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EFFECTS OF FINANCIAL INCLUSION ON ARABLE CROP PRODUCTIVITY IN BAYELSA STATE, NIGERIA

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Abstract: Farmers form the bulk of the group in Nigeria that is denied financial support, which highlights the lack of funding available for agriculture in the country. Access to farm financing could boost output and help lower poverty and malnutrition rates. Based on this, this research examined empirically the effects of financial inclusion on arable crop productivity in Bayelsa State, Nigeria. The questionnaire was used to collect primary data from one hundred (100) arable crop farmers. A multistage sampling procedure was employed to draw samples for the study. The result of the descriptive statistics using standard deviation shows that all the variables clustered around the mean. Sources of credit for arable crop farmers show that about 36.7% accessed credit formally through a cooperative society, while 37.5% accessed credit through informal options such as personal savings. Instrumental variable estimation of effects of financial inclusion: ACCESS (1.06) and CREDIT (0.895) were positively statistically significant at the 0.01 level, while SAVE (0.46) is positively statistically significant at the 0.05 level, affecting arable crop productivity. In conclusion, financial inclusion, irrespective of how it is measured, has exerted positive and statistically significant effects on arable crop productivity in the study area. Hence, it is imperative for financial inclusion efforts to be strengthened and expanded so that more arable crop farmers can be captured in the financial system. Therefore, the study recommends the need for the formulation of proper policies aimed at enhancing financial inclusion services amongst arable crop farmers; policymakers should make agricultural borrowing schemes available land, accessible at lower interest rates for real farmers; and educated people should be encouraged to get involved in arable crop production, this will lead to food security.

Keywords: Accessibility, Arable productivity, Credit, financial inclusion, Savings

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1. Introduction

In Nigeria and other developing countries, farm financing is a key component of economic growth and development because it has the power to remove financial barriers as well as to encourage the adoption of innovative technologies that could otherwise take longer to catch on (Adewale et al., 2022). Even though 40% of the world's population is dependent on agriculture, the effect of access to farm credit on farm production is debatable (World Bank, 2022). Agricultural development, which is crucial to economic growth, has obstacles to the provision of farm credit, which are frequently explained by farmers' asymmetrical knowledge and the challenge of obtaining collateral security. Just 5 percent of the loans provided by commercial banks, which make up the majority of loans in developing nations (87%), are allocated to the agricultural sector (Ndife, 2020). A major factor in raising agricultural productivity is finance, which motivates small and medium-scale enterprises (SMEs) to invest or get past their first financial obstacles in order to buy inputs such as seeds and fertilizer.

The concept of financial inclusion, which entails the accessibility and effective use of financial services, has been increasingly recognized as a pivotal factor in socio-economic development. Despite substantial progress in this area, there remains a discernible gap in our understanding of the broader, systemic impacts of financial inclusion, particularly its 'ripple effects' on various socio-economic dimensions (Mishra et al., 2024). Similarly, Sapre (2023) defined financial inclusion as the ability of people and businesses to obtain practical and reasonably priced financial products and services that satisfy their needs—transactions, payments, savings, credit, and insurance—delivered ethically and sustainably is known as financial inclusion. It is seen as a major force behind financial well-being and economic growth, and includes having and using financial goods, such as mobile money accounts, as well as risk

management (insurance), savings accounts, credit availability, and receiving remittances.

According to Atta and Ibrahim (2024), financial inclusion promotes economic growth and development by facilitating wealth creation. Financial services accessibility boosts economic development, combats poverty, raises welfare and living standards overall, and accelerates economic growth. There has been a discernible change in emerging countries toward placing more emphasis on long-term economic growth and sustainable development. It is acknowledged that one of the most important factors in promoting economic integration is the focus on the financial sector above all others.

Furthermore, access to financial services allows for more balanced spending, efficient planning of recurrent costs, and meeting some emergency needs (Babajide et al., 2015; Lauer and Lyman, 2015). Financial inclusion comprises various characteristics, including availability, increased utilization, and barriers to financial services. A substantial amount of scholarship exists to highlight the factors of financial inclusion in various nations. Various factors, including branch networks (Kumar, 2013), self-help groups and education (Bhanot et al., 2012), socioeconomic factors (Clámara et al., 2014; Rastogi and Ragabiruntha, 2018), domestic agriculture to GDP, literacy ratio, population density, and urbanization (Yadav and Sharma, 2016), economic growth (Sharma, 2016), bank branch quantity, and credit deposit ratio on GDP (Iqbal and Sami, 2017), and infrastructure (Sharma et al., 2018); Inequality and poverty (Erlando et al., 2020); and safety in society (Didenko et al., 2020). People can overcome poverty and get access to economic possibilities thanks to formal financial services, particularly those that may be obtained over the phone. It may be difficult for the poor to save money for future businesses or educational initiatives without a savings account. An agricultural calamity without insurance might bankrupt farmers and their families (Klapper et al., 2016). Several authors (including Marafa (2021); Umaru and Eshiozemhe (2022); Mbelu and Ifionu (2022); and Ashoro et al. (2024)) identified common corporate financial inclusion institutions and schemes in Nigeria that have positively impacted agricultural productivity and general wellbeing. Some of these institutions and schemes include: Agent Banking and Mobile Money, Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL). Agricultural Credit Guarantee Scheme Fund (ACGSF), Bank Verification Number (BVN) System, and Microfinance Institutions (MFIs).

