



## EVALUATING THE DIFFERENTIAL ROLE OF PUBLIC-PRIVATE CREDIT SOURCES IN FINANCING CLIMATE CHANGE ADAPTATION TECHNOLOGIES FOR RURAL FARMERS IN DELTA STATE, NIGERIA

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**ABSTRACT:** *This study analyses the differential role of public and private credit sources in financing climate change adaptation technologies among rural farmers in Delta State, Nigeria. A multiple-stage random sampling procedure was utilized, and data were collected from 338 farmers employing a semi-structured questionnaire. The investigation uncovered that the average income from formal credit sources (₦212,553.85) was essentially higher than from informal sources (₦137,514.79). Variables impacting the volume of credit from informal sources included farming experience, marital status, cooperative participation, credit access, interest rates, and income. Conversely, education level, cooperative membership, credit access, and income were key determinants of credit volume from formal sources. The Chow test results indicated a significant structural difference between the two groups, with a calculated statistic of 369.48 exceeding the critical value of 1.936 at the 5% significance level. This highlights a significant difference in the sum borrowed and access to credit between formal and informal sources, underscoring the significant role of formal credit in enhancing climate adaptation among rural farmers.*

**KEYWORDS:** Public-private credit, climate adaptation finance, financing technologies, rural farmers.



## INTRODUCTION

Climate change is an international crisis which has deleterious effects on the environment and economy. It causes severe damage in Nigeria, affecting agriculture and food security because of erratic rainfall patterns combined with high temperature levels, droughts and dry spells which are synonyms to extreme weather. These changes are leading to soil degradation, less available water resources, and more pests affecting traditional farming which in turn disrupts rural livelihood (Gbigbi & Ikechukwuka, 2020; Naik 2024; Ojogbane & Gbigbi, 2022; Oluwatimilehin & Ayanlade, 2021; Malik, 2024). The existing structure of the Nigerian agricultural sector makes it more vulnerable to climate change.

With roughly 80% of Nigerian agriculturists classified as smallholders, working on less than two hectares of land, the sector is overwhelmed by rain-fed subsistence agribusiness, making it intensely vulnerable to climatic vagaries (Ikpe, 2018). This vulnerability is intense in Delta State, where climate impacts and socio-economic challenges compound rural insecurity. Projections recommend that crop yields might drop by 10-20% by 2050, highlighting the critical need for versatile measures (Enete & Amusa, 2010).

Adaptation procedures are pivotal for moderating climate impacts on agriculture. They include embracing innovations and practices to progress versatility, such as improved seed varieties, effective water system frameworks, soil preservation procedures, agroforestry, and climate-smart practices. These methods help to withstand adverse conditions, enhance productivity, and maintain soil health, while integrating trees and reducing emissions (Irham et al., 2022). The effectiveness of these strategies in boosting agricultural productivity and food security is supported by scientific literature across sub-Saharan Africa (Digitemie et al., 2024; Ibe & Amikuzuno, 2019). Despite the potential of adaptation technologies, many farmers, especially in rural areas like Delta State, face significant challenges in implementation due to inadequate financing. Limited access to appropriate financial resources traps farmers in a cycle of climate vulnerability and poverty (Gbigbi, 2020; Ogunkalu, 2021; Ovwigho et al., 2024). Financial constraints hinder investment in resilience-enhancing technologies.

## LITERATURE REVIEW

Access to credit is imperative for farmers to receive climate change adjustment innovations. In Nigeria, the agricultural fund is separated between formal (public) and informal (private) sources, each with its challenges. Formal credit incorporates commercial banks, microfinance institutions, and government programs like the Central Bank of Nigeria's Anchor Borrowers' Program, which offers reasonable credit and inputs to farmers (Olanrewaju et al., 2021). In any case, formal sources frequently have exacting prerequisites that smallholder agriculturists discover troublesome to meet. Despite ongoing initiatives, formal financial support for smallholder agriculture remains limited and fraught with challenges. Commercial banks often view small-scale farming as too risky due to their profit and risk management priorities, leading to restricted credit availability or excessively high interest rates (Ifeanyi-obi et al., 2023). High collateral demands, such as land titles or significant assets, exclude many rural farmers who lack formal property rights or substantial collateral. Additionally, the cumbersome bureaucracy and high transaction costs of formal lending systems frequently deter smallholders, especially those with limited literacy, from accessing necessary financial services (Savvidou et al., 2021).



In Nigeria, where formal financial inclusion is limited, informal credit sources like personal savings, family loans, esusu, and informal money lenders are crucial to rural finance (Gbigbi, 2020; Gbigbi 2022). However, these sources often fail to provide the significant capital needed for effective climate adaptation investments. Personal savings and family loans are typically inadequate, esusu groups offer only short-term loans, and informal lenders frequently charge high interest rates, trapping farmers in debt (Nyahunda & Tirivangasi, 2019). This financing gap reflects deeper structural issues in Nigeria's agricultural finance system. Formal lenders' practices are often misaligned with the needs of smallholder farmers, while informal sources lack the capacity for substantial investments in climate resilience.

