance within the region, driven primarily by technological progress. Furthermore, the development of inclusive digital finance significantly boosts agricultural productivity, with the positive effects amplified as traditional financial services evolve. Pandey (2022) investigated the current state of agricultural credit in India, identifying prevalent challenges and constraints.

The study, grounded in statistical data from various government sources, highlighted the government's efforts to expand agricultural credit through banking and financial institutions (BFIs) via various policies and programs. However, challenges such as credit ceilings, high collateral demands, limited redemption facilities, inadequate agricultural insurance, financial illiteracy, and insufficient farmer-friendly technologies hinder credit expansion. To encourage investment in agriculture, the government must address these issues and consider segmenting farmers based on their credit needs while promoting branchless banking solutions.

Men et al. (2024) examined the factors influencing farmers' access to agricultural credit, finding that family support, adult labor, and total farm size positively

correlate with credit accessibility, while age has a negative impact. Interestingly, education level, main crop farm size, on-farm income, and farm experience did not show significant associations. High interest rates emerged as the primary challenge, followed by complications in documentation processes, limited access to agricultural credit information, and inadequate collateral security. The study calls for enhanced support mechanisms that involve multiple stakeholders, including farmers, financial institutions (FIs), non-governmental organizations (NGOs), and government officials. Notably, the government has reduced agricultural credit interest rates and provided incentives for importing conservation agriculture (CA) inputs.

NGOs have also played a key role by offering information support for agribusiness plans. An improved process mechanism is essential at both the farmer and FI levels, ensuring access to credit with low interest rates and simplified documentation to promote CA practices effectively among Cambodian farmers. Agbenyo, Jiang and Antony (2019) examined co-integration analysis of agricultural growth and financial inclusion in Ghana using an annual time series data from the period of 1980 – 2014. Johansen Cointegration approach coupled with Fully Modified Ordinary Least Square method (FMOLS) for the estimation of long-run relationship between agriculture growth and financial inclusion in Ghana. The study revealed that, domestic credit to private sector as proxy for usage has an inverse significant relationship and also revealed that lending interest rate proxy for accessibility of financial services to farmers portrayed significantly positive impact on the growth of agriculture. Nakazi and Nathan (2020) examined the effect of commercial bank credit on agricultural growth in Uganda.

Quarterly series data sourced from Bank of Uganda and Uganda Bureau of Statistics are used for the study. Study period is from 2008Q3 – 2018Q4. The study utilizes the Autoregressive Distributed Lag (ARDL) approach to examine the short run and long run relationship between the dependent variable (Agricultural GDP) and independent variable (Commercial Bank Credit). The study reveals that credit has a significant and positive impact on agricultural output in the long run. In the short run credit has an instantaneous impact on agricultural output. Abimbola, Olokoyo and Farouk (2018) indicate that average current and savings account balance, average number of deposit money bank customers, average loan size to the agricultural sector has positive and significant impact on poverty alleviation. On the other hand, the study also reveals that cost of borrowing has negative impact on poverty alleviation.

Many existing studies suggest that increasing agricultural production decreases poverty by increasing farm revenue, improving health and nutrition, and expanding wage employment options (Gollin, 2015. In the same spirit, Majid (2004) demonstrates that poverty is more sensitive to agricultural labour productivity than total factor productivity. Kareem et al. (2013) establishes the relationship between agriculture outputs and macroeconomic variables. According to the findings, foreign direct investment (commercial bank loan, interest rate, and food import value) has a significant positive impact on agricultural output. Ammani (2012) discovered that formal credit had a positive and significant impact on agricultural productivity.

The study is significant because it revealed the impact of formal credit on each of the agricultural sub-sectors (crops, livestock, and fishing). Nyarko, Amoateng, and Aboagye (2023) investigate the influence of financial inclusion on poverty in emerging economies by utilising principal component analysis to create a financial inclusion index based on demand and supply data, including mobile accounts. Because of its efficiency and robustness in dealing with heteroscedasticity and autocorrelation, the authors employ the two-step system GMM estimator for the investigation. Financial inclusion rose and dramatically reduced poverty in the study period, according to the findings. Additionally, income disparity exacerbates poverty.