Through a network of agents and their mobile phones, people can access banking services through Agent Banking and Mobile Money services. The expansion of these services has been made possible in large part by programmes like the CBN's Shared Agent Network Expansion Program (SANEF). Conversely, NIRSAL is a scheme created to encourage loans for agriculture by reducing the risks related to it. In order to promote financing to smallholder farmers and agribusinesses, it offers financial institutions guarantees and credit risk insurance (Mbelu and Ifionu, 2022). The purpose of the Agricultural Credit Guarantee Scheme Fund (ACGSF) is to incentivize financial institutions to lend to the agricultural sector by offering guarantees. It promotes agricultural growth by making loans easier for farmers and agribusinesses to obtain. In a similar vein, Nigeria's Bank Verification Number (BVN) System serves as a special identification for bank clients and was created to reduce fraud and enhance the stability of the financial system. It has aided in improving security and increasing access to financial services (Akyuz et al., 2019). Institutions of Microfinance (MFIs) in Nigeria, underprivileged people receive financial services mostly from microfinance institutions.

As a fundamental component of socioeconomic development, poverty reduction and improved agricultural productivity depend on financial inclusion. Financial inclusion allows people to save, invest, and guard against financial hazards by giving the unbanked and underbanked populations access to fundamental financial services like savings accounts, credit, insurance, and payment services. Increased household income and consumption as a result of empowerment help to reduce poverty (Mishra et al., 2024).

Malik et al. (2020) assert that there is a link between financial inclusion and economic development. Increased access to the formal financial system broadens the pool of capital available for investment, which is essential for economic growth. According to studies, having access to financial services enables people and businesses to make larger investments in their operations, boost productivity, and support the expansion of the economy as a whole. Therefore, this research aimed to examine the effects of financial inclusion on arable crop productivity in Bayelsa State, Nigeria, to fill this knowledge gap. The specific objectives of this research are to: identify the socio-economic characteristics of the arable crop farmers in the study area; ascertain the sources of credit available to arable crop farmers in the study area; and estimate the effects of financial inclusion on arable crop productivity in the study area.

1.1. Theories that Supported The Study

Several economic and agricultural development theories can explain how financial inclusion affects arable crop yield. Here are several important ideas that give insights into this relationship:

Gurley and Shaw (1960) proposed the Financial Intermediation Theory. This theory describes how financial institutions (banks, microfinance organizations) serve as mediators, transferring resources effectively to productive sectors such as agriculture. The availability of financial services allows farmers to get financing for agricultural investments such as better seeds, fertilizers, and mechanization. This theory's application to arable crop productivity includes providing loans to smallholder

farmers so they can adopt high-yielding crop varieties; savings services to help farmers accumulate wealth for future farm expansion; insurance services to protect against risks such as droughts, floods, and pest infestations; and advocating investment in productivity-enhancing approaches.

Stiglitz and Weiss (1981) introduced the Credit Constraint Theory. This hypothesis contends that, owing to knowledge asymmetry, financial institutions limit credit, making it harder for smallholder farmers to receive financing. Farmers sometimes face exorbitant credit rates or collateral restrictions, limiting their ability to invest in advanced farming practices. The application of this theory to arable crop productivity in the study area includes: inadequate access to credit forces farmers to rely on obsolete farming methods; excessive interest rates hinder taking out loans, resulting in insufficient investments in agricultural inputs; and laws and regulations that improve financial inclusion can reduce borrowing costs and increase productivity.

Sandmo (1971) Risk Aversion and Uncertainty Theory proposes that farmers are inherently risk-averse and may be hesitant to engage in productivity-enhancing technology owing to uncertainties such as price swings, weather conditions, and pests. Financial inclusion helps to reduce these dangers. This theory's application to arable crop productivity includes micro-insurance strategies that minimize economic losses due to crop failure; guarantees of credit to encourage farmers to take calculated risks in modernizing their farms; and access to market information via mobile banking improves price predictability.

2. Materials and Methods

2.1. Study Area

The study was carried out in Bayelsa State, Nigeria. The State lies between Latitude 4°15' and 5°23' North and longitude 5°15' and 6°45' East. The State is bounded to the north by Delta State, to the east by Rivers State, and the south and west by the Atlantic Ocean. The State occupies an area of about 21,100 km² (National Population Census, 2006). Figure 1 shows the map of the study area. Bayelsa State lies in the heaviest rainfall area in Nigeria, with heavy rainforest and a short dry season from November to March (Okringbo et al., 2017). The major food crops grown include cassava, maize, yam, cocoyam, potatoes, and vegetables, among others. Dominant perennial crops grown in the area are plantain, banana, and African pear, among others.

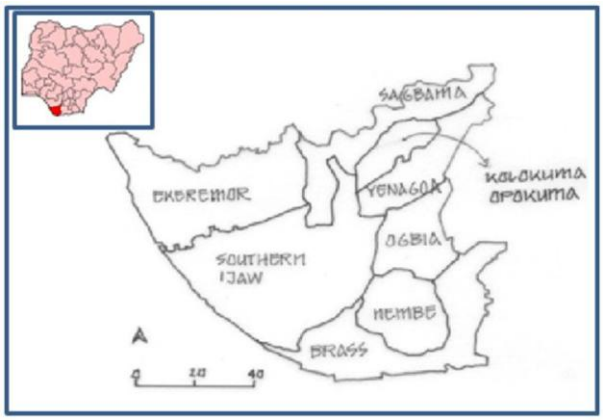

Figure 1. Map of the study area. Source: Brisibe and Pepple (2018).