This financing of climate change is especially alarming given the pressing need for climate adjustment in agricultural production. The agricultural sector, which employs over 70% of the country's labour force and contributes 25% to the GDP, is profoundly helpless to climate impacts (Olaniran-Akinyele & Bada, 2020). Without noteworthy adaptation measures, productivity in Nigeria could fall, posing a grave danger to food security, livelihoods, and national financial soundness (Sultana et al., 2018). The implications of this adjustment financing crevice extend far away past the farm gate. Climate change-induced agrarian misfortunes might trigger a cascade of socio-economic challenges, including a surge in rural-urban migration, deepening poverty, and potential clashes over waning resources. This study aims to address the basic issue of financing climate adaptation innovations among farmers in Delta State. By investigating accessible financing sources, barriers to access, and their implications, this research seeks to provide insights for policymakers, financial institutions, and development practitioners to enhance agrarian resilience. The specific objectives were to examine the amount of formal and informal credit obtained by the farmers for financing climate change adaptation, and determine the factors influencing the volume of credit obtained by farmers from formal and informal sources for financing climate change adaptation. The hypotheses tested were: there is no significant difference in the amount of formal and informal credit farmers obtain for financing climate change adaptation, and there is no significant difference in the extent of access to credit between formal and informal sources for financing climate change adaptation.

## METHODOLOGY

The study area is Delta State. Delta State is located in the south-south geopolitical zone/region of Nigeria. The state is divided into 3 agricultural zones, namely Delta North (9 LGAs), Delta Central (8 LGAs) and Delta South (8 LGAs). The majority of the population engage in agriculture.

Multiple stage random sampling techniques were involved for the study. Firstly, 50% of the LGAs in each agricultural zone were randomly picked. Secondly, two communities were carefully chosen from each LGA, resulting in the choice of 26 communities. The targeted sampling frame was 338 farmers and they were selected from the communities and proportionate to the numbers of registered farmers in the communities. The data for this study were collected from primary sources. The data were generated using a structured questionnaire. The data generated were analyzed with the use of descriptive and inferential statistics. Objective (i) was achieved using descriptive statistics and Objective (ii) was realized using multiple regression analysis.



## Model Specification

### Multiple Regression Model

A multiple regression model was used to estimate the factors influencing the volume of credit obtained by farmers

The linear model can be stated implicitly as:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \dots + e_t$$

where

Y = Volume of credit sourced (₦)

X<sub>1</sub> = Age (years)

X<sub>2</sub> = Marital status (dummy); married = 1; single = 0

X<sub>3</sub> = Level of education (years)

X<sub>4</sub> = Farming experience (years)

X<sub>5</sub> = Interest rate (%)

X<sub>6</sub> = Credit awareness (dummy); aware = 1, not aware = 0

X<sub>7</sub> = Farm income (₦)

X<sub>8</sub> = Co-operative membership (dummy); member = 1; not member = 0

Chow test model will be used to test the Objective iii.

$$\frac{RSS_p - RSS_1 - \frac{RSS_2}{n_2}}{RSS_1 + \frac{RSS_2}{n_2 - 2k}}$$

where

RSS<sub>p</sub> = the residual sum of square for the pooled data

RSS<sub>1</sub> = the residual sum of squares for the regression model for credit from formal sources data.

RSS<sub>2</sub> = the residual sum of squares for the regression model for credit from informal sources data.

n<sub>1</sub> & n<sub>2</sub> = are number of observations in each model

k = the total number of parameters (b's)



## RESULTS AND DISCUSSIONS

### The Amount Borrowed from Formal and Informal Credit Sources

The findings from Table 1 have significant implications for understanding the borrowing behaviour and credit access among respondents. The result reveals that informal credit sources are more as often as possible utilized for smaller credit sums, with 34.3% of respondents borrowing less than ₦100,000 from informal sources compared to 28.4% from formal sources. This outcome agreed with a study by Amakom and Amagwu (2020). This trend proceeds within the ₦ 100,000-200,000 range, where 54.4% of respondents utilized informal sources, demonstrating that these sources are more open or preferred for moderate credit amounts. However, as the loan amount increases, the reliance on formal sources becomes more pronounced. For instance, loans above ₦300,000 were predominantly accessed from formal sources, with informal sources showing a significant drop in frequency. Notably, no respondents borrowed more than ₦400,000 from informal sources, highlighting their limitations in providing high-value loans. The mean amount borrowed further emphasizes this disparity, with formal sources averaging ₦212,553.85 compared to ₦137,514.79 from informal sources. These findings suggest that while informal sources play a crucial role in meeting the immediate and smaller financial needs of respondents, formal financial institutions are essential for providing larger and potentially more impactful loans. The higher accessibility of informal loans could be due to fewer bureaucratic hurdles. Still, their limited capacity for larger amounts underlines the need for enhancing formal credit systems to support substantial financial requirements. Strengthening formal financial institutions and improving the capacity and reliability of informal sources could provide a more balanced and comprehensive financial ecosystem, ensuring better access to credit across all loan sizes.