2.3 Gaps in the Literature

To be sure, the existing literature on finance and agriculture has a bias towards credit access. Therefore, for the poor, access to financial services and increased agricultural output are often not priorities because they are more concerned with other important welfare issues, such as consumption smoothing and cushioning from adverse income shocks. As a result, the importance of broad access to financial services on the lives of the poor and agricultural output must be considered. However, most studies attempting to examine broad financial services frequently employ proxy measures such as Distance to financial institutions and long-term asset ownership are two examples. Such an approach focuses solely on the poor, rather than the financially excluded

population. However, improving access to finance for all excluded societal members, not just the poor, has emerged as a key policy goal in both developed and developing economies.

Previous extant studies have also found a link between financial inclusion, financial stability, and credit risk (Musau, Muathe, and Mwangi, 2018; Musau, Muathe, and Mwangi, 2017). The majority of these studies have been conducted at the cross-national and sectoral levels. None of them examined the relationship between financial inclusion and agricultural output, resulting in a contextual gap. While some research has looked at the relationship between financial inclusion indicators and economic growth, others have looked at the relationship between poverty and agricultural productivity (Agbenyo, Jiang & Antony, 2019; Bekun & Akadiri, 2019; Emenug, 2019). The impact of financial inclusion on agricultural output in West African countries has received little attention.

Despite the fact that some studies have evaluated both financial inclusion and agriculture, there are several motivations for this study because there are few empirical evidences on the impact of financial accessibility on agricultural output in West African states. Its effects on agriculture in West African countries. Given the scope of existing research and the significance of financial accessibility in agricultural output, it is possible to conclude that the area of study has received less attention. As a result, there is a knowledge gap on the impact of financial accessibility on agricultural output in West African countries. This study aims to fill a research gap by examining the impact of financial accessibility on agricultural output.

3. METHODOLOGY

This study used secondary panel dataset covering the period from 2011 to 2020 in estimating the impact of financial accessibility on agricultural output in 15 West African economies. These countries are Benin Republic, Burkina Faso, Cape Verde, Gambia The, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Niger, Nigeria, Senegal, Sierra León, and Togo. However, the data were sourced from World Development Indicators (WDI, 2024) database.

This study adopted the model from the works of Muhammad et al. (2023), Emenuga (2019), Agbenyo, Jiang and Antony (2019) with some modifications to meet the predetermined objectives of this study. However, the choice of the variables captured in the model is guided by the theoretical and empirical evidences. The specification is on the impact of financial accessibility on agricultural output . Thus, the functional models specified as:

$AOP = f$ (ATM, DCPS, CBB) …… (3.1)

Furthermore, the econometric models of the functional specification above are given as:

$$AOP_{it} = \beta_0 + \beta_1 ATM_{it} + \beta_2 CBB_{it} + \beta_3 DCPS_{it} + \mu_{it} \quad (3.2)$$

Where AOP = Agricultural output,

ATM = Automated Tellers' Machine,

CBB = Commercial Bank Branches,

DCPS = Domestic Credit to Private Sector,

μ = Error term or white noise,

i = sampled countries,

t = Time period

$\beta_0 - \beta_3$ = Coefficients of the estimated parameters.

Agriculture output is the dependent variable, whereas the independent variables include financial accessibility components such as automated tellers' machines, domestic credit to the private sector, and commercial bank branches. These components are used to assess financial inclusion in terms of availability, and accessibility. Agricultural output is measured as agricultural value added or contribution to Gross Domestic Products (GDP). In addition, agricultural output entails crops, forestry, and fishing, value added (% of GDP). This is in line with the measurement by World Bank (2021). Automated Tellers' Machine is measured as the number of ATMs per 100,000 adults. Furthermore, this indicator reflected the attribute of financial inclusion from the usage dimension.

This is in accordance with the works of Harley, Adegoke and Adegbola (2017). Domestic credit to private sector is measured as financial resources provided to the private sector by financial institution. Thus, the indicator represents financial inclusion from the availability dimension. This is according to the work of Sarma (2008). Commercial bank branches measured as Commercial bank branches per 100,000 adults. In addition, it represents retail locations of resident commercial banks and other resident banks that function as commercial banks that provide financial services to customers and are physically separated from the main office but not organized as legally separated subsidiaries.

