

RESEARCH REPORT

Enhancing Rural Women Farmers' Resilience to Climate Change-Induced Impacts Through Financial Inclusion in Nigeria

Prepared by

Sarah Edore Edewor (PhD.)
(EFInA Research Fellow)



Executive Summary

Rural women form a large part of Nigeria's smallholder farming population, yet they face a double disadvantage: heavy exposure to erratic rainfall, droughts, and flooding, combined with limited access to the formal financial tools that could help them absorb such shocks. Rural bank-account ownership nationally has risen only slowly, and a third of rural adults remain financially excluded altogether, even as climate stress continues to depress yields, incomes, and food security in the communities most affected. Financial inclusion is widely promoted as a route to climate resilience, but it has remained unclear whether this promise holds for rural women farmers specifically, and which financial services actually deliver that protection rather than merely accompanying it.

The study examined how different financial services, including account ownership, savings, mobile money, credit, insurance, and cooperative savings, amongst others relate to the climate resilience of rural women farmers in Nigeria. It aimed to identify which combinations of services best support women's capacity to cope with climate shocks; to establish whether financial inclusion and climate resilience translate into better agricultural productivity, income, and food security; and to assess how effective an existing financial-inclusion initiative has been, and how that effectiveness varies by state.

Using mixed method approach, the study combined a household survey of 360 rural women farmers, split equally between a financial inclusion initiative programme (Value Chain Development Programme) beneficiaries and non-beneficiaries across Benue, Ebonyi, and Ogun States, complemented with focus group discussions and key-informant interviews. The survey data were used to build a Financial Inclusion Index and a Climate Resilience Index, alongside measures of agricultural productivity (Total Factor Productivity), income, and food security. Propensity-score matching, cross-checked using three separate methods; Nearest neighbour with replacement, nearest neighbour without replacement and Inverse Probability of Treatment Weighing (IPTW), was used to compare statistically similar beneficiary and non-beneficiary households. Twenty-seven possible service combinations was tested individually against resilience, with results corrected for the risk of false positives from multiple testing. Qualitative findings were used to interpret and test the robustness of these statistical patterns.

Treated as a single composite score, the Financial Inclusion Index was a weak and unstable predictor of outcomes (income, agricultural productivity and food security), showing no immediate link to productivity, income, or food security, and even reversing direction across statistical methods for resilience. There was markedly changes at the level of specific financial services combinations: nineteen of twenty-seven combinations tested were significantly linked to resilience, fifteen surviving strict correction from the Bonferroni Sensitivity test, with insurance-based combinations consistently strongest, particularly insurance paired with informal rotating-savings groups (7.4%), card-based banking (6.9%), or mobile money (6.4%). A savings account held alone, without an insurance or group component, showed little benefit and sometimes a mild decline. Insurance was also the service women reported struggling most

to access or understand with the exception of programme beneficiaries in Ebonyi state, making it simultaneously the least-used and most protective instrument in the study.

Programme beneficiaries had higher financial inclusion index (44.4 vs 39.6), scored substantially higher on resilience (54.7 vs 44.8) and were markedly more likely to be food secure (27.2 vs 6.7%) than matched non-beneficiaries, results that held consistently across all matching methods. Agricultural productivity and income showed no comparable immediate gain, and some insurance-based combinations were, if anything, associated with lower measured crop productivity. Interviews suggest this reflects diversification rather than failure: women with access to insurance, savings groups, and mobile money described redirecting resources toward livestock, processing, and trade as a buffer against climate risk rather than intensifying crop farming, consistent with beneficiaries reporting improved income and output even where formal, crop-based productivity measures did not capture it. Programme effects on resilience also varied by state: largest in Benue (14.97), reflecting uneven coverage across communities; smallest in Ogun (2.71), linked to loan-design and literacy concerns; and paired in Ebonyi (9.82) with a fall in crop productivity, again pointing to diversification rather than intensification.

Overall, financial inclusion builds resilience and food security for these rural women farmers most reliably through specific, well-chosen combinations of services, insurance foremost among them, rather than through broad expansion of access alone. Its link to productivity and income is far weaker, and where insurance-based bundles relate to farm output, the association tends to be negative rather than positive, largely because households use financial access to diversify livelihoods rather than intensify production. Financial inclusion and climate resilience also appear to reinforce one another when built together, arguing against treating them individually.

Future programme design or intervention should therefore target the specific combinations shown to build resilience, especially insurance paired with informal or cooperative savings, rather than aggregate access alone, with simplified enrolment and claims processes to close the notable insurance gap. Where raising crop yields is a genuine goal, financial access should be paired with production-side support such as inputs, irrigation, and climate advisory services rather than treated as a substitute; where households are diversifying into livestock, processing, or trade instead, that strategy warrants direct support rather than being read as underperformance. Financial inclusion and resilience should be built jointly through integrated packages, and monitoring should track specific service combinations rather than a single aggregate index, with strategies tailored to each state's distinct pattern: expanding coverage in Benue, improving product design and literacy support in Ogun, while supporting diversification in Ebonyi.

Research Fellowship Acknowledgement

This report was conducted by Sarah Edore Edewor, EFINA Research Fellow (2026), under the EFINA Research Fellowship Programme of Enhancing Financial Innovation & Advancement (EFInA).

Acknowledgements

The fellowship was funded by EFINA. The author is grateful to the EFINA Research and Innovation Team, the fellowship mentors, methodology reviewers and stakeholder review panel who provided successive rounds of feedback that strengthened the technical report. Their emphasis on decision-enabling evidence has also shaped this report.

The author thanks the officials and leaders who gave their time and insight during twelve key informant interviews, conducted in 2026. Participants included representatives of the Value Chain Development Programme (VCDP), Extension agents, State Ministry of Agriculture officials and women leaders from Benue, Ebonyi and Ogun states.

Sincere appreciation goes to the enumeration teams who conducted nine focus group discussions and a survey of 360 respondents across the three states. The author also acknowledges the extension agents and community leaders in Benue, Ebonyi and Ogun States, whose support facilitated community entry and made the fieldwork possible.

The analysis draws on the following sources:

- EFINA Access to Financial Services in Nigeria (A2F) 2023 survey
- World Bank Nigeria Generalised Household Survey (GHS) Data 2018/2019
- The academic literature cited in the References

Disclaimer

The author bears sole responsibility for any errors of fact, analysis or interpretation. The findings and views expressed do not necessarily reflect those of EFINA or of any institution that contributed information to this study.

Table of Content

Executive Summary	1
Research Fellowship Acknowledgement	3
Table of Content	4
List of Tables	6
List of Figures	7
1. Introduction.....	8
2. Literature Review.....	11
2.1 Theoretical framework	11
3 Methodology	14
3.1 Study Area.....	14
3.1.1 Overview of the Value Chain Development Programme (VCDP).....	15
3.2 Data Source & Collection	16
3.3 Sampling Technique.....	16
3.4 Analytical Techniques.....	18
3.4.1 Financial inclusion index (FII)	18
3.4.2 Climate Resilience Index.....	19
3.4.3 Influence of Financial Inclusion and Climate Resilience Interaction on Livelihood Outcomes of Rural Women Farmers	20
3.4.4 Analytical Technique: Propensity Score Matching	21
3.5 Covariate Balance After Matching.....	22
3.6 Ethical Considerations.....	22
4. Results and Discussion	23
4.0. Summary Statistics.....	23
4.1 Socioeconomic Characteristics of Respondents.....	24
4.2 Land Tenure Security	25
4.3 Household Decision-Making.....	26
4.4 Farming System and Climate-Change Awareness	27
4.5 Weather Changes Observed	27
4.6 Financial Account Ownership.....	29
4.7 The Financial Inclusion Index (FII)	30
4.8 Climate Resilience Index (CRI) and Its Components	32

4.9 Agricultural Productivity of Rural Women Farmers.....	34
4.10 Food Security Status of Rural Women Farmers.....	36
4.11 Common-Support Sample for the Propensity-Score Matching Analysis.....	38
4.12 Financial-Service Combinations Effect on Climate Resilience	38
4.13 Financial Inclusion, Climate Resilience and Their Interaction on Livelihood and Welfare Outcomes.....	41
4.13.1 The FII × CRI Interaction Model on Productivity, Income and Food Security	41
4.13.2 Which Service Combinations Drive Productivity, Income and Food Security? ...	42
4.13.3 Respondents' Perceived Change in Income and Agricultural Productivity	43
4.14 Programme Effectiveness — The ATT Triangulation.....	45
4.14.1 State-Level Heterogeneity for Programme Effectiveness	48
4.15 Sensitivity Analysis: Bonferroni Correction for Multiple Testing.....	50
4.15.1 Average Treatment on the Treated Battery (40 Tests)	51
4.15.2 Impact of Financial-Service Combinations on Climate Resilience.....	52
5. Conclusion	53
6. Policy Implications and Recommendations.....	55
References.....	59
Appendices.....	64

List of Tables

Table 1: Proposed Study Location.....	18
Table 2: Climate resilience Indicators	19
Table 3: Covariate Balance Before and After Propensity Score Matching	22
Table 4: Summary statistics of Respondents	23
Table 5: Socio-economic Characteristics of Rural Women Farmers.....	24
Table 6: Land Tenure Arrangement by Rural Women Farmers	26
Table 7: Household Decision-Making Patterns	26
Table 8 : Climate Exposure Distribution by Women Farmers in Nigeria	28
Table 9: Specific Weather Changes Observed by Rural Women Farmers	28
Table 10: Account Ownership and Type Held by Rural Women Farmers.....	30
Table 11: Financial Inclusion Index (FII) and Sub-Dimensions Distribution	31
Table 12: Mean Total Factor Productivity, by State.....	35
Table 13: Food Security Status of Rural Women Farmers	36
Table 14: Ten Financial-Service Combinations Most Strongly Associated with the Climate Resilience Index.....	39
Table 15: FII $\times$ CRI Model on Agricultural Productivity, Income and Food Security	41
Table 16. Strongest Financial-Service Combination per Outcome	42
Table 17: Direction of Perceived Change, by Treatment Status (Raw, Unmatched)	44
Table 18: Matched ATT on Perceived Change (Method A, Matched Pairs).....	44
Table 19: Programme Average Treatment Effect on the Treated (ATT), Method A (Matched Pairs, No Replacement)	46
Table 20: Cross-Method Consistency of the ATT for Three Headline Outcomes	47
Table 21: State-Level Programme ATT on the Climate Resilience Index (Method A)	48
Table 22: Bonferroni-Surviving Combinations by Outcome.....	51
Table 23: Bonferroni-Surviving Combinations by Outcome.....	52

List of Figures

Figure 1: Conceptual Framework	12
Figure 2: Map of Nigeria showing the Study Area.....	14
Figure 3: Farming System and Climate-Change Awareness of Rural Women Farmers	27
Figure 4: Financial Service Institutions Used by Women	29
Figure 5: Financial Inclusion Index (FII) by State and Beneficiary Status	32
Figure 6: Climate Resilience Index Components, by Beneficiary Status (Pooled)	33
Figure 7: Climate Resilience Index (CRI) by State and Beneficiary Status	34
Figure 8: Mean Crop and Total Factor Productivity (TFP) by State	35
Figure 9: Food Security Status of Rural Women Farmers.....	37

1. Introduction

Rural women farmers are central to food systems in sub-Saharan Africa, yet they face disproportionate exposure to climate risks and persistent barriers to finance. Gendered social norms may also serve to hinder their resilience and productivity due to limited access to productive resources and opportunities. Evidence from southwestern Nigeria shows that farmers lived experiences of changing rainfall and temperature patterns closely align with meteorological records, thus underscoring the immediacy of climate stressors in this zone (Ayanlade, et al., 2017) and across the country. Simultaneously, global and Nigerian data continue to document a gender gap in financial inclusion particularly in access to accounts, digital payments, savings, and credit—which constrains women’s capacity to invest in adaptation and recover from shocks (World Bank, 2023; World Bank, 2022; Adegbite & Machethe, 2020). Sector-specific work in Nigeria highlights low awareness and uptake of climate-risk tools such as weather index insurance among smallholders and emphasizes the role of information and financial services in climate risk management (Ayinde et al., 2023).