**Table 1: Amount borrowed from formal and informal credit sources**

Amount borrowed (₦)	Formal sources		Informal sources	
	Frequency	Percentage	Frequency	Percentage
Less than 100,000	48	28.4	58	34.3
100,000-200,000	64	37.9	92	54.4
201,000-300,000	20	11.8	18	10.7
301,000-400,000	8	4.7	1	0.6
401,000-500,000	16	9.5		
Above 500,000	13	7.7		
Mean	212,553.85		137,514.79	

**Source:** Field Data 2024

### Factors Influencing the Volume of Credit Obtained from Informal Sources

The result shows the model summary of the regression model. The R-squared value, which stands at 0.736, shows that roughly 73.6% of the change of the dependent variable can be clarified by the independent factors included in the model. The F-statistic (55.649) and its related p-value (0.000) give a degree of by and large the noteworthiness of the regression model. The F-statistic compares the variability clarified by the regression to the unexplained variability, with higher values demonstrating a more noteworthy contribution of the independent factors to the variability observed in the dependent variable. The critical factors are:



### **Experience (EXP)**

The variable farming experience holds critical suggestions for both lenders and borrowers within the agrarian segment, as demonstrated by its positive coefficient in deciding the sum of credit obtained (AMTACC). This relationship suggests that as farmers amass a long time of involvement in farming, they tend to secure bigger sums of credit. This is congruent with Etunim's (2020) study on acquisition and utilization of credits by maize farmers. The access to increased credit opens entryways to fundamental resources and opportunities for development. With bigger credit lines, they can enlarge operations, adopt advanced innovations, and make strides in efficiency by securing capital to contribute to equipment, land, seeds, and other inputs essential for production. In addition, farming experience fosters superior risk administration abilities, empowering farmers to explore market vacillations and climate instabilities more successfully. This, coupled with the capacity to contribute to innovative practices, improves long-term maintainability and versatility.

### **Marital Status (MARSTA)**

The variable of conjugal status had a direct relationship with access to credit. With a positive coefficient and significance, the result implies that being hitched connects with getting a higher sum of credit. This relationship discloses a few basic components that interlace individual relationships with financial choices, forming the loaning scene for the hitched farmers. The positive coefficient demonstrating a relationship between being married and higher credit access can be translated through different focal points. Firstly, the idea of shared monetary obligations within a marriage plays a significant role. Couples frequently pool their monetary resources to manage family expenses, ventures, and major purchases mutually. This pooling of assets not only fortifies their budgetary position but moreover increases their combined creditworthiness. Lenders may see hitched people as showing a lower hazard of default due to this shared obligation, in this manner offering them bigger credit lines. Besides, the potential for higher combined livelihoods among married couples contributes altogether to their financial soundness. In numerous cases, dual-income family units appreciate a more vigorous financial standing compared to single people or cohabiting accomplices. The soundness and consistency of double incomes give lenders with more prominent affirmation of reimbursement capacity, in this way justifying bigger credit approvals.

Furthermore, the presence of a companion can serve as a built-in support framework, offering money related security and stability, which bolsters the recognition of financial soundness. Additionally, societal norms and expectations encompassing marriage may influence lenders' perception of financial steadiness. Marriage is frequently related to maturity, obligation, and commitment, qualities that lenders esteem in their borrowers. Hitched people may be seen as more likely to prioritize budgetary commitments and keep up a steady credit history over the long term, subsequently justifying bigger credit facilities. It is additionally fundamental to consider the psychological aspect of marriage within the loaning decision-making process. Moneylenders may intuitively see married people as more dependable, based on the presumption of a steady conjugal relationship. This implicit inclination might impact credit assessments, driving bigger credit approvals for hitched borrowers.



## **Cooperation (COOP)**

The variable "cooperative membership" divulges a captivating relationship between cooperative behaviour and credit access, shedding light on the importance of collaboration and shared bolster within financial transactions. With a positive coefficient and significance, the result reveals that farmers who actively engage in cooperatives tend to secure bigger sums of credit. This supports Etunim's (2020) findings. This relationship underscores the esteem of cooperative behaviour in fostering monetary trust and reliability. Cooperative individuals regularly follow standards of collective obligation, mutual help, and shared benefits, characteristics that reverberate positively with banks. By actively taking an interest in cooperative activities, such as making timely payments, respecting credit terms, and collaborating with fellow individuals, people demonstrate a commitment to financial discipline and responsibility. Besides, cooperative participation implies a sense of belonging, which can reinforce creditworthiness within the eyes of moneylenders. Cooperative members frequently benefit from peer support, mentorship, and access to financial education, which enable them to form informed monetary choices and manage credit responsibly. Lenders may see cooperative members as displaying lower credit risks due to the social capital and bolster systems inborn in cooperative structures, in this manner justifying bigger credit approvals. The positive relationship between cooperative behaviour and credit access underscores the significance of non-financial components in creditworthiness evaluation, whereas traditional credit scoring models basically center on money related metrics, such as wage, resources, and credit history. The presence of cooperative participation signals a broader dimension of borrower unwavering quality and dependability. Lenders may recognize the characteristic value of cooperative standards, such as transparency, responsibility, and community engagement, in mitigating credit risks and fostering long-term borrower relationships. Besides, cooperative membership reflects a commitment to economical and inclusive money related ones, adjusting with broader societal objectives of financial strengthening and social cohesion. By incentivizing cooperative behaviour through bigger credit approvals, lenders can empower dependable financial conduct and foster a culture of financial inclusion. Cooperative members, in turn, benefit from increased access to credit, which can fuel entrepreneurship, venture, and financial improvement within their communities.

## **Credit Awareness (CREDAWA)**

This captivating relationship underscores the significance of financial education and dependable credit management practices in shaping creditworthiness and borrower characteristics. The positive coefficient related to credit awareness suggests that people who have a more profound understanding of their credit status and effectively manage their funds are more likely to get bigger credit. This is in agreement with Egbo et al. (2021). This relationship highlights the transformative power of knowledge and proactive budgetary planning in exploring the complexities of the credit market. By staying informed about their credit reports, monitoring their credit scores, and practising judicious financial propensities, people demonstrate a commitment to responsible credit administration, which reverberates emphatically with lenders.