This also represents accessibility aspect of financial inclusion. This is in line with measurement of World Bank (2020) and International Monetary Fund (2020).

The study employs panel data techniques to estimate the variables under investigation in order to examine the impact of financial accessibility on agricultural output in West Africa. In the light of the above, the series were put through the following pre-estimation tests (i.e. cross-sectional dependence (CD) tests, panel unit root tests and panel cointegration tests) in order to identify appropriate panel data estimation techniques for the analysis. This estimation strategy employed for this study encompasses several key steps for carrying-out panel data analysis. The first step is to test for CD using Breusch-Pagan LM and Pesaran (2004) CD tests. If the results indicate the absence of CD among West African countries, the study employed first generation panel unit root tests to examine the stationarity of the variables. If, however, the result indicate the existence of CD among the cross-sectional units, the study used second generation panel unit root tests to examine the stationarity of the variables, such as Bain and Ng test and Pesaran's CIPS tests.

After establishing the integration order of the variables, the subsequent stage involves examining panel cointegration through Pedroni and Kao cointegration approaches. This is to determine if a long-run relationship exists between the variables in cross-sectionally dependent panel data. Since, the result shows evidence of cross-sectional dependency, integration as well as cointegration among the variables, the study used Generalized Method of Moments (GMM) estimate developed by Holtz-Eakin, Newey, and Rosen (1988); Arellano and Bond (1991); Arellano and Bover (1995); and Blundell and Bond (1998) to estimate the variables under investigation. Thus, the difference GMM model is specifies as:

$$lnY_{it} = \phi lnY_{it-1} + YZ'_{it} + \beta X'_{it} + d_t + \varepsilon_{it} \ldots (3.14)$$

Where: Z': Implies control variables, X′: Implies explanatory variables, lnY_{it-1} : is lagged value of dependent variable. The system GMM used the difference GMM model and first difference of the equation (1) as instruments. Thus, the system GMM and its instrumental equation are expressed as:

$$lnY_{it} = \phi lnY_{it-1} + YZ'_{it} + \beta X'_{it} + d_t + \varepsilon_{it} \ldots \quad (3.15)$$

$$i = 1,2,\ldots,N; t = 1,2,\ldots,T$$

$$\Delta \ln Y_{it} = \Delta \ln Y_{it-1} + \Delta Z_{it} + \Delta X_{it} + \Delta \varepsilon_{it} \ldots\ldots (3.16)$$

Hence, the expressions (2) and (3) implied that system GMM used more instrument than the difference GMM. However, the above GMM model noted that if the dependent variable is close to random walk for instance ($\phi -> 1$) that is the lagged dependent variable is moving toward one (1). The Difference GMM estimation will not yield a robust estimate rather a biased and inefficient estimate and consequently could be acute when the time panel is short (Blundell & Bond, 1998). However, in addition to the difference GMM, the system GMM model was developed and it is preferred in most respect as the estimator captures the persistent nature of regressors on the dependent variable which also addresses the problems of measurement error, endogeneity, country-specific and heterogeneity. The system-GMM estimator would be assessed by two specification tests. The Hansen test of over-identifying restrictions tests for the overall validity of the instruments; and the Arellano Bond test which examines that the error term is not serially correlated would be employed. Failure to reject both null hypotheses give support to the model (Arellano & Bond 1991; Arellano & Bover, 1995; Blundell & Bond, 1998).

This study is directed by Bond's (2001) statements in order to identify the right models between difference GMM and system GMM. Bond (2001) observes that if the coefficient of the difference GMM estimation is lower or very close to the coefficient of the fixed effect estimation, the result indicates that the difference GMM is downward biased owing to poor instrumentation and that the system GMM should be employed instead. Finally, the study will determine causality between variables using panel Granger causality approach developed by Dumitrescu and Hurlin (2012).