Financial inclusion has increasingly been recognized as a critical enabler of resilience in the face of climate change. Through access to credit, savings, insurance, and payment systems, financial inclusion provides individuals and communities with the means to manage risk, invest in adaptive strategies, and recover from adverse climate impacts (Zetterli, 2023). Yet, in many developing countries, weak financial infrastructure and gender disparities significantly limit adaptive capacity. The Global Findex Database reports that nearly one billion women globally remain financially excluded, with the highest concentration in Sub-Saharan Africa and South Asia (World Bank, 2023). This exclusion not only prolongs gender inequality but also deters economic transformation, given women’s central role in smallholder agriculture and food security.

Globally, about 50 percent of all farmers do not have access to crucial financial services, a situation more acute for smallholders and rural women (Demirgüç-Kunt et al., 2022; World Bank, 2019). This persistent financing gap emphasises the mismatch between the demand for agricultural credit and the inadequate availability of tailored financial products, thereby reducing progress toward Sustainable Development Goal 13 on climate action. Although Nigeria has made notable progress in financial inclusion, with formal usage rising steadily, rural populations and particularly women remain largely excluded (EFInA, 2023; CBN, 2022). The Access to Financial Services (A2F) survey shows that while rural banked adults increased from 29 percent in 2020 to 38 percent in 2023, the proportion of financially excluded individuals only dropped modestly, from 50 percent to 37 percent during the same period (EFInA, 2023).

Across Sub-Saharan Africa, climate change continues to aggravate food insecurity, poverty, and livelihood instability. Incidence of increased droughts, land degradation, and floods have interrupted agricultural productivity, leaving smallholder farmers, especially women more vulnerable (IPCC, 2022). Rural women face the dual burden of exposure to environmental

hazards and restricted access to adaptation resources such as credit, extension services, and improved inputs (Ifeanyi-obi et al., 2022). Evidence from multiple African countries shows that women farmers are less likely than men to access formal credit or insurance, thereby limiting their ability to invest in adaptive technologies as well as recover from climate shocks (Klapper et al., 2019).

In Nigeria, these challenges are particularly evident. Agriculture remains a cornerstone of the national economy, engaging around 35 percent of the labour force and contributing substantially to GDP (NBS, 2023). Women constitute a significant proportion of smallholder farmers, especially in rural communities where farming is primarily subsistence-based. However, Nigerian agriculture is increasingly threatened by climate-induced stressors, ranging from erratic rainfall and desertification in the north to recurrent flooding and prolonged dry spells in the south (Abraham and Fonta, 2018). These disruptions have already resulted in declining yields, reduced household income, and worsening food insecurity. At the same time, the gender gap in financial inclusion remains significant, with rural women farmers often excluded from formal credit systems, insurance products, and digital financial platforms.

Despite growing recognition of financial inclusion as a pathway to resilience, gender disparities in access persist. This is reiterated by Adegbite (2020) that Nigeria's gender gap in financial inclusion remains wide, undermining progress toward sustainable development. In practice, women farmers who identify the need for adaptation financing often encounter supply-side limitations such as strict collateral requirements, high interest rates, or poorly designed financial products. Beyond access is the ability to use and control these financial services. Abraham and Fonta (2018) note a strong correlation between climate exposure and financial needs among rural farmers, with most unable to secure financial products suited to their adaptation priorities.

This situation raises a critical question on how financial inclusion can be effectively leveraged to enhance the climate resilience of rural women farmers in Nigeria? The issue is multidimensional as climate risks are intensifying, financial inclusion remains uneven, and women farmers continue to bear disproportionate burdens. Without targeted interventions, rural women risk declining productivity, unstable incomes, food insecurity and increasing vulnerability to climate change. This study examined how different forms of financial services such as account ownership, savings, mobile money, agricultural credits, agricultural insurance, and cooperative systems affect the climate resilience of Nigerian rural women farmers.

The research addressed the following questions: (1) Which combinations of financial inclusion services improve women farmers' capacity to cope with or/and adapt to climate change impacts, while controlling for socio-economic factors? (2) How does the association between financial inclusion and climate resilience influence rural women farmer's livelihood outcome (agricultural productivity) and welfare outcome (income and food security)? (3) How effective are existing financial inclusion initiatives in enhancing rural women farmer's climate resilience? The study will specifically: (1) examine the combinations of financial inclusion services that improve women farmers' capacity to cope with or/and adapt to climate change impacts, while controlling for socio-economic and agro-ecological factors? (2) estimate the

association between financial inclusion and climate resilience influence on rural women farmer's livelihood outcome (agricultural productivity) and welfare outcome (income and food security)? (3) assess the effectiveness of existing financial inclusion initiatives in enhancing rural women farmer's climate resilience?

This study is germane because it will help in identifying scalable financial inclusion models or interventions that can strengthen rural women's resilience to climate change. This will serve as actionable insights for policymakers, financial service providers, and development partners to strengthen the adaptive capacity of rural women farmers and advance equitable climate resilience in Nigeria.

2. Literature Review

2.1 Theoretical framework

The theory underpinning this study is the Sustainable Livelihoods Framework (SLF), applied through a Gender and Development (GAD) lens. The SLF offers a comprehensive approach to understanding how individuals and households combine assets and capabilities to pursue livelihood strategies within changing and sometimes vulnerable environments (Chambers & Conway, 1992; Scoones, 1998). It highlights five key asset categories: human, social, natural, physical, and financial capital, that interact to determine livelihood outcomes and resilience to shocks. Within this framework, resilience is conceptualized as the ability of rural households to maintain or improve their livelihoods despite challenges such as climate-related uncertainties (Tanner et al., 2015). The framework's asset-based view aligns with the present study's focus on how financial inclusion strengthens rural women farmers' resilience by augmenting their financial and social capital, promoting diversification, and supporting adaptive livelihood strategies.

Financial inclusion can serve as both a *means* and an *end* in the livelihood sustainability process. Access to credit, savings, insurance, and digital financial services expands the financial capital available for ex-ante risk reduction, such as investment in improved seeds, irrigation, or soil management—and ex-post coping through savings withdrawal, remittances, or emergency borrowing (Ellis & Freeman, 2004; DFID, 1999). Moreover, by participating in savings groups and microfinance institutions, women gain social capital through group solidarity, trust, and collective action, further enhancing their capacity to respond to climate shocks (Panman et al., 2022; Pienaah & Luginaah, 2024). Hence, the SLF underscores the integrative role of financial inclusion in mobilizing diverse asset portfolios to buffer against climate-induced vulnerabilities.

Applying a Gender and Development (GAD) lens deepens the SLF's explanatory power by situating financial inclusion within gendered structures of access and N-bene. The GAD approach moves beyond viewing women as a homogenous vulnerable group to emphasizing the socio-institutional norms and power relations that shape differential access to assets and opportunities (Cornwall, 2016). In many rural contexts, patriarchal norms restrict women's ownership of productive assets and N-bene over financial resources, thereby mediating how financial inclusion translates into livelihood resilience (Dibakoane et al., 2022; Ayanlade et al., 2023). Empirical evidence shows that even when women access financial services, their decision-making power over loan use or investment choices may remain limited by intra-household hierarchies (Agarwal, 2022). Integrating the GAD perspective within the SLF therefore allows the study to account for these socio-cultural dimensions, highlighting that resilience is not only a function of resource availability but also of agency and institutional context.

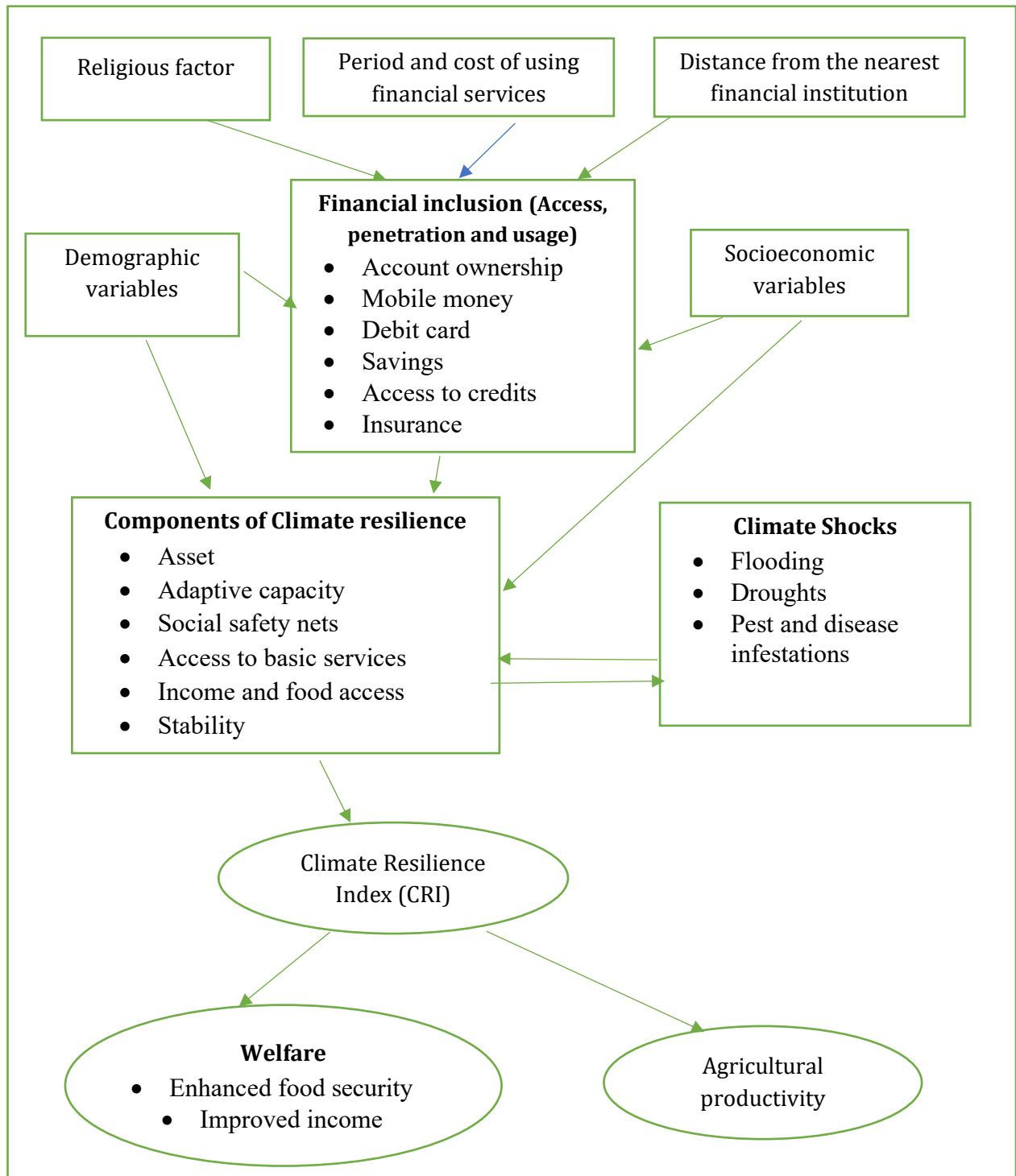


Figure 1: Conceptual Framework

Source: Authors' design (2026)

By combining SLF and GAD, this study conceptualizes rural women farmers' resilience as a gendered process of asset accumulation, transformation, and empowerment. Financial inclusion is hypothesized to enhance resilience not merely by increasing liquidity but by strengthening women's agency, social capital, and participation in livelihood decision-making. This integrated theoretical lens justifies the study's dual focus on formal (banking, insurance)

and semi-formal/informal financial mechanisms as pathways for promoting gender-equitable and sustainable resilience outcomes in rural farming systems.