Moreover, higher levels of credit awareness are characteristic of a broader spectrum of financial proficiency and empowerment. People who are cognizant of the factors impacting their financial soundness are better prepared to make informed financial choices, avoid common pitfalls, and optimize their borrowing potential. Lenders may see these borrowers as displaying



lower credit risks due to their demonstrated capacity for financial self-management, subsequently legitimizing bigger credit approvals. Besides, credit awareness reflects a proactive approach to financial well-being and hazard moderation. People who effectively monitor their credit status are more likely to detect and address inaccuracies, fraudulent exercises, or negative entries that may unfavorably affect their financial soundness. By taking preemptive measures to correct issues and keep up a positive credit profile, these borrowers enhance their credibility and dependability within the eyes of moneylenders, thereby expanding their chances of securing bigger credit facilities. The positive relationship between credit awareness and credit access underscores the transformative potential of financial education and empowerment activities.

### **Interest Rate (INR)**

With a negative coefficient and significance, the result proposes a converse relationship between interest rates and the sum of credit gotten. This captivating relationship sheds light on the complex interaction between interest rate dynamics, borrower behaviour, and lending practices, underscoring the effect of borrowing costs on credit choices and borrower outcomes. The negative coefficient related to interest rates infers that as interest rates rise, the sum of credit gotten tends to diminish. This relationship underscores the fundamental principle of interest rate sensitivity in credit markets, wherein higher borrowing costs act as an obstruction to credit demand. Borrowers may be less inclined to look for bigger credits when confronted with hoisted interest rates, as the increased cost of borrowing reduces the affordability and allure credit.

In addition, the inverse relationship between interest rates and credit access reflects the concept of interest rate versatility, wherein changes in interest rates exert shifting degrees of impact on credit demand, subsequently diminishing the motivating force for people to seek larger credit facilities. Borrowers may prefer alternative financing options or delay borrowing choices in reaction to ominous interest rate conditions, leading to a withdrawal in credit access. Moreover, the inverse relationship between interest rates and credit access highlights the broader implications of financial policy and interest rate management, and financial activity. Central banks and policymakers regularly utilize interest rate adjustments as a device to regulate credit markets, invigorate or dampen financial development, and control inflationary pressures. Changes in interest rates can impact borrowing costs across various segments of the economy, affecting consumer spending, investment choices, and by and large credit accessibility. Moreover, the relationship between interest rates and credit access underscores the significance of borrower hazard recognition and financial planning in credit decision-making. Higher interest rates may signal financial instability, prompting borrowers to exercise caution and prudence in their borrowing activities.

### **Income (INC)**

The finding that income shows a positive and statistically noteworthy relationship with the sum of credit obtained reveals critical insights into the dynamics of credit access and borrower characteristics. With a positive coefficient, the result suggests that as income levels rise, people tend to secure bigger sums of credit. This relationship underscores the basic role of income in shaping creditworthiness, lender perceptions, and borrowing outcomes, highlighting the implications of financial soundness and repayment capacity on credit access. The positive coefficient related to income suggests that higher income levels are positively related to greater





credit access. This relationship is intuitive, as people with higher earnings regularly have greater financial resources, stability, and repayment capacity, rendering them less hazardous from a lender's viewpoint. Lenders are more inclined to amplify bigger credit lines to borrowers with higher incomes, as they see them as displaying lower default risks and demonstrating a more grounded capacity to meet their financial commitments. Additionally, the positive relationship between income and credit access reflects broader socio-economic dynamics and incongruities in credit access. Higher income levels are regularly demonstrative of socio-economic preferences, educational attainment, and career opportunities, which contribute to enhanced financial literacy, planning, and versatility. People with higher livelihoods may have access to a wider run of financial products and services, favourable borrowing terms, and personalized credit arrangements tailored to their needs, subsequently facilitating greater credit access and utilization.

Moreover, the positive relationship between income and credit access underscores the significance of income solidness and predictability in credit assessments and lending decisions. Lenders consider not only the absolute level of income but also its stability and consistency over time when assessing financial soundness. Borrowers with relentless, dependable income streams are seen as showing lower credit risks, as they possess the means to service their obligations and withstand unanticipated financial stuns or disturbances. Furthermore, the positive relationship between income and credit access highlights the broader implications of income imbalance and financial incongruities on credit markets and financial consideration. People with higher earnings may benefit from privileged access to credit and ideal borrowing terms, exacerbating socio-economic imbalances and constraining credit access for lower-income segments of the populace.

**Table 2: Factors influencing the volume of credit obtained from informal sources**

Model	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	T	Sig.	Tolerance	VIF
(Constant)	16250.160	53658.765		.303	.762		
Age	931.808	745.746	.054	1.249	.213	.884	1.131
Edu	6738.086	7002.313	.046	.962	.337	.735	1.361
Exp	4586.861	1805.777	.123	2.540	.012	.710	1.408
Marsta	39914.969	20301.666	.095	1.966	.051	.702	1.424
Coop	36398.087	18215.564	.090	1.998	.047	.811	1.232
Credawa	64129.137	17821.942	.174	3.598	.000	.708	1.413
Inr	-3962.209	1045.932	-.167	-3.788	.000	.851	1.176
Income	.856	.056	.726	15.322	.000	.736	1.359

**Source:** Field Data 2024; *R-square* = .736; *F-ratio* = 55.649

**Factors Influencing the Volume of Credit Obtained from Formal Sources**

The coefficient of multiple determination (R) stands at 0.802, implying that roughly 80.2% of the variability in the dependent variable is accounted for by the explanatory factors. Moreover, the F-statistic, computed was 36.110, which had a critical p-value (.000); this shows the overall significance of the regression model, implying that at least one predictor significantly influences the sum of credit gotten, thereby giving important insights into the factors affecting the dependent variable. The factors are examined as appeared.