4. DATA PRESENTATION AND ANALYSIS

4.1 Descriptive Statistic

The results of descriptive statistic of the variables used in the estimation are presented in table 4.1. Table 4.1 shows that, the mean of agricultural output, automated teller machines, domestic credit to private sector, and commercial bank branches are positive. This explains that the variables recorded positive growth rate over the sample period. However, from the estimation, the result attested that, automated teller machines have the highest standard deviation of 1.13, which indicate that, the variable fluctuates more than any variable in the distribution.

Table 4.1 Descriptive Statistics

Statistic	LAOP	LATM	LDCPS	LCBB
Mean	3.1536	1.5150	3.0870	1.5150
Median	3.1010	1.5818	2.8079	1.5271
Maximum	4.1044	3.9525	6.4320	3.5307
Minimum	1.5331	-1.2463	1.5623	0.2231
Std. Dev.	0.5040	1.1275	1.1066	0.7036
Skewness	-0.6285	-0.2863	1.5605	1.2346
Kurtosis	4.1111	3.8119	5.6319	5.0358
Jarque-Bera	16.4189	5.7582	97.2281	59.7479
Probability	0.0002	0.0561	0.0000	0.0000
Observations	140	140	140	140

Furthermore, the results show that all the variables positively skewed except agricultural output and automated teller machines, which proposes that majority of the distribution in these variables are concentrated to the right of the distribution. The results also attested that; all the variables have excess kurtosis greater than 3.00. This is showing that the distribution of all the variables is leptokurtic in nature and exhibit fat tail (thick-tail). This is reflected to the fact that the probability values of all the variables in the model are less than 5% level of significant while that of automated teller machines is greater than 5%.

4.2 Cross-Section Dependency Test

This sub-section presents the outputs of cross-sectional dependency test in the sampled African countries. Thus, the result is presented in table 4.2.

Table 4.2: Results of Cross-Section Dependency Test

Test	Statistic	Prob.
Breusch-Pagan LM	408.0353	0.0000
Pesaran scaled LM	23.50022	0.0000
Pesaran CD	5.563998	0.0000

Source: *Author's computation Using E-views version 10.0 (2024).*

From the results presented in table 4.2, that shows there is evidence of cross sectional dependency among the variables. This is because the probability values of all the three approaches are statistically significant at 1% level. Therefore, null hypothesis of no cross-section dependence in residuals will not be accepted. Thus, based on the results, this study concludes that there is presence of cross-section dependence among the variables. Based on the foregoing tests in all the two model, the results attested that there is presence of cross-section dependence among the variables. Therefore, the first-generation unit root tests approaches are not appropriate in testing the behavior of the variables and second-generation unit root test approaches are appropriate. Thus, the tests are conducted and the results are presented in table 4.3.

4.3 Results of Unit Root for Cross-Sectionally Dependent Panels

The results of unit root tests from Bain and Ng-PANIC and CIPS testing approaches. The results are summarized and tabulated in table 4.3.

Table 4.3: Results of Unit Root Test

Variables	Breusch-Pagan LM Bain and Ng-PANIC test		CIPS test	
	Constant	Constant and Trend	Constant	Constant and Trend
LAOP	-1.3123	-2.34102**	-1.4106	-7.0015***
LATM	0.3034	2.9456***	-12.6099***	-6.0361***
LDCPS	0.5017	0.7216	-3.0243***	-4.3465***
LCBB	1.2513	-1.0237	-9.1417***	-26.8681***

*Note: ***, ** and * indicate significant at 1%, 5% and 10% respectively.*
Source: *Author's computation (2024).*

This study conducted a cross-sectionally dependent panels unit root test using Bain and Ng, and CIPS testing approaches. From the Bain and Ng test the results show that agricultural output and automated teller machines are stationary at constant and trend while domestic credit by banking sector is stationary at constant. However, domestic credit to private sector and commercial bank branches are not stationary either at constant or constant and trend. From the CIPS test, the results show that automated teller machines, domestic credit to private sector, and commercial bank branches are stationary at both constant and constant and trend. On the other hand, the CIPS test shows that agricultural output constant and trend.

4.4 Panel Cointegration Tests

Based on the findings of the panel unit root tests, it is possible to run panel cointegration tests to determine the existence or absence of cointegration. This study used Kao and Pedroni panel cointegration tests to supplement the procedure, and the findings are shown in table 4.4.