Figure 1 presents the conceptual framework of the study. As shown in Figure 1, climate resilience index (CRI) is constructed from six key dimensions: assets, adaptive capacity, social safety nets, access to basic services, income and food access, and stability (Food and Agriculture Organisation [FAO], 2012; Mekuyie et al., 2018; Tambo, 2016). Households with a greater stock of assets, stronger adaptive capacity, improved stability, more robust social safety nets, and better access to income, food, and basic services tend to be more resilient to the impacts of climate change (Asmamaw et al., 2019).

Inclusive financial services support farm households by enabling them to acquire livestock, land, housing, and other productive resources, thereby increasing their asset base. These services also facilitate income diversification and higher household expenditure, which enhance adaptive capacity, access to income and food, and access to basic services. Furthermore, financial inclusion helps households to plan ahead, manage risks, and cope with shocks, leading to greater stability. Access to digital payment systems, in particular, simplifies the receipt of remittances and government support, thereby reinforcing household social safety nets (Haworth et al., 2016; Hussain et al., 2021).

Consequently, financial inclusion plays a significant role in strengthening the climate resilience of farm households. Additionally, demographic and socio-economic factors influence household climate resilience, with some of these variables also shaping the level of financial inclusion among farm households. The use of one or more financial inclusion services may help improve agricultural productivity in the short term and enhance household welfare and income in both the short and long term.

3 Methodology

3.1 Study Area

The study was conducted in Nigeria, a country with over 200 million people and extensive agricultural potential. Nigeria possesses approximately 34 million hectares of arable land, 28.6 million hectares of pastures and meadows, and 6.5 million hectares of land dedicated to permanent crops (Statista, 2023). The country is divided into seven agro-ecological zones (AEZs): Northern Guinea Savanna (NGS), Sahel Savanna (SAH), Sudan Savanna (SUD), Southern Guinea Savanna (SGS), Derived Savanna (DS), Rainforest (RF), and Mid Altitude (MA). These zones vary in their climatic characteristics, including rainfall distribution, sunlight intensity, and humidity. The humid rainforest zone experiences prolonged and intense rainfall, while the northern zones receive comparatively less rainfall and have shorter rainy seasons.

According to the A2F report (EFInA, 2023), more men than women in Nigeria use formal financial services, resulting in an 11% gender gap (70% as compared to 59%). More women relied on informal providers. Regionally, the South-West, records the highest financial inclusion (95%), followed by the South-South (90%). The South-East faces rising exclusion, increasing from 17% in 2020 to 22% in 2023, due to a decline in banked populations despite gains in informal access. The North-East and North-West remain most excluded (38% and 47% respectively). Lagos leads in formal access, while Borno lags; Ebonyi and Benue rely heavily on informal systems. The study covered three states (Ebonyi, Benue and Ogun) as representative states in the South East, North Central, and South West respectively (Figure 2).

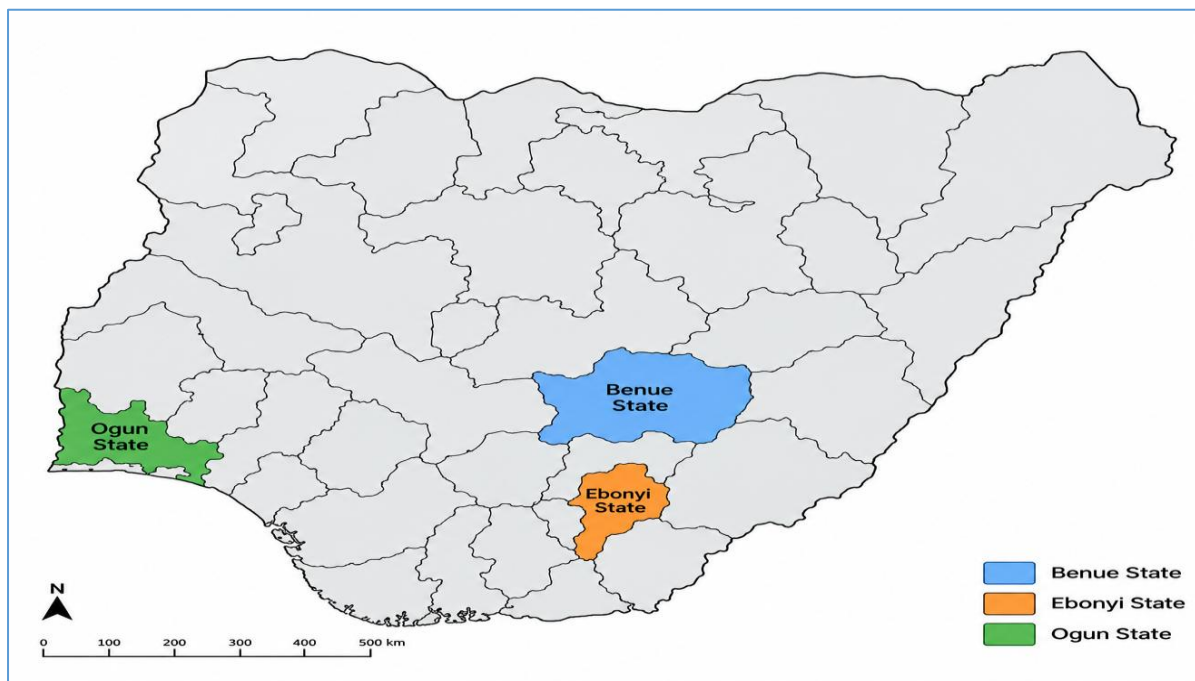


Figure 2: Map of Nigeria showing the Study Area

3.1.1 Overview of the Value Chain Development Programme (VCDP)

To better appreciate the role that financial inclusion initiatives play in driving resilience and how it affects household livelihood and welfare outcomes, the study relied on a government intervention programme that is actively implemented across several states in Nigeria and the study states: the Value Chain Development Programme (VCDP) to make a comparison between the programme beneficiary and non-beneficiary.

The Value Chain Development Programme (VCDP)

It is an initiative of the Federal Government of Nigeria, supported by funding from the International Fund for Agricultural Development (IFAD). The programme focuses on supporting smallholder farmers engaged in rice and cassava production through a value chain approach. Its core objective is to improve agricultural productivity, strengthen agro-processing activities, and expand farmers' access to markets. The broader goal of the VCDP is to stimulate transformation within rural Nigeria's agricultural sector. It seeks to enhance food security, raise household incomes, and generate employment opportunities across participating communities.

Initially, the programme operated in six states: Anambra, Benue, Ebonyi, Ogun, Niger, and Taraba. Following positive outcomes and demonstrated impact, additional funding was secured to expand implementation into three more states: Enugu, Kogi, and Nasarawa.

Key Programme Components

1. Agricultural Market Development

This component is designed to improve the profitability of smallholder farmers and small- to medium-scale agro-processors. It emphasizes better market access and strengthens participants' capacity to add value to locally produced agricultural commodities. By improving linkages between producers and markets, the programme enhances income-generating opportunities.

2. Smallholder Productivity Enhancement

This component aims to increase the productivity of smallholder farmers in a manner that is both economically viable and environmentally sustainable. It promotes improved farming practices, access to inputs, and techniques that ensure long-term agricultural sustainability.

With the expansion of the programme, special attention has been given to several priority themes, including: Gender equality and women's empowerment, financial inclusion, nutrition improvement, and climate change adaptation and environmental sustainability

To effectively assess the programme, the following methods were used:

1. Case Studies

- i. Conduct in-depth analysis of selected beneficiary farmers in VCDP communities.
 - ii. Examine changes in livelihood and welfare from VCDP participation.
- 2. Beneficiaries' vs non-beneficiaries Group Comparison
 - i. Compare VCDP beneficiaries with non-beneficiaries in similar communities.
 - ii. Assess differences in productivity, income levels, and resilience.

3.2 Data Source & Collection

Both secondary data and primary data were used for the study. Secondary data were obtained from institutional datasets and documents from EFinA A2F 2023, and the 4th nationally representative Nigeria's General Household Survey for 2018 and 2019, a part of the World Bank Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) project and other policy documents. The secondary data serves as a framework for assessing variations in impacts across temporal and regional dimensions. Furthermore, it enhanced the methodological rigor of the study by enabling data triangulation, cross-validating insights derived from primary qualitative and quantitative findings with empirical evidence from secondary sources. Ahead of the primary data collection, a preliminary analysis of these secondary sources was conducted to sharpen the study's objectives and instruments.

Primary data was obtained from:

- i. Household surveys (quantitative): Semi-structured questionnaire capturing demographics, farm characteristics, climate shocks, adaptation, resilience indicators (e.g., food security, income stability), and financial access/usage (bank, mobile money, cooperatives, savings groups).
- ii. Focus group discussions (FGDs (qualitative): 3 FGD per state (8–10 participants) to explore financial services, social norms, barriers, coping strategies, and perceptions of financial services for climate risks.
- iii. KIIs (qualitative): 4 KIIs per state with extension agents, women leaders, agent bankers/mobile money operators, and state agriculture officials

3.3 Sampling Technique

The study adopts a mixed-methods approach, combining both quantitative and qualitative research methods to provide a comprehensive understanding of the research problem. To ensure statistically robust results and fair representation, the sample size of 360 rural women farmers across the three states was arrived at using the Cochran formula (Cochran, 1977).

The Cochran formula is expressed as:

$$n_0 = \frac{\{Z^2 \cdot p \cdot (1-p)\}}{\{e^2\}} \dots\dots\dots (1)$$

Where:

- n_0 = initial sample size (before adjustment for finite population)
- Z = Z-score corresponding to the desired confidence level (e.g., 1.96 for 95%)
- P = estimated proportion of the population with the characteristic of interest (commonly 0.5 for maximum variability)
- e = margin of error (e.g., 0.05 for 5%)

$$n_0 = \frac{\{(1.96)^2 \cdot 0.5 \cdot (1-0.5)\}}{\{(0.05)^2\}} \dots\dots\dots (2)$$

$$n_0 = \frac{\{(1.96)^2 \cdot 0.5 \cdot (1-0.5)\}}{\{(0.05)^2\}} \dots\dots\dots (2)$$

$$n_0 = 384.16 \approx 384$$

Step 2, by adjusting the sample size for a finite population

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \dots\dots\dots (3)$$

n_0 = initial sample size from step 1

N = Population size. Since N is unknown, we will assume a population size of 5800.

$$n = \frac{384}{1 + \frac{384 - 1}{5800}} = 360.22 \approx 360$$

Where at Stage 1, 3 Local Government Areas (LGAs) were purposively selected from each of the three states (two LGAs where the VCDP programme exist and one LGA the programme does not exist; at Stage 2, there was a random selection of 3 rural communities from 2 VCDP LGAs and 3 rural communities from the only non-VCDP selected LGA based on proportional to size. Stage 3 involved a random selection of 20 women farmers from each community using snowball techniques to give a total of 360 rural women farmers (120 from each state) engaged in agricultural activities. Table 1 presents the proposed study location across the three states.