2.2. Sampling Procedure

A multistage sampling procedure was used to select the respondents. In the first stage, two (2) agricultural zones (Brass and Yenagoa agricultural zones) were randomly selected from the three agricultural zones of the State. In the Second stage, two Local Government Areas were randomly selected from each of the two agricultural zones (Ogbia and Nembe LGAs were selected from Brass zone, while Yenagoa and Southern Ijaw were selected from Yenagoa zone), making it four (4) LGAs in total. Thirdly, five communities were randomly selected from each LGA, which gives a total of twenty (20) communities in all. Lastly, five arable crop farmers were randomly selected from each community, making a total sample size of one hundred (100) for the study. The Agricultural Development Programme in the State provided a list of farmers. The population size used includes the farmers who grow at least two of the following arable crops: cassava, maize, yam, cocoyam, or potatoes. Primary data were collected using a questionnaire. Data collected were analyzed using descriptive statistics and inferential statistics via instrumental variable estimation using SPSS. The Global Findex database categorizes financial inclusion indicators generally along three measurements: ownership and use of an account at a formal financial institution; saving behaviour; and borrowing (Demirguc-Kunt and Klapper, 2013). According to Fowowe (2020), financial inclusion can be measured in the following ways: The first measure is financial access (ACCESS), which provides information on arable crop farmers who have a bank account, and this can be subdivided into the formal and informal components. The second measure of financial inclusion is saving (SAVE), which captures either a formal or semi-formal financial institution to save. The third measure of financial inclusion is borrowing or credit (CREDIT).

The population was determined using Yamane's (1967) procedure to calculate the sample size (equation 1):

$$n=N/(1+N.e^2) \quad (1)$$

Where n is the expected sample size, N is the population size (763), and e2 is the level of precision (9.2%).

n=763/(1+763*〖0.092〗^2) = 102.31

Thus, a sample size of 100 was used.

2.3 Model Specification

In order to achieve the stated objectives, financial inclusion was modelled after Fowowe (2020) in a broad model, thus (equation 2):

$$ARAP=\beta_0+\beta_1 FI+\beta_2 HC+\beta_3 AC+\beta_4 AI+\varepsilon_i \quad (2)$$

Where;
ARAP = Arable productivity (kg)
FI = Financial inclusion
HC = Household characteristics
AC = Arable crop farmers' characteristics
AI = Arable crop production inputs

Financial inclusion includes financial access (ACCESS), saving (SAVE), and borrowing or credit.
(CREDIT). Household characteristics include household size (HHSiz) and farm capital (FrmCap). Arable crop farmers' characteristics include age (Age), educational level (EduLev), and gender (Gender). While arable crop production inputs include labour size (LabSiz), the quantity of fertilizer used (Fert), the quantity of herbicides used (Herb), and farm size (FrmSiz).

From the above, three dimensions of financial inclusion were considered, and the three financial inclusion dimensions cannot all be in a single equation. Therefore, each dimension of financial inclusion has to be included separately in the equations. Thus, FI, which captures financial inclusion in equation (1), will have three dimensions. As a result, the model to be estimated will change from equations (1) to equations (2), (3), and (4), respectively, as shown below. The first dimension of financial inclusion (ACCESS) is included in equation (2), the second dimension of financial inclusion (SAVE) is included in equation 3, and the third dimension of financial inclusion (CREDIT) is included in equations 4 and 5. The estimated equations will take the form below:

$$\begin{aligned} ARAP_i = {} & \beta_0 + \beta_1 ACCESS_i + \beta_2 HHSiz_i + \beta_3 FrmCap_i \\ & + \beta_4 Age_i + \beta_5 EduLev_i \\ & + \beta_6 Gender_i + \beta_7 LabSiz_i \\ & + \beta_8 Fert_i + \beta_9 Herb_i \\ & + \beta_{10} FrmSiz_i + \varepsilon_i \end{aligned} \quad (3)$$

$$\begin{aligned} ARAP_i = {} & \beta_0 + \beta_1 SAVE_i + \beta_2 HHSiz_i + \beta_3 FrmCap_i \\ & + \beta_4 Age_i + \beta_5 EduLev_i \\ & + \beta_6 Gender_i + \beta_7 LabSiz_i \\ & + \beta_8 Fert_i + \beta_9 Herb_i \\ & + \beta_{10} FrmSiz_i + \varepsilon_i \end{aligned} \quad (4)$$

$$\begin{aligned} ARAP_i = {} & \beta_0 + \beta_1 CREDIT_i + \beta_2 HHSiz_i + \beta_3 FrmCap_i \\ & + \beta_4 Age_i + \beta_5 EduLev_i \\ & + \beta_6 Gender_i + \beta_7 LabSiz_i \\ & + \beta_8 Fert_i + \beta_9 Herb_i \\ & + \beta_{10} FrmSiz_i + \varepsilon_i \end{aligned} \quad (5)$$

Arable crop productivity with the three dimensions of financial inclusion can be stated as (equation 6):

$$\begin{aligned} ARAP_i = {} & \beta_0 + \beta_1 ACCESS_i + \beta_2 SAVE_i \\ & + \beta_3 CREDIT_i + \varepsilon_4 \end{aligned} \quad (6)$$

All the variables used were in their log (logarithm) form. Variance Inflation Factors (VIF) were used to test for the collinearity among the variables as used by Aroyehun et al. (2024), and stated thus (equation 7):

$$VIF(j) = 1/(1 - R(j)^2) \quad (7)$$

Where,
R(j) is the multiple correlation coefficient between variable j and the other independent variables.