Table 4.4: Pedroni and Kao Residual Cointegration Test Results

Pedroni Residual Cointegration Test	Statistics	P-value
Within-Dimension		
Panel v-Statistic	-2.2477	0.9877
Panel rho-Statistic	1.9415	0.9739
Panel PP-Statistic	-3.5541	0.0002***
Panel ADF-Statistic	-1.4364	0.0754*
Between-Dimension		
Group rho-Statistic	3.7504	0.9999
Group PP-Statistic	-8.6319	0.0000***
Group ADF-Statistic	-2.6915	0.0036***
Kao Residual Cointegration Test	1.2921	0.0982*

Note: *, ** *and * indicating significant at 1%, 5% and 10% levels.*
Source: *Author's computation Using E-views version 10.0 (2024).*

Table 4.4 shows that there is evidence of cointegration among the variables. This is due to the fact that the t-statistic coefficients in both models are statistically significant at the 10% and 5% levels. As a result, the null hypotheses are rejected, and we infer that the variables are cointegrated. This study however, used the Pedroni cointegration test to confirm the Kao cointegration test, and the results ndicate that there is evidence of cointegration among the variables. Although, several tests in both models, such as Panel v-Statistics, Panel Rho-Statistics, and Group Rho-Statistics, are not statistically significant even at 10% level. Nonetheless, the null hypothesis of no cointegration cannot be accepted for the vast majority of tests. This is reflected to the fact that majority of the statistics are statistically significant at 1%, 5% and 10% levels. According to Pedroni (2004), the panel ADF and group ADF tests have superior small sample qualities than the other tests and hence provide statistically significant test findings at the 1%, 5% and 10% levels. Based on the test results, this study concludes that there is evidence of cointegration among the variables.

4.5 Correlation Analysis of the Models

Prior to the regression analysis, it is important to know the correlation coefficient of the variables. This is because understanding the nature of correlation coefficient will guide in deciding the variables that will be included in the model. Correlation analysis also serves as diagnostic test for checking the presence of multicollinearity.

Table 4.5 Correlation Analysis

Variables	LAOP	LATM	LDCPS	LCBB
LAOP	1.0000			
LATM	-0.6016	1.0000		
LDCPS	-0.1899	0.3581	1.0000	
LCBB	-0.5882	0.1065	0.3488	1.0000

Source: *Author's computation (2024) Using E-views version 10.0.*

From table 4.5, this study offers the correlation analysis of the model. The model measured the effect of financial accessibility on agricultural output in West African countries. According to the results automated teller machines, domestic credit to private sector, and commercial bank branches are negatively correlated with agricultural output going by the correlation coefficient of -0.6016, -0.1899, -0.2282 and -0.5882 respectively. The results suggest that concentrating more on financial accessibility components such as automated teller machines, domestic credit to the private sector domestic, credit by banking sector, and commercial bank branches is strongly associated with agricultural output in West African economies. Hence, according to the findings, there is no presence of multicollinearity among the variables, and the variables are well suited to be included in the model for analysis.

4.6 Results of Generalized Method of Moment (GMM) Regression

In table 4.6, the results show that system Generalized Method of Moment (GMM) is more appropriate. This is because the coefficient of lag value (0.7314) of the dependent variable (agricultural output) is less than the coefficient of the fixed effect regression. Thus, the results suggest that difference GMM is downward biased and the system GMM should be used. Hence, for the sake of comparison, results obtained using difference GMM is also reported. Based on the foregoing, this study will only interpret the results of system GMM regression. According to the results reported that previous value (lag value) of agricultural output has significant positive effect on the current agricultural output at 1% level. An increase in previous agricultural output by 1% will lead to rise the current agricultural output by 0.69% over the sampled period.