A total of 360 rural women farmers were surveyed across three states. A multi-stage stratified random sampling technique was employed, with LGAs stratified by VCDP presence. In Stage 1, three Local Government Areas (LGAs) were purposively selected from each state: two LGAs where the Value Chain Development Programme (VCDP) operates and one LGA where it does not, giving nine LGAs in total. In Stage 2, six rural communities were selected per state using probability proportional to size. Three communities were drawn from the two VCDP LGAs combined, and three from the non-VCDP LGA. This gave 18 communities across the three states. In Stage 3, 20 women farmers engaged in agricultural activities were randomly selected from each community. In the VCDP communities, selection was made from the list of registered VCDP beneficiary farmers. In the non-VCDP communities, women were randomly selected from a list of registered farmers obtained from the extension agent assigned to the

LGA. This gave a total of 120 respondents per state (60 VCDP beneficiaries and 60 non-beneficiaries) and 360 in total. Table 1 presents the study locations across the three states.

Table 1: Proposed Study Location

States	Local Government Area	Communities
Benue	Kwande Gwer West Agatu (non-beneficiaries)	1. Mbakyan Tse Adagi 2. Adagi Ikyura-ya 3. Tse Aboh 4. Mbamyar 5. Orvande 6. Obagaji
Ebonyi	Ikwo Izzi Abakaliki (non-beneficiaries)	1. Echara-alike 2. Noyo 3. Ndiagu Okpuitumo 4. Amagu 5. Ndieze 6. Edda
Ogun	Obafemi Owode Odogbolu Ijebu North (non-beneficiaries)	1. Owode 2. Mokoloki 3. Odogbolu 4. Farm Settlement 5. Imope 6. Ita-omo

3.4 Analytical Techniques

Data was analysed using both descriptives and econometric models. Qualitative data was analysed using: Thematic analysis (iterative coding of transcripts; development of theme codebook around resilience, risk, access, usage, barriers) and Cluster mapping of themes. Quantitative data was analysed using descriptive statistics for inclusion/resilience profiles by state and econometric models such as the Financial Inclusion Index (FII), Climate resilience index (CRI), United State Development of Agriculture (USDA) 18 questions Food Security Module, Total Factor Productivity (TFP), Logit regression, and Propensity Score Matching.

3.4.1 Financial inclusion index (FII)

The principal component analysis (PCA) was used to construct the FII and the CRI. The Financial inclusion index (FII) consists of three dimensions: penetration(access), availability and usage, following Negera (2025) and Wuddasie (2023). The indicators for access dimension were measured using account ownership at financial institutions while the availability dimension indicators were measured by ownership of mobile money accounts or debit cards or internet banking or agent banking services. Finally, the usage dimension was measured using savings and access to credit in the past 12 months. The FII estimation followed three stages. First, each indicator was normalized to a scale of 0 to 1 using:

$$x_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}} \dots\dots\dots (4)$$

where A_{ij} , M_{ij} , and m_{ij} denote the actual, maximum, and minimum values of indicator i in dimension j , respectively. Since the indicators were binary (1 = yes, 0 = no) Second, the dimension-specific indices (FII_j) Indicator weights (w_{ij}) will be derived from their coefficients of variation (CV), computed as the standard deviation divided by the mean: and finally, the overall FII was obtained by aggregating the three dimensions. The FII ranges from 0 (complete exclusion) to 1 (full inclusion).

3.4.2 Climate Resilience Index

Table 2 shows the climate resilience indicators used for generating the climate resilience index following Wuddasie (2023). The Climate Resilience Index (CRI) for household i was defined as a composite of six dimensions: assets, adaptive capacity, social safety nets, access to basic services, stability, and income and food access.

$$CRI_i = A_i, AC_i, SSN_i, ABS_i, S_i, IFA_i,$$

Table 2: Climate resilience Indicators

Component	Indicators	Units
Adaptive capacity	Income source	Count
	Number of coping mechanisms	Count
	Climate change awareness and importance	Dummy
Asset	Tropical livestock owned	livestock unit
	Farmland owned	Hectare
	Housing owned	Dummy
	Adult in household labour	Count
	Access to irrigation water	Dummy
	Access to improved seed	Dummy
Social safety nets	Remittance	Dummy
	Aid from government or safety net	Dummy
Basic services access	Travel time/cost to nearest water service	Minutes / ₦
	Travel time/cost to nearest health centre	Minutes / ₦
	Travel time/cost to nearest school	Minutes / ₦
	Travel time/cost to nearest market	Minutes / ₦
	Travel time/cost to nearest veterinary clinic	Minutes / ₦
	Electricity access	Dummy
	Mobile phone access	Dummy
Income and food access	Average annual income from all income sources	₦
	Experience food shortage	Dummy
Stability	Livestock loss	Count
	Crop loss	Count
	Illness and death of family member	Count
	Income change	Ordinal
	Expenditure change	Ordinal

Source: Adapted from Wuddasie (2023)

The two-stage Principal Component Analysis was employed to estimate the CRI. PCA was used because of the absence of predefined indicator weights, thereby allowing for the derivation of statistically optimal loadings (Boka, 2017). In the first stage, indicators were aggregated into six component indices of resilience using PCA, retaining components with eigenvalues greater than one. In the second stage, the overall CRI was derived as a weighted combination of these component indices. This approach ensures an unbiased and balanced measure of household climate resilience across multiple dimensions.

3.4.3 Influence of Financial Inclusion and Climate Resilience Interaction on Livelihood Outcomes of Rural Women Farmers

In assessing the impact of the interaction between financial inclusion and climate resilience on livelihood outcomes (Objective 2), this study will examine three key dimensions: income, agricultural productivity, and welfare: proxied by food security and measured using the USDA 18 questions Food Security Module.

- Household income. First, respondents were asked to report their wages, remittances received and crop and livestock income was calculated from what was earned from their sales. Second, respondents reported both the income change they had experienced within the last five years and indicated whether their income has increased, remained the same, or decreased over time. This self-reported measure captures the perceived change in household income over time.
- Agricultural productivity was assessed using Total Factor Productivity (TFP), computed as the ratio of total agricultural output to total input ($TFP = \text{Total Output} / \text{Total Input}$). This provides an efficiency-based measure of how effectively inputs are converted into outputs in agricultural production systems.
- Welfare was proxied by Food security. The food security condition of a household exists along a spectrum that ranges from high food security to very low food security. According to USDA (2006), this spectrum is classified into four categories described below:
 - i. High food security: Households experienced no difficulties or concerns regarding consistent access to sufficient food.
 - ii. Marginal food security: Households occasionally faced challenges or worries about obtaining adequate food; however, the quality, variety, and amount of food consumed were not significantly affected.
 - iii. Low food security: Households compromised the quality, variety, and desirability of their diets, although the quantity of food consumed and normal eating habits remained largely unchanged.
 - iv. Very low food security: During certain periods of the year, one or more household members experienced disrupted eating patterns and reduced food intake due to insufficient financial and other resources for obtaining food.

Households classified under high or marginal food security are regarded as food secure, while those under low or very low food security are considered food insecure. Classification along this continuum is based on household responses to a set of questions relating to experiences and behaviours linked with challenges in meeting food requirements. These questions capture varying degrees of food insecurity severity.

3.4.4 Analytical Technique: Propensity Score Matching

Because programme beneficiaries were not randomly assigned, a simple comparison of mean outcomes between beneficiaries and non-beneficiaries risks confounding. For example, if the programme selectively recruited women with larger landholdings or higher literacy. Propensity Score Matching (PSM) addresses this by constructing a statistically comparable non-beneficiary group and estimating the Average Treatment effect on the Treated (ATT), the average difference in outcomes between beneficiaries and their matched non-beneficiary counterparts (Rosenbaum & Rubin, 1983). This study followed the four-step implementation sequence recommended by Caliendo and Kopeinig (2008).

First, a logistic regression of programme participation on baseline, pre-programme covariates, that is age, years of education, marital status, household size, dependency ratio, farming experience, log of farm size, literacy rates, house ownership, and state fixed effects was estimated to generate each respondent's propensity score (i.e. the predicted probability of being a beneficiary given observed characteristics). Financial-service ownership, the FII, the CRI, the interaction of FII and CRI (FIIxCRI), and cooperative-association membership were deliberately excluded from the selection model because the programme itself supplies or mediates these variables; therefore, including them would condition away part of the very effect being estimated, a form of post-treatment bias (“bad control”).

Second, the region of common support, that is, the range of propensity scores over which treated and comparison distributions overlap was also identified, and respondents who fall outside this region, that is those who have no comparable counterpart in the opposite group, were excluded from matching. Third, the Average Treatment effect on the Treated (ATT) was estimated in three different ways to guard against any single matching choice driving the results: (A) one-to-one nearest-neighbour matching without replacement on the Logit of the propensity score, using a caliper of 0.2 standard deviations of the logit propensity score, following Austin (2011), with each control used at most once and inference based on a paired t-test and the non-parametric Wilcoxon signed-rank test; (B) nearest-neighbour matching with replacement, using the same caliper but allowing a control to be matched to more than one treated unit, which increases the effective treated sample at the cost of reusing some controls; and (C) Inverse Probability of Treatment Weighting (IPTW) on the full common-support sample, in which every respondent is reweighted by the inverse of their probability of receiving (or not receiving) treatment and the ATT is recovered from a weighted least-squares regression with heteroskedasticity-robust (HC3) standard errors. Fourth, covariate balance was assessed before and after matching using standardised mean differences (SMD), Welch t-tests, and variance ratios for every baseline covariate, with a well-balanced match defined as one in which $|SMD| < 0.10$ after matching.

Each of the 27 possible financial-service combinations (pairs and triples) was regressed individually against the CRI, controlling for the propensity score and state fixed effects with Heteroskedasticity consistent (HC3) robust standard errors; combinations were tested individually, rather than jointly, because several combinations are highly collinear (e.g., mobile-money and ATM/debit ownership), which would render a joint model's coefficients unstable. Because testing many outcomes and many combinations raises the risk of finding statistically significant results by chance alone, a Bonferroni correction sensitivity test was applied to the ATT significance tests across ten outcomes and up to four estimators, and the 27 individual combination regressions on the CRI (Objective 1), dividing the conventional $\alpha = 0.05$ threshold by the number of simultaneous tests in each family.

3.5 Covariate Balance After Matching

Table 3 reports the standardised mean differences (SMD) for each baseline covariate before and after matching. Across all eleven covariates, matching reduced bias substantially (80–95%) and no post-matching SMD exceeds the conventional $|0.10|$ threshold by a material margin, with all post-matching p-values comfortably above the conventional 0.10 threshold used to indicate covariate balance. This indicates that the matched comparison group used throughout the analysis is statistically identical from programme beneficiaries on observed pre-programme characteristics, supporting the validity of the ATT estimates.