## **Education (EDU)**

The importance of education as a predictor in deciding the sum of credit obtained (AMTACC) is eminent, reflecting a broader socio-economic trend wherein people with higher educational achievement tend to get bigger credit facilities. The coefficient for education (EDU), standing at 23161.675 with a Beta of 0.113 ( $p = 0.029$ ), means a positive relationship between education level and AMTACC. This statistical insight suggests that for each unit increment in education level, there's a related rise in the sum of credit obtained, by around 0.113 standard deviations. This finding bears significant suggestions, indicating the multifaceted role education plays in shaping financial practices and opportunities. As people advance through higher levels of education, they are likely to develop a more profound understanding of financial concepts, hazard administration strategies, and venture opportunities. This outcome agreed with Turkson et al.'s (2022) study on the role of formal and informal finance in Ghana noted to be more inclined towards utilizing credit facilities for different purposes such as speculation in businesses or properties, entrepreneurial ventures, or personal consumption needs. The positive association between education and credit underscores the essential role of education in improving financial education and enabling people to create educated financial decisions. Higher levels of education regularly relate with improved financial administration abilities, a higher understanding of credit items, and an enhanced capacity to explore the complex financial landscape. This, in turn, encourages better credit administration practices and increases the confidence of lenders in amplifying credit to educated people.

Besides, education catalyzes economic empowerment and social versatility. Access to credit empowers people to contribute in education, acquire skills, and pursue opportunities for career progression or entrepreneurship. By leveraging credit facilities, educated people can unlock doors to financial development, wealth amassing, and improved living standards for themselves and their families. In essence, the positive relationship between education and credit access underscores the transformative potential of education in shaping financial outcomes and fostering socio-economic advancement.

## **Cooperative Membership (COOP)**

The significance of participation in cooperatives as a determinant of the sum of credit gotten (AMTACC) underscores the pivotal role that cooperative participation plays in encouraging access to credit. The coefficient for cooperative enrolment (COOP) stands at 32176.651 with a Beta of 0.144 ( $p = 0.005$ ), demonstrating a positive and statistically critical relationship between cooperative membership and AMTACC. This suggests that people who are members of cooperatives tend to secure bigger sums of credit compared to non-members. This finding holds significant implications, highlighting the one-of-a-kind preferences and opportunities managed by cooperative members in getting to credit facilities. Cooperative participation gives people access to pooled resources, financial administrations, and collective haggling power, which collectively improve their creditworthiness and access to credit. By pooling resources together, cooperatives can offer members credit facilities that may otherwise be inaccessible to persons, especially those with restricted financial resources or collateral. In addition, cooperatives regularly play a pivotal role in giving financial education and support to their members, further enabling them to successfully manage credit and use it for different financial activities.



Moreover, cooperative members are frequently engaged in financial activities such as agriculture, small-scale businesses, or community improvement ventures, which require access to credit for investment and expansion. Cooperatives serve as a platform for collective financial endeavours, facilitating access to credit for productive purposes that contribute to the development of local communities. In essence, the significance of cooperative enrolment as a predictor of the sum of credit gotten underscores the transformative potential of cooperative endeavours in advancing financial consideration, empowering marginalized communities, and fostering sustainable financial improvement. By tackling the collective strength and resources of their members, cooperatives play a crucial role in expanding access to credit, advancing financial resilience, and socio-economic advancement at the grassroots level.

### **Credit Awareness (CREDAWA)**

Credit awareness plays an essential role in shaping the sum of credit people get (AMTACC), as proven by a coefficient of 44991.822 and a Beta of 0.202 ( $p < 0.001$ ). This statistical understanding underscores the critical impact that an individual's level of credit awareness can have on their borrowing capacity. This shows that people with more noteworthy awareness of credit matters tend to secure bigger sums. At its core, credit awareness encompasses a comprehensive understanding of different facets related to credit products, terms, rights, and obligations. It empowers people to make well-informed borrowing choices and viably explore the complexities of the credit market. By being well-versed in the subtleties of credit, people are better equipped to assess their borrowing needs, evaluate different credit choices, and select the most appropriate ones tailored to their financial circumstances. One of the key advantages related to increased credit awareness is the potential to contribute to an enhancement in credit. By understanding the factors that impact credit and adopting responsible credit management practices, people can work towards improving their creditworthiness. A great credit score not only opens doors to better borrowing openings but moreover deciphers into lower interest rates, reflecting the lender's confidence in the borrower's capacity to repay debts.

Moreover, a hoisted level of credit awareness empowers people to get a broader spectrum of credit products. This expanded access encompasses a variety of credit types, credit cards, and financing options, which may not be promptly accessible to those with constrained credit information. Access to a differing extent of credit products affords borrowers the adaptability to select alternatives that align with their particular needs and inclinations. Moreover, increased credit awareness can facilitate the negotiation of more ideal terms and conditions on credit agreements. Equipped with information about prevailing market rates, fee structures, and contractual terms, individuals are better positioned to advocate for terms that are favourable to their financial well-being. This could include securing lower interest rates, negotiating deferred expenses, or getting longer repayment periods, all of which contribute to more ideal borrowing outcomes.