Table 4.7: Financial Accessibility and Agricultural Output

Dependent Variable: Agricultural Output				
Difference GMM Regression			**System GMM Regression**	
Variables	Coef.	St. Error	Coef.	St. Error
LAOP (-1)	0.7314	0.1583*	0.6973	0.0927***
LATM	-0.2818	0.3042	-0.2001	0.1057*
LDCPS	-0.2722	0.4895	-0.1304	0.1302
LCBB	0.4432	0.6285	0.2531	0.3042

Note: PLS coef. = 0.9495, FE coef. = 0.8327, AR (1) = -1.1442 (0.2525), AR (2) = 1.5578 (0.1193), J-Sta.1 = 6.7231 (0.6659) and J-sta.2 = 5.9762 (0.7422)
PLS = Panel Least Square, FE = Fixed Effect, AR = Autocorrelation and J-Sta. = Sagan Test.1 for model 1., and J-Sta. = Sagan Test.2 for model 2.
Note: *, **** *and * indicating significance at 1%, 5% and 10% levels.*

Source: *Author's computation Using E-views version 10.0 (2024).*

The results presented in Table 4.6 indicate a negative and statistically significant relationship between automated teller machines (ATMs) and agricultural output in the sampled African countries, with a 1% increase in ATMs associated with a 0.20% decrease in agricultural output. This finding underscores the digital literacy gaps theory, as many rural farmers lack the skills and knowledge to effectively use ATMs. Furthermore, the reliance on ATMs in rural West African communities is challenged by infrastructure mismatches, such as unreliable electricity and limited internet access, which are crucial for the functionality of these machines.
Additionally, the cultural preference for cash-based transactions and a general distrust of digital systems may further inhibit ATM usage among farmers accustomed to traditional financial practices. This situation highlights the urgent need to address digital literacy through targeted training programs, enabling farmers to leverage technology effectively and potentially enhance agricultural productivity.

The results also reveal a negative and statistically insignificant relationship between domestic credit to the private sector and agricultural output. This indicates that fluctuations in domestic credit do not significantly influence agricultural output in the sampled countries. In contrast, domestic credit provided by the banking sector demonstrates a significant positive influence on agricultural output at the 5% level. Specifically, a 1% increase in domestic credit from the banking sector is associated with a 0.17% increase in agricultural output. This underscores the importance of enhancing access to credit through reliable banking services, which can provide the necessary financial support for farmers to invest in their agricultural activities.

Additionally, the results show that commercial bank branches have no significant effect on agricultural output even at 10% level. This means that an increase or decrease in commercial bank branches do no increase or decrease the performance of agricultural output over the sampled period. This is true because majority of the farmers they don't have bank accounts and they are also not educated. Thus, increase or decrease in bank branches do not influence their agricultural activity. Finally, the diagnostic tests for autocorrelation and Sargan (J-Statistics) test show that the result is free from serial correlation and model is not over identified. This because the probability values of the two tests are not statistically significant even at 10% level.

4.7 Result of Panel Causality Test

According to table 4.7, there is no evidence of causality runs from automated tellers' machine to agricultural output or from agricultural output to automated tellers' machine. Because the probability values of W-statistic and Zber-statistic are not statistically significant even at the 10% level, the null hypothesis must be accepted. According to the findings, automated tellers' machine cannot be used to forecast the agricultural output and vice versa in the sampled African countries.

Table 4.7: Panel Causality Test

Null Hypothesis:	**W-Stat.**	**Zb-Stat.**	**Prob.**
LATM does not homogeneously cause LAOP	2.65918	1.29311	0.1960
LAOP does not homogeneously cause LATM	1.94366	0.49492	0.6207
LDCPS does not homogeneously cause LAOP	3.80379	2.56998	0.0102
LAOP does not homogeneously cause LDCPS	0.72211	-0.86777	0.3855
LCBB does not homogeneously cause LAOP	2.07903	0.64593	0.5183
LAOP does not homogeneously cause LCBB	2.14518	0.71973	0.4717

Source: *Author's computation (2023).*

Again, the findings show significant evidence of unidirectional causality running from domestic credit to private sector to agricultural output. This is because the test's probability value is statistically significant at the 5% level. As a result, the alternative hypothesis is accepted. This also indicates that the domestic credit to private sector may be used to forecast the level of agricultural output in the sampled economies. Also, the findings indicates that there is no evidence of causality between domestic credit by banking sector and agricultural output even at the 10% level. The findings specify that the null hypothesis that domestic credit by the banking sector does not homogeneously cause agricultural output and vice versa can be accepted. Also, the findings indicates that there is no evidence of causality between commercial bank branches and agricultural output even at the 10% level. The findings suggest that the null hypothesis that commercial bank branches does not homogeneously cause agricultural output and vice versa cannot be rejected.