Table 3: Covariate Balance Before and After Propensity Score Matching

Covariate	SMD before	SMD after	% Bias reduction	p-value after
Age (years)	0.168	-0.007	95.6%	0.9494
Married (1/0)	0.082	-0.033	59.0%	0.7757
Household size	-0.063	-0.098	-55.2%	0.4045
Dependency ratio	0.043	0.114	-166.4%	0.3298
Years of education	-0.051	0.031	39.4%	0.7928
Farming experience (years)	0.096	-0.002	98.1%	0.9874
Log of Farmland size	0.287	-0.049	82.9%	0.6751
Owns house (1/0)	0.133	-0.014	89.8%	0.9071
Literate (1/0)	-0.068	0.056	17.7%	0.6347
State = Ebonyi	0.000	0.043	n/a	0.7119
State = Ogun	0.000	0.073	n/a	0.5361

Source: Field Survey data (2026).

n/a- not applicable

3.6 Ethical Considerations

All respondents provided informed consent prior to participation, were assured of the confidentiality and anonymity of their responses, and were informed of their right to withdraw at any stage. Identifying details of FGD and KII participants are anonymised throughout this report.

4. Results and Discussion

This section presents the findings on enhancing rural women farmers' resilience to climate change-induced impacts through financial inclusion in Nigeria. The discussion is organized by objectives. Comparison is made between a financial inclusion initiative programme: Value Chain Development Programme (VCDP) Beneficiaries (Beneficiary) and N-beneficiaries (N-bene) groups across Benue, Ebonyi and Ogun States.

4.0. Summary Statistics

Table 4 presents the summary statistics of the women farmers across the N-beneficiary and Beneficiary groups in Benue, Ebonyi and Ogun States. The results show clear differences in the demographic and farm characteristics of respondents across the three states. The average age was lowest (36.25 years) in Benue and highest (49.87 years) in Ogun, while beneficiaries were generally older than N-beneficiaries in Benue and Ebonyi. Ogun N-beneficiaries also recorded the highest farming experience, averaging 19.22 years, compared with beneficiaries in Ebonyi (17.53 years) and Benue (17.05 years). This indicates that the study population consisted largely of experienced female farmers.

Education levels also varied across the states. Beneficiaries recorded slightly more years of schooling compared to N-beneficiaries in Benue and Ebonyi, but the reverse occurred in Ogun, where N-beneficiaries averaged 8.57 years compared with 6.10 years among beneficiaries. Beneficiaries cultivated larger farm sizes in Benue (2.07ha) and Ebonyi (1.64 ha), while N-beneficiaries had larger farms in Ogun (1.74 ha). Farm sizes are modest throughout (1.2–2.1 ha) and are consistently smaller for women than the customary land holdings of male farmers in the same communities, a pattern that recurs in the qualitative record.

"Men have access to a larger portion of lands, so their farm yields tend to be bigger than that of women, who rely quite more heavily on external funds to help them cope, like e.g. funds help with irrigation to navigate effects of dry spells."

— KIII2 — Lead Farmer, Odogbolu, Ogun State

These differences are important because landholding and education can influence the capacity of women farmers to adopt technologies, access finance and respond to climate risks.

Table 4: Summary statistics of Respondents

	Benue		Ebonyi		Ogun	
	N-Bene	Bene	N-Bene	Bene	N-Bene	Bene
Age (years)	36.25	40.97	37.52	41.50	49.87	47.85
Dependents	3	3	2	3	3	2
Household size	9	8	7	8	6	6
Education (years)	7.97	8.53	8.13	9.27	8.57	6.10
Farm size (ha)	1.19	2.07	1.17	1.64	1.74	1.40
Farming experience (years)	17.02	17.05	13.17	17.53	19.82	18.62
Marital status	91.67	80.00	68.33	90.00	71.67	71.67

Source: Field Survey Data (2026)

4.1 Socioeconomic Characteristics of Respondents

Table 5 presents the socioeconomic characteristics of women farmers in the N-bene and Beneficiary groups across Benue, Ebonyi and Ogun States. Across the three states, most respondents were married. Beneficiary groups generally showed stronger participation in farmer associations and cooperatives than N-bene groups, particularly in Ebonyi and Ogun. This suggests that the VCDP intervention successfully mobilized women into collective organizations, which are known to facilitate access to credit, information and climate adaptation resources.

Literacy and mobile phone ownership were high across all states, with Ogun recording the highest smartphone use. Similarly, mobile phone ownership levels were high in Ogun state, with 96.67% of N-bene respondents and Beneficiaries respectively owning phones. These findings indicate that mobile phone penetration among rural women farmers is relatively high, thereby creating opportunities for digital financial inclusion.

However, differences emerged in the type of phones owned. In Benue, almost all respondents owned feature phones (96.67%), with only 3.33% owning smartphones. In contrast, Ogun recorded the highest smartphone ownership, with 56.67% of N-bene respondents and 43.33% of Beneficiary respondents owning smartphones. Ebonyi occupied an intermediate position, with smartphone ownership reaching 30.0% among Beneficiary respondents. These differences suggests varying levels of access to digital financial technologies across the states.

Beneficiaries in Ebonyi and Ogun State had a larger share of respondents with tertiary education. Most beneficiaries across the three states had access to extension services. The findings suggest that the Beneficiary group possessed stronger social and communication networks that could facilitate financial inclusion and climate-resilience interventions.

Table 5: Socio-economic Characteristics of Rural Women Farmers

	Benue		Ebonyi		Ogun	
	N-Bene	Bene	N-Bene	Bene	N-Bene	Bene
<i>Marital Status</i>						
Single	0.00	3.33	11.67	3.33	1.67	3.33
Married	91.67	80	68.33	90	71.67	71.67
Widowed	8.33	16.67	18.33	6.67	26.67	23.33
Divorced	0.00	0.00	1.67	0.00	0.00	1.67
<i>Educational Status</i>						
No formal education	21.67	18.33	18.33	11.67	10	33.33
Primary	28.33	26.67	30	33.33	41.67	38.33
Secondary	43.33	46.67	48.33	38.33	41.67	18.33
Tertiary	6.67	8.33	3.33	16.67	6.67	10
<i>Literacy Level</i>						
Can read and write	51.67	51.67	68.33	61.67	61.67	58.33
Cannot read and write	48.33	48.33	31.67	38.33	38.33	41.67
<i>Primary Occupation</i>						
Crop farming	98.33	96.67	100	100	98.31	95
Trading	1.67	3.33	0	0	1.69	5
<i>Secondary Occupation</i>						

	Benue		Ebonyi		Ogun	
	N-Bene	Bene	N-Bene	Bene	N-Bene	Bene
None	23.21	51.67	64.81	30.19	60.71	29.09
Crop farming	0.00	1.67	0	7.55	5.36	10.91
Livestock	30.36	13.33	1.85	5.66	1.79	10.91
Trading	46.43	33.33	33.33	56.6	32.14	49.09
House Ownership Type						
Rented	0.00	16.67	16.67	16.67	63.33	51.67
Own	50	53.33	70	73.33	28.33	41.67
Family	50	30	13.33	10	8.33	6.67
Farmers' Association / Cooperative Membership						
No	95	8.33	50	0	16.67	3.33
Yes	5	91.67	50	100	83.33	96.67
Position in Cooperative/Association						
Member	100	89.66	75	71.67	84	64.41
Exco	0	10.34	25	28.33	16	35.59
Access to Extension Services						
No	93.33	20	66.67	0	10	8.33
Yes	6.67	80	33.33	100	90	91.67
Presence of Commercial/Microfinance Bank in Community						
No	63.33	40	95	75	95	25
Yes	36.67	60	5	25	5	75
Electricity Access						
No	26.67	45	61.67	38.33	5	6.67
Yes	73.33	55	38.33	61.67	95	93.33
Mobile Phone Ownership						
No	15	28.33	13.33	5	3.33	3.33
Yes	85	71.67	86.67	95	96.67	96.67
Phone Type						
Feature/basic phone	96.67	96.67	86.67	70	75	56.67
Smart phone	3.33	3.33	13.33	30	25	43.33

Source: Field Survey Data (2026)

4.2 Land Tenure Security

Land tenure security is a critical determinant of agricultural investment and resilience. Table 6 presents land acquisition and tenure arrangements. It reveals that rented land is a prevalent tenure in Ebonyi and Ogun (77–87% of respondents), whereas Benue relies more heavily on family land (65–75%). Formal land purchase is rare everywhere but comparatively more common in Benue (25–37%). The near-total reliance on rented or inherited/family arrangements, rather than owned title, is consistent with the qualitative account of women's constrained land access and it reinforces why financial services rather than land itself emerge as the primary lever available to women farmers for expanding cultivated area or investing in inputs (Table 6). Beneficiaries of VCDP often exhibited more diversified tenure arrangements, potentially reflecting increased economic capacity.

Secure land rights encourage investment in long term climate-smart agricultural practices, while insecure tenure discourages long-term adaptation measures. The prevalence of communal and family land therefore has important implications for resilience-building interventions.

Table 6: Land Tenure Arrangement by Rural Women Farmers

Tenure type	Benue		Ebonyi		Ogun	
	N-Bene	Bene	N-Bene	Bene	N-Bene	Bene
Purchased	36.67	25.00	8.33	11.67	1.67	6.67
Rented	36.67	46.67	76.67	78.33	86.67	85.00
Communal land	0.00	0.00	1.67	5.00	0.00	0.00
Inherited	25.00	25.00	26.67	35.00	10.00	6.67
Family land	75.00	65.00	58.33	36.67	5.00	1.67
Gift	20.00	3.33	0.00	3.33	0.00	1.67

Source: Field Survey Data (2026)

4.3 Household Decision-Making

Sole female decision-making is markedly more common in Ogun (46.67–73.33% across all empowerment domains) than in Benue or Ebonyi, where joint spousal decision-making is prevalent (60–75% in Ebonyi; and 62–71% among Benue beneficiaries. (Table 7). Programme beneficiaries in Benue report the highest rate of sole authority over what the household consumes (83.33%), while joint decision-making over income use is the norm among Ebonyi beneficiaries (75%). These patterns are consistent with the qualitative record's depiction of women household members' responsibility for providing even where major decisions are nominally shared.

Table 7: Household Decision-Making Patterns

	Benue		Ebonyi		Ogun	
	N-Bene	Bene	N-Bene	Bene	N-Bene	Bene
<i>What to Produce</i>						
Spouse	30.00	25.00	0.00	0.00	0.00	3.33
Myself	15.00	6.67	46.67	25.00	73.33	46.67
Joint decision	55.00	68.33	53.33	75.00	26.67	50.00
<i>What to Sell</i>						
Spouse	25.00	16.67	0.00	0.00	0.00	1.67
Myself	8.33	23.33	46.67	23.33	73.33	56.67
Joint decision	66.67	60.00	53.33	76.67	26.67	41.67
<i>Use of income</i>						
Spouse	26.67	20.00	1.67	0.00	0.00	6.67
Myself	6.67	8.33	45.00	25.00	73.33	55.00
Joint decision	66.67	71.67	53.33	75.00	26.67	38.33
<i>What to consume/eat</i>						
Spouse	10.00	5.00	5.00	0.00	3.33	8.33
Myself	55.00	83.33	46.67	26.67	66.67	61.67
Joint decision	35.00	11.67	48.33	73.33	30.00	30.00

Source: Field Survey Data (2026)

"It has affected women more because the woman is the parent that the children run to when they are hungry'."