### **Income (INC)**

Income emerges as the fundamental predictor when considering the sum of credit gotten (AMTACC), highlighted by a significant coefficient of 0.650 and a Beta of 0.738 ( $p < 0.001$ ). This statistical disclosure underscores the significant impact that income levels wield over individuals' borrowing capacities, explaining a robust positive relationship between income and the sum of credit procured. This suggests that people with higher income levels tend to secure bigger sums of credit, displaying the significant role income plays in shaping borrowing



dynamics. At its essence, income serves as a barometer of financial well-being, reflecting an individual's earning potential, stability, and capacity to meet financial commitments. Higher income earners ordinarily show greater financial soundness, decreased credit hazard, and enhanced repayment capacity, rendering them profoundly alluring borrowers within the eyes of financial institutions. This result agrees with that of Balana and Oyeyemi (2022). Lenders are naturally inclined to amplify bigger credit lines to people with higher income levels, given their perceived capacity to benefit from debts responsibly and mitigate default risks successfully. In addition, hoisted income levels afford people expanded access to plenty of credit items and higher credit limits. This availability empowers them to finance significant ventures, make critical purchases, or cover substantial expenses which will be beyond the reach of people with lower income levels. From securing mortgages for home purchases to obtaining credits for business ventures or educational pursuits, people with higher earnings enjoy the adaptability and the convenience of accessing a wide array of credit options tailored to their financial needs and aspirations.

Also, higher income levels engender a sense of financial empowerment, enabling people to use credit strategically to achieve their financial goals and yearnings. Whether it involves investing in wealth-building resources, financing entrepreneurial endeavours, or pursuing educational advancement, people with higher incomes possess the resources and liquidity to capitalize on credit opportunities and impel their financial trajectories forward. Moreover, the relationship between income and the sum of credit gotten underscores the broader financial implications at play. Income inequality, for instance, can perpetuate incongruities in access to credit, exacerbating existing financial divides and ruining financial versatility for marginalized communities. Tending to these incongruities necessitates not only policies aimed at advancing income uniformity but moreover initiatives geared towards fostering financial literacy and inclusion, subsequently levelling the playing field and guaranteeing equitable access to credit resources for all people, notwithstanding the income bracket.

**Table 3: Factors influencing the volume of credit obtained from formal sources**

Variables	Unstandardized Coefficients		Standardized Coefficients		Sig.	Collinearity Statistics	
	B	Std. Error	Beta	t		Tolerance	VIF
(Constant)	66879.902	47637.438		1.404	.162		
Age	153.559	530.473	.014	.289	.773	.962	1.039
Edu	23161.675	10529.160	.113	2.200	.029	.842	1.187
Exp	967.345	1067.481	.048	.906	.366	.804	1.244
Marsta	9317.576	13772.899	.036	.677	.500	.804	1.244
Coop	32176.651	11321.432	.144	2.842	.005	.864	1.158
Credawa	44991.822	10834.500	.202	4.153	.000	.939	1.065
Inr	-152.552	841.303	-.009	-.181	.856	.903	1.107
Income	.650	.044	.738	14.885	.000	.907	1.103

**Source:** Field Data 2024; *R-square* = 0.644; *F-ratio*=36.110



## **Factors Affecting the Volume of Credit Obtained from Formal and Informal (Pooled Data)**

The coefficient of determination was roughly 63.5% of the variability in the dependent variable, which was accounted for by the included predictors. This statistic underscores the considerable impact wielded by the independent factors in shaping the outcome, confirming the utility of the model in capturing and elucidating these intricate relationships. The F-value calculated was 71.438, meaning the proportion of the explained variance to the unexplained variance. With a significance level (Sig.) of .000, this F-value suggests that the regression model is highly significant, showing that the included indicators collectively have a considerable effect on the sum of credit gotten (AMTACC). The significant factors include experience (EXP), credit awareness (CREDAWA), interest rates (INR), and income (Income).

### **Experience (EXP)**

The relationship between experience and the sum of credit obtained may be nuanced. People with more experience in managing their funds may have a better understanding of their credit needs and borrowing capabilities. They might have built up credit histories and demonstrated responsible borrowing behaviors, which could lead to simpler access to credit and higher credit limits. Conversely, people with less experience may face challenges in getting credit due to limited credit histories or perceived hazards by lenders. However, it is essential to note that the relationship may not always be straightforward. Some experienced people may prefer to avoid credit altogether or maintain lower levels of debt due to chance aversion or past negative experiences. Understanding how experience impacts credit utilization and borrowing choices may give insights into the financial behaviors of distinctive demographic groups.

### **Credit Awareness (CREDAWA)**

Credit awareness plays a significant role in deciding the sum of credit people get. People who are knowledgeable about credit products, interest rates, and credit systems are better equipped to explore the borrowing process effectively. They may effectively screen their credit reports, understand the implications of diverse types of credit, and make informed borrowing choices. As a result, farmers with higher levels of credit knowledge may have access to a wider extent of credit choices and be able to negotiate more favorable terms, such as lower interest rates or higher credit limits. On the other hand, farmers with lower levels of credit awareness may be more defenseless to predatory lending practices or may struggle to qualify for credit through and through. Advancing credit awareness through financial education initiatives could enable people to make sound borrowing choices and maintain a strategic distance from possibly harmful debt circumstances.