5. CONCLUSION AND RECOMMENDATIONS

On the basis of the findings of this study, the following conclusions are drawn. Firstly, financial inclusion measured by availability has no significant influence on agricultural output. Secondly, financial inclusion measured using accessibility has a significant positive impact on agricultural output. Moreover, the study's results reveal a unidirectional causal relationship running from financial accessibility to agricultural output. This indicates that enhancing access to finance can lead to improvements in agricultural productivity, while the reverse does not hold true-suggesting that simply increasing agricultural output does not necessarily lead to greater financial accessibility. This finding highlights the importance of targeted financial interventions aimed at the agricultural sector, as they can create a virtuous cycle of growth and development:

i. To address the negative impact of financial exclusion on agricultural output, stakeholders should prioritize the establishment of additional banking outlets in rural communities. This could include setting up mobile banking units and agent banking services to reach underserved populations. By enhancing the accessibility of financial services, rural residents will be more likely to engage with the financial system. Partnerships with local organizations can facilitate outreach and education about these services.

ii. To capitalize on the positive relationship between financial inclusion and agricultural output, it is essential to develop credit channels with low-interest rates specifically designed for rural farmers. Stakeholders, including government agencies and financial institutions, should collaborate to create microfinance products tailored to the needs of less privileged farmers. This will enhance access to affordable credit, enabling farmers to invest in essential resources like seeds, fertilizers, and equipment.

iii. Relevant stakeholders should actively encourage private sector banks to increase their lending to the agricultural sector. This can be achieved by offering incentives for banks that provide loans to farmers at competitive rates. Additionally, establishing credit guarantee schemes can mitigate risks for banks while promoting lending. This will facilitate greater investment in agricultural productivity, ultimately boosting output.

iv. To maximize the effectiveness of expanded financial services, targeted financial literacy programs should be implemented in rural communities. These programs should educate farmers on how to effectively use banking services, manage credit, and understand financial products. Collaborations with local NGOs and agricultural extension services can enhance the reach and impact of these educational initiatives.

v. Stakeholders should invest in technology improvements that facilitate easier access to financial services. This includes enhancing mobile banking platforms and digital payment systems. By leveraging technology, financial institutions can provide efficient and cost-effective services, further encouraging rural residents to engage with the financial system.

REFERENCES

Abimbola, A. Olokoyo, F. O. Babalola, O & Farouk, E. (2018). Financial inclusion as a catalyst for poverty reduction in Nigeria. *International Journal of Scientific Research and Management*, *6*(6), 481-490.

Adejumo, O.B. & Omonona, B.T. (2017). Analysis of the performance of the agricultural credit guarantee scheme fund in Nigeria (1981 to 2016). *Journal of Agriculture and Veterinary Science*, 10(10), 24-30.

Agbenyo, W., Jiang, Y.S. & Antony, S. (2019) Cointegration Analysis of Agricultural Growth and Financial Inclusion in Ghana. *Theoretical Economics Letters*, 9(3), 895-911.

Alen, A. D. & Coulibaly, O. (2017). The Impact of Agricultural Research on Productivity and Poverty in sub-Saharan Africa. *Food Policy*, 34(2), 198-209.

Ammani, A. A. (2012). An investigation into the Relationship between Agricultural Production and Formal Credit Supply in Nigeria. *International Journal of Agriculture and Forestry*, 2(1), 46-52.

Bekun, V.F. & Akadiri, S.S. (2019). Poverty and Agriculture in Southern Africa Revisited: A Panel Causality Perspective. *Social Science and Art Journal*, 1-10.

Chandio A. A., Jiang Y., Gessesse A. T. & Dunya, R. (2017). The Nexus of Agricultural Credit, Farm Size and Technical Efficiency in Sindh, Pakistan: A Stochastic Production Frontier Approach. *Journal of the Saudi Society of Agricultural Sciences*, 3(1), 76-89.