— FGD6, Tse Adagi, Benue State"

4.4 Farming System and Climate-Change Awareness

Rain-fed farming system is the most practiced across the three states. It is not surprising because many farmers are usually unable to afford the cost associated with irrigation. Climate change awareness was very high (83.33–98.33%) in every state among all the respondents (beneficiary and N-beneficiary), confirming that the resilience gap documented is not just a gap in climate literacy but in the ways through which they respond to a risk that virtually all respondents already recognize and experience (Figure 3). An Ogun state participant reported during a FGD that:

"It doesn't rain at the time it is supposed to rain anymore."

— FGD1 — Odogbolu, Ogun State

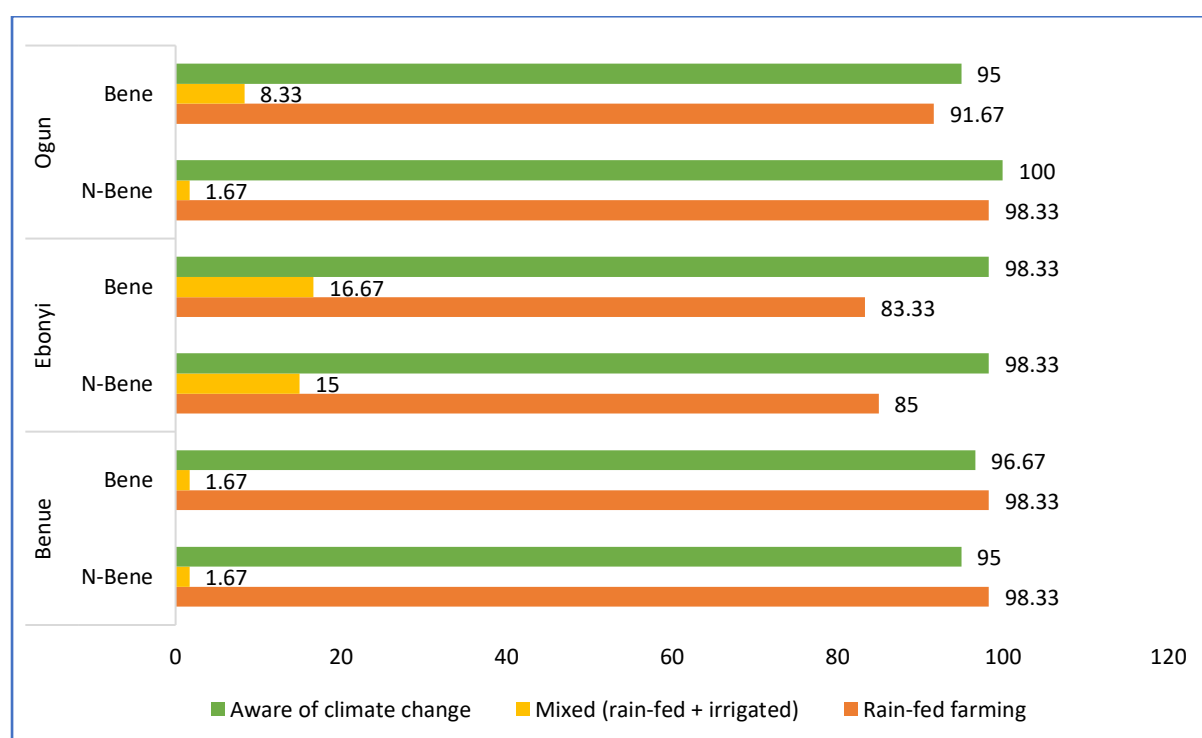


Figure 3: Farming System and Climate-Change Awareness of Rural Women Farmers

Source: Field Survey Data (2026)

4.5 Weather Changes Observed

The result from the GHS-Panel 2018/2019 data provided a complementary preliminary picture of climate exposure in the three study states (National Bureau of Statistics [NBS] & World Bank, 2019). Heavy rainfall, pest infestation, extreme heat and erosion were the most commonly reported shocks, and most affected households reported these shocks as recurring rather than occurring once, underscoring that resilience in this context is better understood as

the capacity to withstand repeated, compounding stressors than as protection from a single event.

Table 8 : Climate Exposure Distribution by Women Farmers in Nigeria

State	Population affected	Benue (%)	Ebonyi (%)	Ogun (%)
Drought	685	2.5	1.2	1.3
Flood	2808	1.9	1.5	1.3
Heavy rainfall	1765	2.7	0.8	0.8
Extreme Winds	1174	1.3	0.8	0.8
Extreme temperatures (cold/heat)	249	0.8	3.6	1.6
Fire Disaster	191	2.1	2.6	0.5

Source: Generalised Household Survey Data (2018/2019)

From the field survey, Ebonyi respondents reported the highest incidence of flooding (59–76%) and pest/disease incidence (95%), consistent with first-hand accounts from Izzi and Ikwo LGAs (Table 9).

"Much flood came last year and spoiled all my cassava."

— FGD7 — Ndieze, Izzi LGA, Ebonyi State

"For those who grow rice and yam, we have lost our rice field to flood."

— FGD8 — Noyo, Ikwo LGA, Ebonyi State

Contrarily, Benue is dominated by late or erratic onset of rains (63–91%) rather than flooding. This is echoed by a Benue Women Leader's description of the planting calendar:

"We used to start farming activities from the end of March to April, but due to lack of rainfall, farming activities start fully in the month of May."

— KIII — Women Leader, Tse Adagi, Benue State

Ogun stands out for the reports of increased temperature (96–97%) alongside the region's lowest drought incidence among beneficiaries (19.3%), suggesting a distinct climate-stress profile of heat rather than water scarcity.

Table 9: Specific Weather Changes Observed by Rural Women Farmers

	Benue		Ebonyi		Ogun	
	N-Bene	Bene	N-Bene	Bene	N-Bene	Bene
Weather change						
Increased temperature	87.72	50.88	76.27	81.36	96.67	96.49
Erratic rainfall	52.63	22.81	64.41	66.10	60.00	40.35
Drought	19.30	36.84	62.71	57.63	50.00	19.30
Flooding	28.07	12.28	76.27	59.32	55.00	45.61
Late onset of rains	91.23	63.16	81.36	74.58	98.33	89.47
Early cessation of rains	56.14	26.32	62.71	67.80	85.00	43.86
Increased pest/disease	68.42	35.09	94.92	94.92	58.33	43.86

Source: Field Survey Data (2026)

Note. Multiple responses

4.6 Financial Account Ownership

Results from the EFINA A2F 2023 survey indicated that formal and informal financial channels co-exist among rural women farmers rather than one substituting for the other: commercial banks accounted for the largest share of financial-service use, while village/community associations, thrift collectors and savings groups together accounted for roughly a quarter of reported use, considerably more than mobile money and cooperative societies (Table 10).

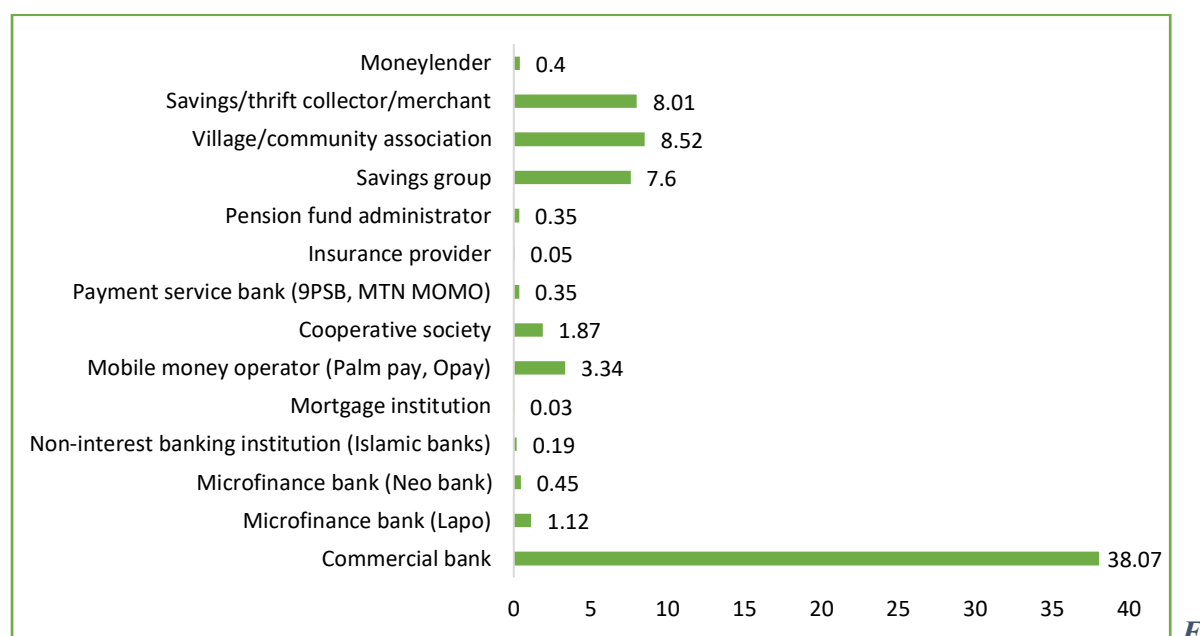


Figure 4: Financial Service Institutions Used by Women

Source: Access to Finance Survey (2023)

Formal risk-transfer products were, by contrast, almost entirely absent, with insurance, non-interest/Islamic banking and pension uptake all below one percent, suggesting that women farmers' financial portfolios are dominated by transaction and savings instruments rather than products explicitly designed to buffer climate-related risk (EFInA, 2023). A preliminary Logit regression model of account ownership (Appendix A) further showed that access-related factors such as proximity to a service agent, mobile phone use and educational attainment were the strongest predictors of account ownership, while cost, distance to a bank and marital status reduced the odds of ownership; variables often assumed to be central barriers, such as trust, lack of identification and low literacy, were not statistically significant (Annex A). This is broadly consistent with evidence from Sub-Saharan Africa that observable access-related characteristics, rather than gender or literacy per se, explain much of the unconditional gender gap in financial-service use (Aterido, Beck, & Iacovone, 2013).

This reiterates the findings from the field survey where formal account ownership is lowest among Ebonyi non-beneficiaries (50%) and highest among Ogun beneficiaries (85%). The most striking contrast is in mobile-money uptake: just 2.08% of Ebonyi beneficiary account holders use mobile money, against 54.90% of Ogun beneficiaries (Table 10). This is nearly identical to the qualitative account from Ebonyi's own mobile-money agent, who frames POS as an emerging bridge rather than a dominant channel for financial inclusion:

"Current level of access to financial services among rural women farmers is mostly informal, but by use of POS, some are now upgraded to formal financial services."

— KII8 — Mobile Money Agent (POS), Ikwo, Ebonyi State

In Ogun, the pattern is corroborated from the supply side by a POS operator describing near-total dependence on cooperative and agent-based channels where bank access is limited:

"Account ownership is very low, no access to financial bank. They only practice cooperative."