3. Results and Discussion

Table 1 shows the socio-economic characteristics of the arable crop farmers. There is no disparity between the mean and the median as seen in the Table. This Table summarizes key characteristics associated with arable agricultural operations, including productivity, financial access, and resource usage, components also stressed in the study of Fasakin and Akinbode (2019). Output varies greatly amongst farms. Some farms yield as little as 2.56 units, while others exceed 12.0 units. This variation in productivity is consistent with findings by Ogunniyi and Oladejo (2011), who noted that differences in resource allocation and management practices contribute to yield disparities. Despite this variation, the small standard deviation in access to finance suggests uniformity in farmers' financial inclusion, aligning with studies by Awotide et al. (2015), who reported limited but equitably distributed access to rural credit. The small standard deviation indicates that most farmers have similar access to financial resources. Farmers' savings rates fluctuate considerably but stay close to the average. Farmers' access to financing is relatively steady, with only minor variations. Most farmers have a comparable degree of agricultural capital investment, with very slight differences. This finding is consistent with the assertion of Idiong (2007) that smallholder farmers often operate within a narrow range of capital intensity due to financial constraints. The typical household size is five persons; however, some have as few as one or as many as eleven. Farmers are typically middle-aged or older, with the youngest at 28 and the oldest at 70. The dataset has almost equal numbers of male and female farmers. The majority of farmers have completed at least high school; however, others have no formal education. Most farms have tiny labour sizes, with few employing more than three people. Fertilizer use varies greatly, with some farms using none while others use up to 5.01 units. Some farmers do not use herbicides, while others apply up to 4.61 units. Farm sizes vary greatly, from modest (0.3 ha) to huge (up to 8 ha). This farm size highlights the heterogeneity in landholding sizes as documented in studies by Akpan, Nkanta, and Udofia (2023).

Farm production (output) among arable crop farmers was highly variable, a finding that aligns with previous studies attributing such variability to differences in farm

size, input use, and access to financial resources (Idiong, 2007; Ogunniyi and Oladejo, 2011). Farm production (output) was very variable. This may be modified by farm size, inputs (fertilizers, herbicides), or financial availability. Larger farm sizes and more intensive input use have been shown to enhance output, particularly when accompanied by adequate financial support (Akpan et al., 2023). Most farmers have access to finance and savings, but variations in agricultural capital investment indicate varying amounts of resources. The majority of farmers are middle-aged or older, with an average family of five people. Farm sizes and manpower utilization vary greatly, indicating various farming scales. Fertilizer and pesticide use are uneven, potentially affecting productivity. According to the results, there are no outliers. Using standard deviation, all the variables clustered around the mean, as seen in Figure 2.

Table 1. Socio-economic characteristics of the arable crop farmers

Variable	Mean	Median	S.D	Minimum	Maximum
Output	7.48	6.96	1.85	2.56	12.0
ACCESS	12.3	12.4	0.450	11.3	13.5
SAVE	11.7	11.5	0.959	9.90	14.0
CREDIT	12.2	12.2	0.630	10.5	15.9
Farm capital	10.6	10.6	0.897	7.82	12.9
Household size	5	5	1.70	1	11
Age	54.25	55.50	9.28	28	70
Gender	0.51	1.00	0.50	0	1.00
Educational level	2.23	2.00	0.83	0	3.0
Labour size	1.44	1.39	0.476	0.693	2.94
Fertilizer	2.27	3.27	1.98	0	5.01
Herbicides	1.64	1.70	1.68	0	4.61
Farm size	2.30	2	1.50	0.30	8.0

Note= S.D. means Standard deviation. Source: Field Survey, 2024.

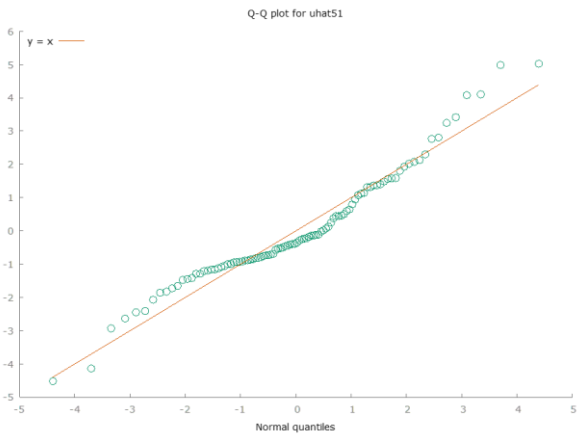

Figure 2. Dependent and independent residue. Source: Field Survey, 2024.

Credit has been shown by Ogbuabor and Nwosu (2017) to considerably boost farm productivity in Nigeria, hence increasing farm family income and assisting the impoverished in building wealth to invest in farming. This tool has the potential to modernize the agriculture industry and generate jobs in the traditional sense. The results of Table 2 reveal the common sources of farm credit available to arable crop farmers in the study area. It showed that rural farmers obtained most of their credits from both approved formal sources and non-formal sources. The formal sources include: Nigeria Incentives-Based Sharing Agricultural Lending System, NIRSAL (9.2 percent), cooperative societies (36.7 percent); Bank of Agriculture (8.1 percent), Bank of Industry (2.3 percent), Commercial banks (28.5 percent), and Microfinance banks (15.2 percent).

Table 2. Sources of credit for arable crops farmers

Sources	Type	Frequency	Percentage
Formal	NIRSAL	9	9.2
	Cooperative Society	36	36.7
	Bank of Agriculture	8	8.1
	Bank of Industry	2	2.3
	Commercial Banks	28	28.5
	Microfinance Banks	15	15.2
	Total	98	100
Informal	Mobile money	16	16.2
	Family	29	30.0
	Personal savings	37	37.5
	Traditional Moneylenders	11	11.2
	Friends	5	5.1
	Total	98	100

Source= Field Survey, 2024.

These findings are consistent with those of Ololade and Olagunju (2013) and Awotide et al. (2015), who reported that cooperative societies and microfinance institutions remain key providers of credit to smallholder farmers due to their more flexible conditions and local accessibility. Other credit sources recognized were mainly from informal sources. Results from the survey reveal that the most dominant informal sources of credit in the area were: personal savings (37.5 percent); family members (30.0 percent); mobile money lenders (16.2 percent), traditional moneylenders (11.0 percent); and friends (5.1 percent). This pattern aligns with the observations of Olomola (2000), who emphasized that informal credit sources continue to play a crucial role in rural financial systems due to their ease of access, absence of collateral requirements, and social trust mechanisms.