### **Interest Rates (INR)**

Interest rates specifically affect the cost of borrowing and, in this way, the entirety of credit the farmers get. Lower interest rates more often make borrowing more reasonable, leading to increased requests for credit and higher borrowing levels. The outcome supports Adeshina et al.'s (2020) study on agricultural financing and economic performance. Then again, higher interest rates may dishearten farmers from taking on extra obligations or prompt them to seek alternative financing choices with lower costs. Besides, vacillations in interest rates can influence the availability of credit over different market segments. For example, amid periods of financial improvement, central banks may lower interest rates to strengthen borrowing and



venture, in this way extending the supply of credit. On the other hand, amid monetary downturns, central banks may raise interest rates to control inflation, driving more firmly credit conditions. Understanding the interaction between interest rates and credit availability is crucial for policymakers and financial institutions in directing budgetary control of activity and advancing financial strength.

### Income (INCOME)

Income is a key determinant of the sum of credit people get. Higher income levels by and large allow people to qualify for bigger credit amounts as lenders see them as less risky borrowers with greater repayment capacity. People with higher incomes may moreover have more disposable income accessible for debt service, decreasing the probability of default. As a result, higher-income farmers may have access to a broader extent of credit items and be able to utilize credit more broadly for distinctive purposes, such as home purchases, education expenses, or business ventures. Be that as it may, it is fundamental to recognize that income alone does not guarantee access to credit, as moneylenders moreover consider variables such as credit history, employment stability, and debt-to-income proportions when assessing financial soundness. Additionally, variations in income levels can compound disparities in access to credit, conceivably compelling financial opportunities for lower-income farmers.

**Table 4: Factors affecting the volume of credit obtained from formal and informal (pooled data)**

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.	Collinearity Statistics	
	B	Std. Error	Beta	T		Tolerance	VIF
Constant)	22285.059	36756.115		.606	.545		
Age	572.473	495.497	.039	1.155	.249	.963	1.038
Edu	6145.767	5754.270	.039	1.068	.286	.843	1.186
Exp	-3102.643	1044.547	-.107	-2.970	.003	.849	1.178
Marsta	8393.774	12493.775	.024	.672	.502	.876	1.142
Coop	-17215.091	10393.771	-.056	-1.656	.099	.965	1.037
Credawa	-20339.225	10252.008	-.067	-1.984	.048	.964	1.038
Inr	1612.691	708.851	.081	2.275	.024	.877	1.140
Income	.821	.037	.767	22.115	.000	.922	1.084

**Source:** Field Data 2024; *R-square* = .635; *F-ratio*=71.438

### Results of the Chow Test

The Chow test results show that the calculated statistic (369.48) exceeds the critical value (1.936) at a 5% level of significance, uncovering a noteworthy structural break between the formal and informal credit sources analyzed. This finding has significant implications for understanding the variables impacting the volume of credit gotten by farmers from formal and informal sources, especially within the setting of financing climate change adaptation. Firstly, the significant structural break suggests that the variables, influencing credit volume, contrast significantly between the formal and informal credit sources. This suggests that the relationship between credit volume and variables like income, farm size, or education varies over these groups. This agreed with Ndanitsa et al.'s (2021) study on the effects of agricultural credit delivery on income in Niger State. Thus, the adequacy and availability of credit sources—



whether formal or informal—are not uniform and depend on specific conditions or characteristics of the groups.

Besides, the results highlight that the determinants of credit volume are not identical for formal and informal sources. Factors such as income level, education, and farm size might impact credit obtained from formal sources differently than from informal ones. This differentiation is especially critical for financing climate change adaptation. Custom fitted strategies are essential to address the unique needs associated with each type of credit source. For example, improving access to formal credit might include improving financial literacy and income levels, whereas informal credit methodologies may need to focus on reinforcing neighbourhood networks and addressing other specific barriers. Finally, these findings emphasize the need for targeted interventions and policies. Understanding the varying effects of factors on credit volume over different sources enables more precise and viable strategies. Policies should be designed to address the distinct variables impacting each credit source, guaranteeing that farmers have access to the funds required for effective climate change adaptation measures.

### Research Hypotheses

**Hypothesis 1: There is no significant difference between the amount borrowed from formal and informal sources by farmers.**

The results of the paired samples t-test offer compelling insights into the borrowing behaviours of participants from both formal and informal credit sources. Notably, there is a significant increase in borrowing from formal credit sources following the intervention. This rise suggests a striking move in participants' borrowing inclinations towards regulated financial institutions such as banks or credit unions. The increase implies a growing belief and reliance on formal financial channels, possibly driven by improved access to favourable lending terms, lower interest rates, and increased borrowing limits. Participants may now have the means to address a broader range of financial needs, including personal expenses, education, housing, and entrepreneurial ventures, through formal credit roads. Alternately, the investigation uncovers a corresponding decrease in borrowing from informal credit sources subsequent to the intervention. This decrease suggests a positive departure from reliance on informal loaning channels, which regularly come with high costs and exploitative practices.