— KII11 — POS Operator, Odogbolu, Ogun State

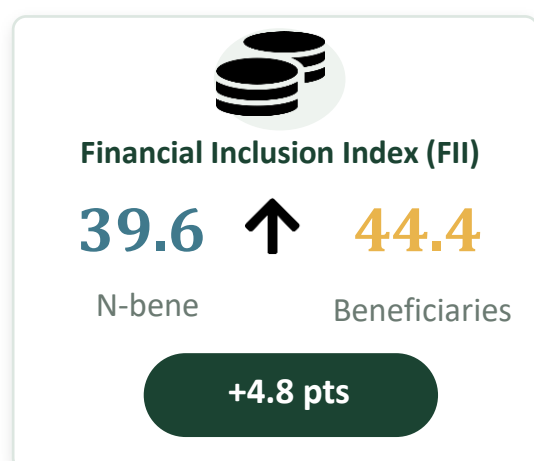
Table 10: Account Ownership and Type Held by Rural Women Farmers

Indicators	Benue		Ebonyi		Ogun	
	N-Bene	Bene	N-Bene	Bene	N-Bene	Bene
Owens a formal account	61.67	66.67	50.00	80.00	75.00	85.00
- Commercial bank	78.38	65.00	96.67	95.83	88.89	82.35
- Microfinance bank	0.00	32.50	3.33	6.25	11.11	9.80
- Mobile money	32.43	15.00	3.33	2.08	11.11	54.90
- Cooperative society	2.70	2.50	3.33	0.00	0.00	11.76

Source: Field Survey Data (2026)

4.7 The Financial Inclusion Index (FII)

This section describes the raw (unmatched) Financial Inclusion Index (FII, scaled 0–100) and its three sub-dimensions: Access, Availability, and Usage across the three states. These descriptive patterns motivate and contextualise the ATT results. From the results in Table 11,



beneficiaries score higher than non-beneficiaries on overall FII (44.35 vs 39.63) implying that rural women farmers were fairly financial included and, more on Access (77.22 vs 62.22, a 15-point gap) and Availability (18.89 vs 12.22). Usage, however, runs in the opposite direction: non-beneficiaries report slightly higher Usage (44.44) than beneficiaries (36.94). This access–usage divergence is consistent with the ATT results, where the initiative's effect on the overall FII is small and

not statistically significant from zero. Benefiting from a financial inclusion initiative appears to expand which financial services women can reach, without necessarily translating into more intensive use of them. The qualitative record offers deeper insights. Barriers such as high interest rates, collateral and documentation demands, distance, and in some communities, the requirement of spousal authorisation, persist "even where a service nominally exists", meaning nominal access does not automatically convert into active use.

“At times they ask you if your husband is aware of this loan, they want you to bring your husband as a guarantor or surety.”

— FGD7, Ndieze, Izzi LGA, Ebonyi State

“The cooperative members may not have enough fund to go round due to first call, first serve — it sometimes affects us.”

— FGD7, Ndieze, Izzi LGA, Ebonyi State

Table 11: Financial Inclusion Index (FII) and Sub-Dimensions Distribution

	N	FII (0–100)	Access	Availability	Usage
Group					
Non-beneficiary	180	39.63	62.22	12.22	44.44
Beneficiary	180	44.35	77.22	18.89	36.94
State					
Benue	120	36.67	64.17	11.25	34.58
Ebonyi	120	39.44	65.00	8.75	44.58
Ogun	120	49.86	80.00	26.67	42.92

Source: Field Survey Data (2026)

Ogun records the highest overall FII (49.86) and leads decisively on Access (80.00) and Availability (26.67), while Ebonyi has shown the lowest Availability of any state (8.75) despite a comparatively strong Usage score (44.58). Benue trails on overall FII (36.67) but is not far behind on Usage (34.58). These state rankings from Figure 5 echo the qualitative account of how financial services are actually used. In Ebonyi and parts of Ogun, access to mobile-money and point-of-sale (POS) supplements informal savings and credit, whereas in Benue and Ogun’s more remote communities, formal banking remains physically distant even where cooperative-based informal access is functioning well.

“Commercial banks are far! They are not close to us at all. But Microfinance banks are close.”

— FGD3, Owode, Ogun State

“Current level of access to financial services among rural women farmers is mostly informal, but by use of POS some are now upgraded to formal financial services.”

— KII8, Mobile Money Agent (POS), Ebonyi State

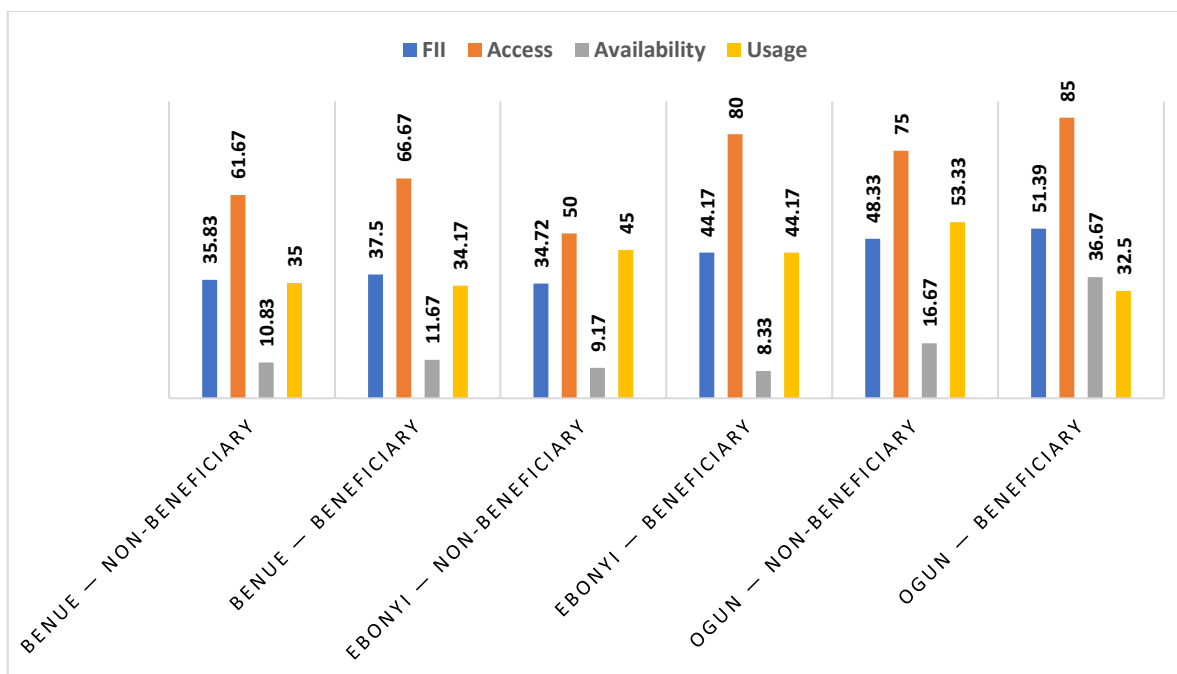


Figure 5: Financial Inclusion Index (FII) by State and Beneficiary Status
Source: Field Survey Data (2026)

The beneficiary/non-beneficiary gap in overall FII is smallest in Benue (37.50 vs 35.83, a gap of only 1.67 points) and largest in Ebonyi (44.17 vs 34.72, a gap of 9.44 points), with Ogun in between (51.39 vs 48.33). Benue’s narrow FII gap is notable given that, Benue records the largest matched CRI treatment effect of the three states, an apparent dissociation of the raw FII gap from the resilience gain. This is consistent with the qualitative finding that Benue’s comparison group is not simply “less financially included” in a generic sense but, in some communities, entirely without an active financial-inclusion initiative at all, while the resilience gain among Benue beneficiaries could stem substantially from being benefiting from financial inclusion initiative training and input support that is not fully captured in the FII construct.

“No program or organization has supported us.”

— FGD9, Uburu Amachi, Ebonyi State

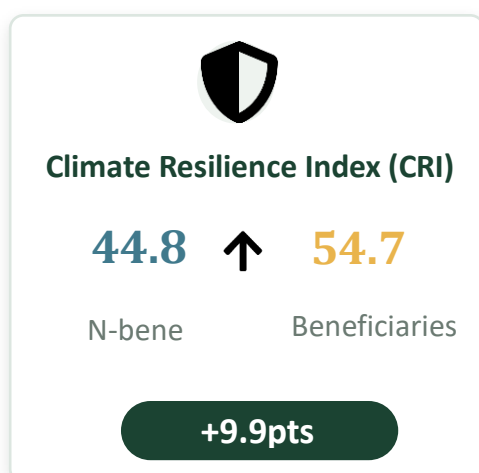
“Government policies and donor programs are currently not in the community to support financial inclusion, but we have been given palm trees to plant by ACRReSAL.”

— KII2, Extension Agent, Benue State

4.8 Climate Resilience Index (CRI) and Its Components

The Climate Resilience Index (CRI, 0–100) is constructed from six components: Adaptive Capacity, Asset, Social Safety Nets, Basic Services, Income & Food, and Stability (Figure 6). The higher the value of the CRI, the more resilience a farmer is. This section reports the raw, unmatched CRI and its components before the matched ATT results. The 9.95-point pooled gap in overall CRI (54.71 vs 44.76) is driven to a great extent by one component: Social Safety

Nets, where beneficiaries score more than double non-beneficiaries (70.83 vs 30.56, a 40.3-point gap), and, to a lesser extent, by Asset (29.66 vs 19.95) and Income & Food (25.47 vs



13.46). Contrarily in Figure 6, Adaptive Capacity is essentially identical across groups (59.83 vs 59.98), Basic Services shows only a marginal beneficiary advantage (85.13 vs 83.86), and Stability is, if anything, slightly lower among beneficiaries (57.33 vs 60.78). In other words, participation in a financial inclusion initiative raises climate resilience principally by strengthening the social safety-net and asset dimensions, the very dimensions that the qualitative data identify as the functional core of informal group-based finance rather than by improving general

adaptive capacity or shielding households from market-level price instability, which appears comparably exogenous to both groups.

“It gives us peace of mind! — when the money is there.”

— FGD3, Owode, Ogun State

“The Esusu that we have collected helps us to re-cultivate the farm.”

— FGD8, Noyo, Ikwo LGA, Ebonyi State

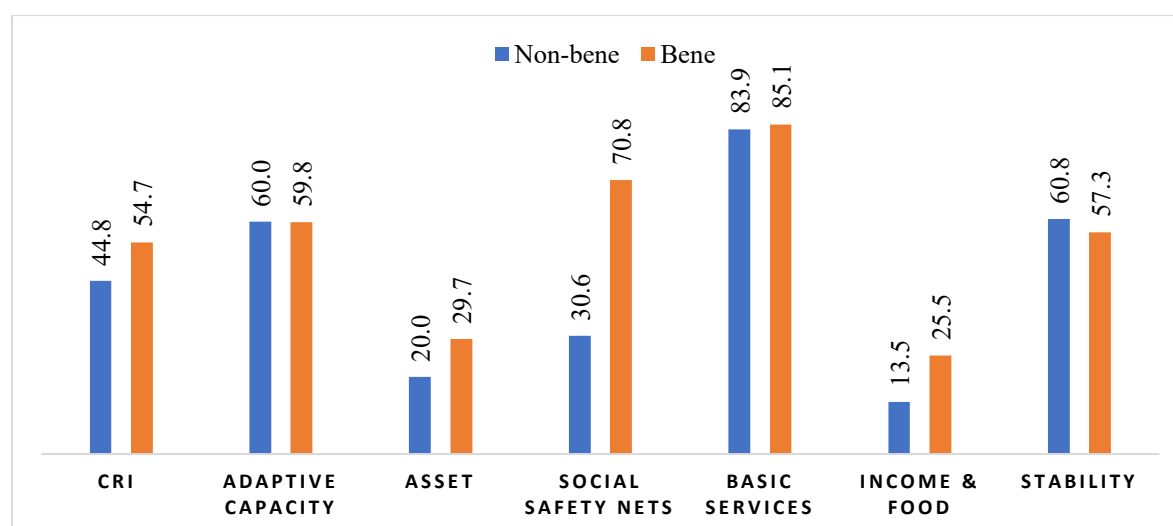


Figure 6: Climate Resilience Index Components, by Beneficiary Status (Pooled)

Source: Field Survey Data (2026)

“They borrow from their cooperative societies to start afresh after climate impacts or to fund other lines of business.”