Table 3. Variance Inflation Factors (VIF)

Variables	VIF
ACCESS	3.48
SAVE	1.16
CREDIT	2.87
Farm capital	1.26
Household size	1.11
Age	1.14
Gender	1.14
Educational level	1.06
Labour size	1.52
Fertilizer	2.51
Herbicides	2.49
Farm size	1.52

Source= Field Survey, 2024.

Table 3 shows that the VIF results show that collinearity does not exist among the variables. At the utmost, some variables (ACCESS, CREDIT, Fertilizer, and Herbicides) indicate a low level of correlation since they were above one (1). Financial factors (ACCESS, CREDIT, and SAVE) are most likely associated, since farmers with better access to financial services may save more and receive more credit.

Table 4. Pairwise Correlation (Rho) Coefficient Estimation in Pairs of Financial Inclusion (FI)

Variable Pair	Correlation (Rho) coefficients
ACCESS and SAVE	-0.456**
ACCESS and CREDIT	-0.211*
SAVE and CREDIT	0.187

Note: **, * means the correlation is significant at the 0.01 and 0.05 levels, respectively, Source= Field Survey, 2024.

Table 4 shows the pairwise correlation (Rho) coefficient estimation in pairs of financial inclusion (FI). The correlation between ACCESS and SAVE is moderately negative (-0.456, $p < 0.01$). This suggests that farmers with better financial access save less, presumably because they use loans rather than personal savings. A slight negative relationship exists between ACCESS and CREDIT (-0.211, $p < 0.05$). Similar conclusions were drawn by Olomola (2001), who emphasized that improved financial inclusion may lead to more efficient fund allocation, thereby reducing dependence on traditional loan mechanisms. This suggests that increasing financial access lessens credit reliance, maybe owing to other funding sources. A modest positive association exists between SAVE and CREDIT (not statistically significant). Awotide et al. (2015) noted that in some cases, savings serve as collateral or prerequisites for accessing credit, but this is often mediated by institutional lending policies rather than behavioral patterns alone. This suggests that some farmers may save and borrow at the same time, although the association is weak and not statistically validated. Therefore, both formal and informal financial structures shape how farmers balance savings, credit, and broader financial access.

Table 5. Effects of financial inclusion (ACCESS) on arable productivity in the study area

Variables	1	2
FI (ACCESS)	1.06*** (2.64)	−81430.5 (-0.46)
Farm capital		−3710.93 (-0.05)
Household size		50064.2 (0.25)
Age		−455450 (-1.21)
Gender		−27408.4* (-1.81)
Educational level		26931.6 (0.43)
Labour size		459017*** (2.70)
Fertilizer		−35548.3 (-0.68)
Herbicides		−20047.1 (0.33)
Farm size		506721*** (4.32)
Constant		2.6e+6 (0.99)
R-squares	0.067	0.403

Note: ***, **, and * means significant at 1%, 5%, and 10% levels respectively. Source= Field Survey, 2024.

Table 5 shows the results of instrumental variable estimation using access as the measure of financial inclusion. Different specifications are estimated. The coefficient of financial inclusion, represented by having access to an account in a financial institution, is positive and statistically significant at the 0.01 level. Financial inclusion is positive and statistically significant at the 0.01 level in the baseline model (column 1), where it serves as the sole explanatory variable. This finding supports the assertion that financial inclusion plays a critical role in enhancing agricultural productivity, as it facilitates access to credit, savings, and investment services. This outcome corroborates the findings of Demirgüç-Kunt, Klapper, Singer, Ansar, and Hess (2020), who argue that access to formal financial services enables smallholder farmers to smooth consumption,

invest in productivity, enhancing inputs, and adopt improved technologies.

However, in the extended model (column 2), where all the household characteristics variables and arable crop input variables have been included, the effect of financial inclusion becomes statistically insignificant. This suggests that while financial inclusion is beneficial, its direct influence may be mediated by other factors such as input access, education, or farm management practices a dynamic also noted by Awotide et al. (2015) in their analysis of credit access and cassava productivity in Nigeria. Thus, financial inclusion has stimulated increases in arable crop productivity in the study area. This highlights the importance of the financial sector in enhancing agricultural productivity. This reinforces earlier arguments by Olomola (2001) that improved access to financial services is key to unlocking productivity among rural farming populations. Labour size and farm size were also statistically significant at the 0.01 level. This implies that a 1% increase in labour size and farm size could result in a unit increase of arable crop productivity and increase access to finance by the arable crop farmers in the study area. These findings are in line with those of Idiong (2007) and Akpan et al. (2023), who demonstrated that both labour input and land size are vital determinants of technical efficiency and output levels in smallholder farming systems.

Table 6. Effects of financial inclusion (SAVE) on arable productivity in the study area

Variables	1	2
FI (SAVE)	0.46** (2.44)	−0.086 (-1.12)
Farm capital		−0.011 (-0.12)
Household size		0.053 (0.24)
Age		0.320 (0.79)
Gender		−0.018 (-1.14)
Educational level		0.009 (0.26)
Labour size		0.485*** (2.73)
Fertilizer		−0.005 (0.09)
Herbicides		−0.046 (-0.69)
Farm size		0.623*** (5.35)
Constant		11.91*** (5.69)
R-squares	0.057	0.425

Note: ***, **, and * means significant at 1%, 5%, and 10% levels respectively. Source= Field Survey, 2024.

Table 6 shows the estimation results when the financial inclusion measure is savings (SAVE) in financial institutions. Financial inclusion, measured by savings (SAVE), is positive and statistically significant at the 0.05 level. This finding aligns with Demirgüç-Kunt et al. (2020), who emphasized that access to and use of financial services particularly savings enable smallholder farmers to smooth income, plan for production cycles, and invest in productivity enhancing technologies. The positive relationship between savings and productivity also mirrors the findings of Awotide et al. (2015), who showed that improved financial behaviour, including savings mobilization, is critical for farm investment and performance, especially in contexts where credit access is limited or uncertain. Hence, financial inclusion has led to increased arable crop productivity in the study area.