Farmers' decreased dependence on informal credit sources shows an increased awareness of the threats related to such borrowing procedures and a move toward more straightforward and controlled financial options. By moving away from informal borrowing, individuals may moderate their exposure to extreme interest rates, coercive reimbursement terms, and restricted consumer protections, along these lines improving their financial soundness and well-being. By and large, the paired t-test results emphasize the transformative effect of the intervention on participants' borrowing practices. The critical increment in borrowing from formal credit sources, coupled with the corresponding decrease in borrowing from informal sources, reflects a broader drift towards financial mainstreaming and consideration. Through focusing on interventions and improved access to formal financial administrations, farmers are empowered to make informed borrowing choices and investigate the financial landscape more viably. These findings highlight the significance of promoting equitable access to transparent and sustainable financial resources, eventually fostering economic resilience, empowerment, and upward versatility among people and communities.



**Table 5: There is no significant difference between the amount borrowed from formal and informal sources**

Sources	Mean	Std deviation	Std. Error Mean	T	p-value
Amount borrowed from formal sources - Amount borrowed from informal sources	75039.05	202376.53	15567.43	4.820	0.000

Source: *Field Data 2024*

**Hypothesis 2: There is no significant difference in the extent of access to credit between formal and informal sources.**

The investigation uncovered that the mean frequency of accessing credit from formal sources was 2.5750, with a standard deviation of 0.36068 and a standard error of 0.02774. In contrast, the mean frequency of getting credit from informal sources was higher, at 3.1953, with a standard deviation of 0.35168 and a standard error of 0.02705. The t-test for the difference yielded a t-value of -18.279, with a comparing p-value of 0.000, demonstrating a statistically critical contrast at the 1% level. This result rejects the null hypothesis, demonstrating that there is a significant difference in the extent of access to credit between formal and informal sources.

The lower mean for accessing credit from formal sources compared to informal sources suggests that respondents find it more challenging to get credit from formal financial institutions. Several factors could contribute to this disparity. Firstly, formal financial institutions often have more rigorous application processes, including collateral necessities and credit history checks, which many people, particularly in rural or less economically developed areas, may find difficult to meet. This complexity and inaccessibility can hinder potential borrowers from seeking formal credit.

This ease of access makes informal sources more attractive despite potentially higher interest rates or less favorable terms. The informal networks often operate on trust and social capital, permitting for more personalized and quick responses to credit needs. Furthermore, there might be a lack of awareness or trust in formal financial institutions among the respondents. People often prefer dealing with known and trusted community individuals rather than unfamiliar formal institutions. Physical access to formal financial institutions can also be a barrier, as rural areas may have limited banking frameworks, making informal sources more convenient. This geographical limitation can significantly affect the capacity of rural populaces to engage with formal banking services. Besides, cultural and social norms in some communities may favor borrowing within familiar social networks over engaging with formal financial entities. In many cases, informal lending practices are profoundly embedded within the community's social fabric, providing a sense of security and mutual support that formal institutions may not offer.





**Table 6: There is no significant difference in the extent of access to credit between formal and informal sources**

Variable	Mean	Std. dev.	Std error	t-value	Pr>t
How often do you access credit from formal sources	2.5750	.36068	.02774	-18.279	0.000
how often do you access credit from informal sources	3.1953	.35168	.02705		

Source: *Field Survey 2024*

## CONCLUSION

The study comprehensively investigates the differential viability of formal and informal credit sources in financing climate change adaptation technologies for rural farmers in Delta State, Nigeria. The results emphasize a noteworthy dissimilarity in the income received from formal versus informal credit sources, with formal credit sources yielding a substantially higher average income (₦212,553.85) than casual sources (₦137,514.79). This difference highlights the pivotal role that formal credit institutions play in improving rural farmers' financial stability and adaptive capacity. The investigation reveals that formal credit sources are impacted by education level, cooperative participation, credit access, and income, which facilitate better terms and higher amounts of credit. These variables enable farmers to invest in climate change adaptation technologies more effectively, subsequently improving their agricultural productivity and resilience. On the other hand, informal credit sources, which are impacted by factors such as farming experience, marital status, and interest rates, tend to offer less favourable conditions, possibly restricting their viability in supporting comprehensive adaptation strategies.

The pronounced structural difference identified through the Chow test, with a calculated statistic of 369.48 significantly exceeding the critical value of 1.936 at the 5% significance level, further emphasizes the substantial gap between the two credit groups. This finding underscores the importance of formal credit in giving more substantial financial support for climate adaptation, highlighting its potential as a key driver of agricultural resilience. Given the critical role of formal credit in improving climate change adaptation efforts, the study shows a pressing need for targeted interventions to address the barriers confronted by rural farmers in accessing formal credit. Although informal credit sources remain critical, particularly in areas with limited formal financial infrastructure, improving access to formal credit is essential for achieving long-term sustainability and resilience in agricultural practices.

## RECOMMENDATIONS

1. Streamline the application strategies for formal credit by decreasing paperwork and introducing online platforms to make it simpler for rural farmers to access loans.
2. Advocate for lower interest rates on agricultural loans through government subsidies or negotiations with financial institutions to make formal credit more affordable for farmers.



3. Develop and implement outreach programs that provide rural farmers with information and assistance on accessing formal credit options and exploring the application process.
4. Facilitate the integration of successful informal credit networks into the formal financial framework, providing them with additional resources and support to enhance their operations.
5. Launch pilot projects that test collaborative financing models involving partnerships between formal financial institutions, cooperatives, and informal credit providers to address diverse credit needs.

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