Demirgüç-Kunt, A., Klapper, L. F., Singer, D., & Van Oudheusden, P. (2015). *The Global Findex database: Measuring financial inclusion around the world*. Washington, DC: The World Bank.

Duvendack, M. & Mader, P. (2019). *Impact of Financial Inclusion in Low- And Middle-Income Countries: A Systematic Review of Reviews.* International Initiative for Impact Evaluation (3ie). Available at: Doi: https://doi.org/10.23846/SR00042.

Emenug, P.E. (2019). Effect of Commercial Banks' Credit on Agricultural Productivity in Nigeria. *AUDOE*, 15(3), 417-428.

Musau, S., Muathe, S. & Mwangi, L. (2017). *Financial Access, Competitiveness and Stability of Commercial Banks in Kenya*. Paper Presented at Gretsa University International Multidisciplinary Conference.

Nakazi, N. and S. Nathan (2020). The Effect of Commercial Bank's Agricultural Credit on Agricultural Growth in Uganda. Africa Journal of Economic Review. 3(1), 162 – 175.

Nyarko, E.S., Amoateng, K. and Aboagye, A.Q.Q. (2023), "Financial inclusion and poverty: evidence from developing economies", *International Journal of Social Economics*. https://doi.org/10.1108/IJSE-11-2021-0690

Gollin, D. (2015). *Agriculture as an Engine of Growth and Poverty Reduction: Lessons for Africa*. Chapter 4 in Economic Growth and Poverty Reduction in Sub-Saharan Africa: Current and Emerging Issue, ed. Andrew McKay and Erik Thorbecke. Oxford University Press.

Hansen, A.R. (2019). *Rural Financial inclusion and poverty eradication: Challenges and Gaps*. Angelarhansen.

Harley, T. W., Adegoke, A. J., & Adegbola, D. (2017). Role of Financial Inclusion in Economic Growth and Poverty Reduction Role of Financial Inclusion in Economic Growth and Poverty Reduction. *Internal Journal of Research in Economics and Social Sciences*, 265-271.

Kareem, R., Bakare, H., Raheem, K., Ologunla, S., Alawode, O. & Ademoyewa, G. (2013). Analysis of Factors Influencing Agricultural Output in Nigeria: Macro- Economic Perspectives. *American Journal of Business, Economics and Management*, 1(1), 9-15.

Men, P., Hok, L., Seeniang, P., Middendorf, B. J., & Dokmaithes, R. (2024). Identifying credit accessibility mechanisms for conservation agriculture farmers in Cambodia. *Agriculture*, *14*(6), 917.

Muhammad, S., Ibrahim, S.S., Zubair, Z.A., & Kyarem, R. (2023). Financial Development and Income Inequality Nexus in West African Countries: The Mediating Role of Trade Openness and Institutional Quality. *Sokoto Journal of the Social Sciences*, 13(3): 143 – 160.

Musau, S., Muathe S., Mwangi, L. (2018). Financial Inclusion, GDP and Credit Risk of Commercial Banks in Kenya, *International Journal of Economics and Finance*, 10 (3), 181-195.

Pandey, A. (2022). Credit and financial access in Nepalese agriculture: prospects and challenges. *Journal of Agriculture and Environment*, 56-70.

Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP

hypothesis. Econometric Theory, 20, 597–627.

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. Cambridge Working Papers in *Economics*: 0435. Faculty of Economics, University of Cambridge.

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. Cambridge Working Papers in *Economics*: 0435. Faculty of Economics, University of Cambridge.

Sarma, M. (2008). Index of Financial Inclusion. *Indian Council for Research on International*

Seck, O., Naiya, I.I. & Muhammad, A. D. (2017). Effect of Financial Inclusion on Household Consumption in Nigeria, *IRTI Working Paper No. WP/2017/03*, Jeddah: Islamic Research and Training Institute.

Shen, Z., Hong, T., Blancard, S., & Bai, K. (2024). Digital financial inclusion and green growth: analysis of Chinese agriculture. *Applied Economics*, *56*(46), 5555-5573.

Terfa, W. A. (2018). Estimating the effects of financial access on poor farmers in rural northern Nigeria. *Financial Innovation*, *4* (25).