Furthermore, both labour size and farm size were positively and statistically significant at the 0.01 level, indicating that increases in these variables significantly enhance arable crop productivity and financial savings. This supports the assertion of Idiong (2007) and Akpan et al. (2023), who found that greater land area and available labour improve production capacity and efficiency, thereby enhancing the farmer's financial standing and inclusion in the formal financial system. The relationship also suggests that larger and more labour-intensive farms are more likely to generate surplus income that can be saved or reinvested, reinforcing the link between farm-scale characteristics and financial sector participation (Olomola, 2001). Also, labour size and farm size were positively statistically significant at the 0.01 level, influencing arable crop productivity and savings in financial institutions.

Table 7. Effects of financial inclusion (CREDIT) on arable productivity in the study area

Variables	1	2
FI (CREDIT)	0.895*** (-0.99)	0.68** (2.30)
Farm capital		0.48** (2.26)
Household size		−0.04 (-0.08)
Age		0.84 (0.86)
Gender		0.01 (0.34)
Educational level		0.01 (0.15)
Labour size		0.10 (0.23)
Fertilizer		−0.12 ** (-0.87)
Herbicides		0.33** (2.12)
Farm size		0.28 (0.95)
Constant		−9.69* (-1.77)
R-squares	0.093	0.250

Note: ***, **, and * means significant at 1%, 5%, and 10% levels respectively. Source= Field Survey, 2024.

Table 7 shows the results when the financial inclusion measure is borrowing (CREDIT) from a financial institution. Financial inclusion (CREDIT) is positively statistically significant at the 0.01 level in column 1. This implies that a 1% increase in CREDIT could increase arable crop productivity by a unit. This underscores the pivotal role of institutional credit in supporting farm investments and productivity gains. Similar findings were reported by Awotide et al. (2015), who emphasize that access to credit enables farmers to overcome liquidity constraints. Farm capital, which is the farmer's asset, is statistically significant at the 0.05 level. This implies that arable crop farmers can borrow to add to their assets to increase arable crop production. This supports the argument by Idiong (2007) that asset

ownership improves a farmer's ability to invest in more efficient production systems, and also increases their creditworthiness, thereby enabling further capital accumulation and productivity improvement. Herbicides are significant at the 0.05 level with a positive coefficient. This implies that any unit increase in the use of herbicides could increase arable crop production by a certain unit in the study area.

However, the quantity of fertilizer applied is negatively significant at the 0.05 level, suggesting that beyond a certain threshold, increased fertilizer use may reduce productivity. This counterintuitive finding may be attributed to over-application, poor soil compatibility, or incorrect timing of fertilizer use (Ayoola and Chude, 2021). It reinforces the importance of extension services and agronomic education to optimize fertilizer use for sustainable yield outcomes.

Table 8. Arable crop productivity and financial inclusion in the study area

Variables	Values
Constant	−7.53 (-1.52)
FI (ACCESS)	−0.29 (-0.45)
FI (SAVE)	0.49** (2.57)
FI (CREDIT)	1.06 ** (2.29)

Note: ***, **, and * means significant at 1%, 5%, and 10% levels respectively. Source= Field Survey, 2024.

Table 8 shows the relationship between arable crop productivity and financial inclusion. Saving (SAVE) and borrowing (CREDIT) were positively significant at the 0.05 level, influencing arable crop production. This implies that any increase in SAVE and CREDIT could increase the arable crop production by a certain unit. This result aligns with the findings of Awotide et al. (2015), who argue that both personal savings and access to credit play critical roles in financing agricultural input purchases, investing in improved technology, and mitigating production risks. However, ACCESS is not significant, and the coefficient is negative. This means that having ACCESS to finance without actually utilizing it cannot be transferred to any increase in arable crop production. This finding is consistent with Olomola (2001) and Demirgüç-Kunt et al. (2020), who emphasized that financial inclusion must be both physical and functional, that is, actual participation in the financial system is what drives impact, not mere access. Therefore, structural and behavioral barriers often prevent rural households from fully utilizing available financial services, thereby limiting their contribution to agricultural development.

4. Conclusion and Recommendation

This research examined empirically, the effects of financial inclusion on arable crop productivity in Bayelsa State, Nigeria. Primary data was used to examine the behaviour of arable crop farmers and financial inclusion. The empirical results showed that financial inclusion, irrespective of how it is measured, has exerted positive and statistically significant effects on arable crop productivity in the study area. Therefore, it is imperative for financial inclusion efforts to be further strengthened so that more arable crop farmers can be captured in the financial system. This will further enhance arable crop productivity. All the financial inclusion dimensions were found to be positively influencing arable crop productivity in the study area. The study, therefore, recommends that:

i. Central Bank of Nigeria (CBN) and other financial institutions formulate policies that will enhance financial inclusion that will be beneficial to arable crop farmers.
ii. There are several schemes initiated by government agencies to make borrowing in agriculture readily available and at interest rates such as Agricultural Credit Guarantee Scheme Fund (ACGSF), Agricultural Credit Support Scheme (ACSS), and Commercial Agriculture Credit Scheme (CACS) among others. Regrettably, it has been commonly tough for the real individuals involved in agricultural production to gain access to these schemes. Since access to finance positively influences arable crop productivity, policymakers and other stakeholders need to make these schemes available, and accessible at lower interest rates for real farmers.
iii. Education shows no significant level at all in all the findings, and based on this, farmers may not be able to adopt new technology or innovation, which could lead to low output. Hence, educating farmers should be set as a priority by all the stakeholders, and educated people should be encouraged to get involved in arable crop production, which will lead to food security.
iv. The distinction between access and use highlights an important policy implication: efforts to deepen financial inclusion in agriculture must go beyond expanding financial service availability and should focus on improving affordability, farmer literacy, trust in institutions, and alignment of financial products with farming cycles.

Author Contributions

Percentages of the authors' contributions are present below. All authors reviewed and approved final version of the manuscript.

	M.I.E.E.	A.R.A.	F.C.E.
C	40	35	25
D	35	40	25
S	35	35	30
DCP	40	40	20
DAI	30	50	20
L	35	35	30
W	35	35	30
CR	30	40	30
SR	30	50	20
PM	35	40	25
FA	35	35	30

C= concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

This study obtained approval from the Ethics Committee of the University of Port Harcourt (approval date: May 11, 2024, protocol code: 09). The study participants were also informed about the purpose of the study and responded to the questionnaires anonymously, and they were allowed to skip any item they did not wish to answer. The information supplied by the respondents was strictly treated with utmost confidentiality.

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Data Availability

The dataset used and analyzed in this study is available upon reasonable request.

References

Adewale AT, Lawal OA, Aberu F, Toriola AK. 2022. Effect of credit to farmers and agricultural productivity in Nigeria. East Asian J Multidiscip Res, 1(3): 377-388. https://doi.org/10.55927/eajmr.v1i3.99

Akpan S, Nkanta VS, Udofia E. 2023. Farm labour choices and productivity for small-scale arable crop farmers in Akwa Ibom State, Southern Nigeria. Anadolu Tarım Bilimleri Dergisi, 38(3): 493-512. https://doi.org/10.7161/omuanajas.1279300

Akyuz M, Tony LW, Opusunju MI. 2019. Impact of bank verification number (BVN) on corrupt business practices in United Bank for Africa in Abuja. Int J Manage Stud Soc Sci Res, 1(6): 39-52.

Aroyehun AR, Ugwuja VC, Onoja AO. 2024. Determinants of melon farmers' adaptation strategies to climate change hazards in south-south Nigeria. Sci Rep, 14: 17395. https://doi.org/10.1038/s41598-024-61164-6

Ashoro CO, Gbigbi TM, Ovharhe OJ. 2024. Financial inclusion and impacts on agriculture in Delta State, Nigeria. GSC Adv Res Rev, 18(2): 87-96. https://doi.org/10.30574/gscarr.2024.18.2.0479

Atta A, Ibrahim UA. 2024. Effect of financial inclusion on economic development in Nigeria. Int J Prof Bus Rev, 9(4): e04580.

Awotide BA, Abdoulaye T, Alene A, Manyong VM. 2015. Impact of access to credit on agricultural productivity: Evidence from smallholder cassava farmers in Nigeria. Int Assoc Agric Econ (IAAE), 1-33. https://doi.org/10.22004/ag.econ.210969

Ayoola GB, Chude V. 2021. Economic optimization of soil-crop specific fertilizer formulations in Nigeria. Int Conf Agric Econ. https://1_Ayoola_G_p19107_1_C.pdf (accessed date: January 13, 2024)

Babajide AA, Adegboye FB, Omankhanlen AE. 2015. Financial inclusion and economic growth in Nigeria. Int J Econ Financ Issues, 5: 629-637.

Bhanot D, Bapat V, Sasadhar B. 2012. Studying financial inclusion in North-East India. Int J Bank Mark, 30(6): 465-485. https://doi.org/10.1108/02652321211262221

Brisibe WG, Pepple TD. 2018. Lessons learnt from the 2012 flood disaster: Implications for post-flood building design and construction in Yenagoa, Nigeria. Civil Eng Archit, 6(3): 171-180. https://doi.org/10.13189/cea.2018.060307

Clámara N, Peña X, Tuesta D. 2014. Factors that matter for financial inclusion: Evidence from Peru. AESTIMATIO Int J Finance, 9: 8-29. https://doi.org/10.5605/IEB.10.1

Demirgüç-Kunt A, Klapper L, Singer D, Ansar S, Hess J. 2020. The Global Findex Database 2017: Measuring financial inclusion and opportunities to expand access to and use of financial services. World Bank Econ Rev, 34(Supplement): S2-S8. https://doi.org/10.1093/wber/lhz013

Demirguc-Kunt A, Klapper L. 2013. Measuring financial inclusion: Explaining variation in use of financial services across and within countries. Brookings Pap Econ Act, 1: 279-340. https://doi.org/10.1353/eca.2013.0002

Didenko I, Puacz-Olszewska J, Lyeonov S, Ostrowska-Dankiewicz A, Ciekanowski Z. 2020. Social safety and behavioral aspects of population's financial inclusion: A multicountry analysis. J Int Stud, 13(2): 347-359. https://doi.org/10.14254/2071-8330.2020/13-2/23

Erlando A, Riyanto FD, Masakazu S. 2020. Financial inclusion, economic growth, and poverty alleviation: Evidence from Eastern Indonesia. Heliyon, 6(10): e05235. https://doi.org/10.1016/j.heliyon.2020.e05235

Fasakin IJ, Akinbode BB. 2019. Technical efficiency of maize farmers in Oyo State, Nigeria. Agric J, 14(4): 70-74. https://doi.org/10.36478/aj.2019.70.74

Fowowe B. 2020. The effects of financial inclusion on agricultural productivity in Nigeria. J Econ Dev, 22(1): 61-79. https://doi.org/10.1108/JED-11-2019-0059

Gurley JG, Shaw ES. 1960. Money in a theory of finance. Brookings Institution, Washington, USA. ISBN: 978-0815733225, pp:56-65.

Idiong IC. 2007. Estimation of farm level technical efficiency in small-scale swamp rice production in Cross River State, Nigeria: A stochastic frontier approach. World J Agric Sci,

3(5): 653-658.

Iqbal BA, Sami S. 2017. The role of banks in financial inclusion in India. Cont Adm, 62(2): 644-656. http://dx.doi.org/10.1016/j.cya.2017.01.007

Klapper L, El-Zoghbi M, Hess J. 2016. Achieving the sustainable development goals: The role of financial inclusion. https://www.cgap.org/sites/default/files/Working-Paper-Achieving-Sustainable-Development-Goals-Apr-2016_0.pdf (accessed date: January 13, 2024)

Kumar N. 2013. Financial inclusion and its determinants: Evidence from India. J Financ Econ Policy, 5(1): 4-19. https://doi.org/10.1108/17576381311317754

Lauer K, Lyman T. 2015. Digital financial inclusion: Implications for customers, regulators, supervisors, and standard-setting bodies. CGAP Brief, The World Bank. https://www.cgap.org/sites/default/files/Brief-Digital-Financial-Inclusion-Feb-2015.pdf (accessed date: January 11, 2024)

Malik MI, Awan HM, Abbas N. 2020. How does financial inclusion impact economic growth, poverty, and income inequality in developing countries? J Econ Struct, 9(1): 1-25. https://doi.org/10.1186/s40008-020-00214-4

Marafa AA. 2021. Agricultural financing and productivity nexus in Nigeria: An ARDL analysis. NOUN J Manage Int Dev, 6(1): 241-259.

Mbelu ON, Ifionu EP. 2022. Agricultural financing and economic growth in Nigeria. Afr J Account Financ Res, 5(3): 30-48. https://doi.org/10.52589/AJAFR-VV0CKXM8

Mishra D, Kandpal V, Agarwal N, Srivastava B. 2024. Financial inclusion and its ripple effects on socio-economic development: A comprehensive review. J Risk Financ Manag, 17(3): 105. https://doi.org/10.3390/jrfm17030105

National Population Commission. 2006. Nigerian Census Report Abuja 2006. https://nationalpopulation.gov.ng/census-enumeration (accessed date: February 2, 2024)

Ndife CF. 2020. Impact of Central Bank of Nigeria development financing on the growth of the agricultural sector of the Nigerian economy. J Bus Manage, 22(6): 64-69. https://doi.org/10.9790/487X-2206076469

Ogbuabor JE, Nwosu CA. 2017. The impact of deposit money bank's agricultural credit on agricultural productivity in Nigeria: Evidence from an error correction model. Int J Econ Financ Issues, 7(2): 513-517.

Ogunniyi LT, Oladejo JA. 2011. Technical efficiency of tomato production in Oyo State, Nigeria. Agric Sci Res J, 1(4): 84-91.

Okringbo IJ, Ibe MN, Oduehie TC. 2017. Perceived effect of climate variability on arable crop production in Bayelsa State, Nigeria. Int J Environ Agric Biotechnol, 2(5): 2328-2335. https://doi.org/10.22161/ijeab/2.5.7

Ololade RA, Olagunju FI. 2013. Determinants of access to credit among rural farmers in Oyo State, Nigeria. Glob J Sci Front Res Agric Vet Sci, 13(2): 17-22.

Olomola AS. 2000. The nature and determinants of rural loan repayment performance in Nigeria: The case of FADU's micro-credit programme. Nigerian Institute of Social and Economic Research (NISER), Ibadan, Nigeria. ISBN: 9781812354

Olomola AS. 2001. Financial intermediation and resource mobilization for agricultural development in Nigeria. NISER Monograph Series, No. 15, NISER, Ibadan, Nigeria, pp: 56-69.

Rastogi S, Ragabiruntha E. 2018. Financial inclusion and socioeconomic development: Gaps and solutions. Int J Soc Econ, 45(7): 1122-1140. https://doi.org/10.1108/IJSE-08-2017-0324

Sandmo A. 1971. On the theory of the competitive firm under price uncertainty. Am Econ Rev, 61(1): 65-73. https://www.jstor.org/stable/1910541 (accessed date: January 29, 2024)

Sapre N. 2023. Financial inclusion: Philosophical and methodological underpinnings. Qual Res Financ Mark, 15(3): 445-452. https://doi.org/10.1108/QRFM-10-2022-0179

Sharma D, Bhattacharya S, Thukral S. 2018. Assessment of financial inclusive policy in Indian economy. Int J Ethics Syst, 34(1): 304-320. https://doi.org/10.1108/IJOES-11-2017-0211

Sharma D. 2016. Nexus between financial inclusion and economic growth: Evidence from the emerging Indian economy. J Financ Econ Policy, 8(1): 13-36. https://doi.org/10.1108/JFEP-01-2015-0004

Stiglitz JE, Weiss A. 1981. Credit rationing in markets with imperfect information. Am Econ Rev, 71(3): 393-410. https://www.jstor.org/stable/1802787 (accessed date: February 1, 2024)

Umaru A, Eshiozemhe MI. 2022. Financial inclusion and agricultural output nexus in Nigeria: An asymmetric approach. Appl J Econ Manage Soc Sci, 3(4): 1-12. https://doi.org/10.53790/ajmss.v3i4.61

World Bank. 2022. World development report 2022: Finance for an equitable recovery. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1730-4

Yadav P, Sharma AK. 2016. Financial inclusion in India: An application of TOPSIS. Humanomics, 32(3): 328-351. https://doi.org/10.1108/H-09-2015-0061

Yamane T. 1967. Statistics: An introductory analysis. 2nd ed., Harper and Row, New York, USA. https://www.scirp.org/reference/ReferencesPapers?ReferenceID=1440506 (accessed date: February 13, 2024)