— KII7, Women Farmer Leader, Ebonyi State

“The prices keep fluctuating wildly; it’s not stable at all, sometimes we just sell at a loss just to have some cash on hand.”

— FGD4, Kwande, Benue State

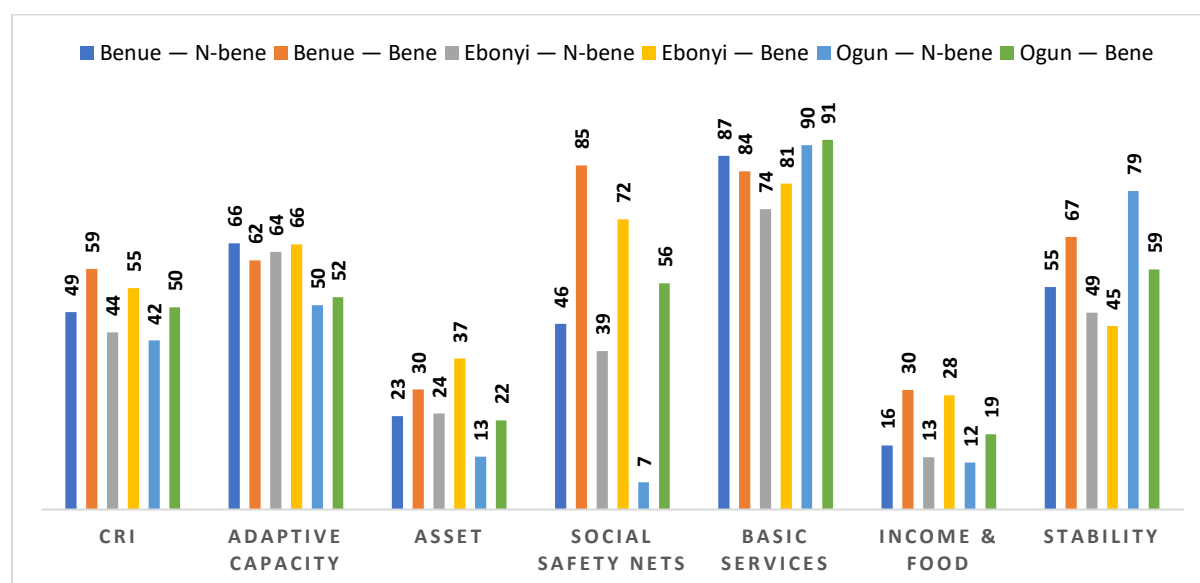


Figure 7: Climate Resilience Index (CRI) by State and Beneficiary Status
Source: Field Survey Data (2026)

The state by beneficiary breakdown of CRI (Figure 7) further reiterates the previous finding. Benue’s Social Safety Nets score nearly doubles between non-beneficiaries and beneficiaries (45.83 → 85.00, +39.2 points), the single largest within-cell jump anywhere consistent with the strong financial inclusion initiative and cooperative presence reported in beneficiary communities such as Tse Adagi, set against the near-total absence of initiative or financial infrastructure described in non-beneficiary communities such as Tarka. Ogun shows the opposite pattern on the same component: Social Safety Nets rises from a very low base among non-beneficiaries (6.67) to 55.83 among beneficiaries, but Ogun’s overall CRI gain (41.74 → 49.92, +8.18 points) remains the smallest of the three states, consistent with the loan-design and farmer-capacity concerns raised uniquely in Ogun’s key informant interviews.

“Not very effective, due to loan design for agricultural sector: high interest rate, short tenure/repayment window, and inadequate grace period.”

— KII12, Lead Farmer, Odogbolu, Ogun State

4.9 Agricultural Productivity of Rural Women Farmers

To achieve the second objective of the study on the association between financial inclusion, climate resilience, and livelihood/welfare outcomes, Total Factor Productivity (TFP), an index of output relative to combined crop and livestock inputs is reported here for all the households by financial inclusion initiative participation and by state. Pooled Mean TFP and Crop TFP are both higher among beneficiaries (4.14 and 4.08) than non-beneficiaries (3.73 and 3.72)

respectively, consistent with the qualitative account that access to credit and inputs supports farm expansion and productivity.

Benue records the highest pooled Mean TFP (4.848) and Crop TFP (4.924) of the three states by a wide margin, while Ebonyi and Ogun are comparatively similar and lower (Table 12). The state ranking (Benue > Ebonyi > Ogun) matches the CRI state ranking, suggestive of a shared underlying driver, likely the stronger cooperative and initiative input-support presence documented qualitatively in Benue’s beneficiary communities.

Table 12: Mean Total Factor Productivity, by State

State (Zone)	Mean TFP	Mean Crop TFP
Benue (North Central)	4.848	4.924
Ebonyi (South East)	3.574	3.546
Ogun (South West)	3.378	3.233

Source: Field Survey Data (2026)

Benue shows the largest beneficiary productivity advantage of any state. Crop TFP rises from 3.86 among non-beneficiaries to 5.99 among beneficiaries, a gain that parallels Benue’s outsized CRI and Social Safety Nets gains reported above, and is consistent with farmer accounts of loan and cooperative-funded farm expansion (Figure 8). Ogun shows a smaller, same-direction gain (3.10 → 3.36). Ebonyi, however, reverses the pooled pattern: non-beneficiaries record higher Crop TFP (4.20) than beneficiaries (2.89). Because Ebonyi beneficiaries simultaneously register the state’s largest CRI and FII gains, this disparity suggests that VCDP/IFAD-linked support in Ebonyi may be translating more into savings capacity, social safety nets, and income diversification than into raw crop-input productivity per hectare.

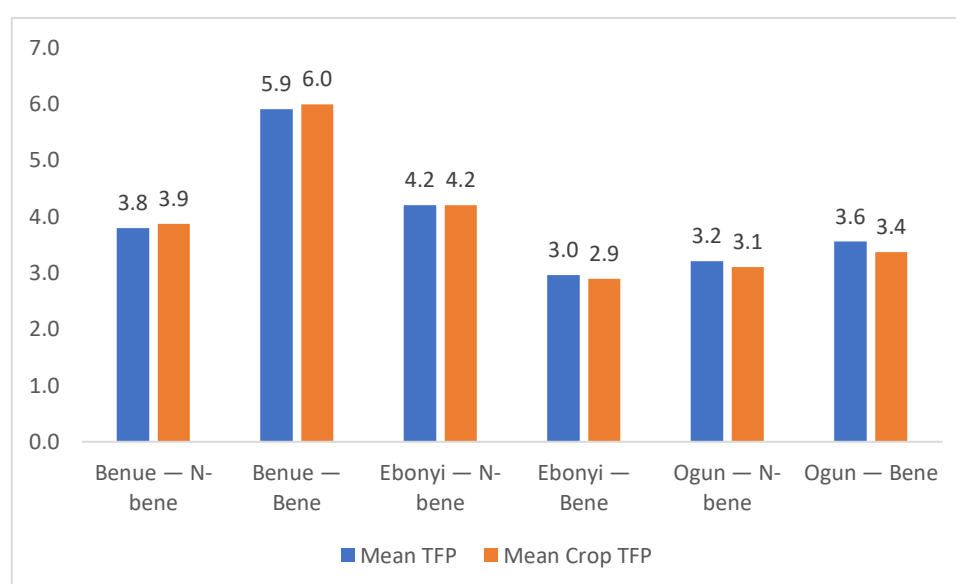


Figure 8: Mean Crop and Total Factor Productivity (TFP) by State

Source: Field Survey Data (2026)

This nuance is consistent with the qualitative record, where Ebonyi’s VCDP narrative centres on savings, POS/agent-banking rollout and “champion farmer” development.

“Champion women farmers have been raised through the activities of IFAD/VCDP (Value Chain Development Programme) in Ebonyi State.”

— **KII6, Extension Agent, Ebonyi State**

“Climate change really affected our time of planting, reduce yield and quality of the seed and also affect our income.”

— **KII11, POS Operator, Odogbolu, Ogun State**

“Climate change has reduced productivity; altered the months of farming because of unexpected dry spells, which has in turn reduced household income and food availability in all seasons.”

— **KII12, Lead Farmer, Odogbolu, Ogun State**

More broadly, participants and key informants describe a direct causal chain from climate variability, through reduced yields and income, to food insecurity, and describe financial access as the primary lever for breaking that chain. For example, a beneficiary from Ebonyi attributed an expansion of cultivated area from 1–2 ha to 2–4 ha directly to loan access, while a lead farmer in Ogun noted that women farmers, who typically cultivate smaller plots than men, rely more heavily on external funds such as loans to buy irrigation equipment to offset this structural land-access disadvantage.

4.10 Food Security Status of Rural Women Farmers

Result from the GHS 2018/19 data has shown that recovery from shocks was slow for a large share of affected households, with high incidence (60.0% of food insecure households) of widespread food insecurity (Table 13). Preliminary regression estimates showed a consistent, statistically significant negative association between climate exposure and food security, alongside a positive and significant association between household asset value and food security, whereas credit access alone was not significantly associated with food security once other factors were controlled for. This mirrors experimental evidence from northern Ghana that credit alone did not substantially increase smallholder investment, whereas complementary risk-transfer instruments did, because uninsured risk rather than credit access per se was often the binding constraint (Karlan, Osei, Osei-Akoto, & Udry, 2014), and is consistent with related Nigerian evidence that households with lower climate-change adaptive capacity face a significantly greater likelihood of food insecurity (Ibrahim et al., 2022).

Table 13: Food Security Status of Rural Women Farmers

	Benue		Ebonyi		Ogun	
	N-Bene	Bene	N-Bene	Bene	N-Bene	Bene
High food security	0.00	33.33	5.00	23.33	5.00	3.33
Low food security	56.67	33.33	15.00	20.00	16.67	21.67
Marginal food security	8.33	3.33	1.67	18.33	0.00	0.00
Very low food security	30.00	5.00	78.33	38.33	60.00	78.33

Source: Field Survey Data (2026)

The result presented in figure 9 shows the distribution of food-secure and food-insecure households among the N-bene and Bene groups across Ogun, Ebonyi, and Benue States. Overall, food insecurity was substantially more prevalent than food security across the three states, although the magnitude of the difference varied between the two groups. In Ogun State, food insecurity was extremely high in both groups, accounting for 95.00% of N-bene households and 96.67% of Bene households, while only 5.00% and 3.33%, respectively, were food secure. This indicates a generally poor food-security situation in the state, with virtually no difference between the two groups. Interestingly, the proportion of food-insecure households was slightly higher among the Bene group than the N-bene group, suggesting that beneficiaries had a lower propensity to be food insecure in Ogun State.

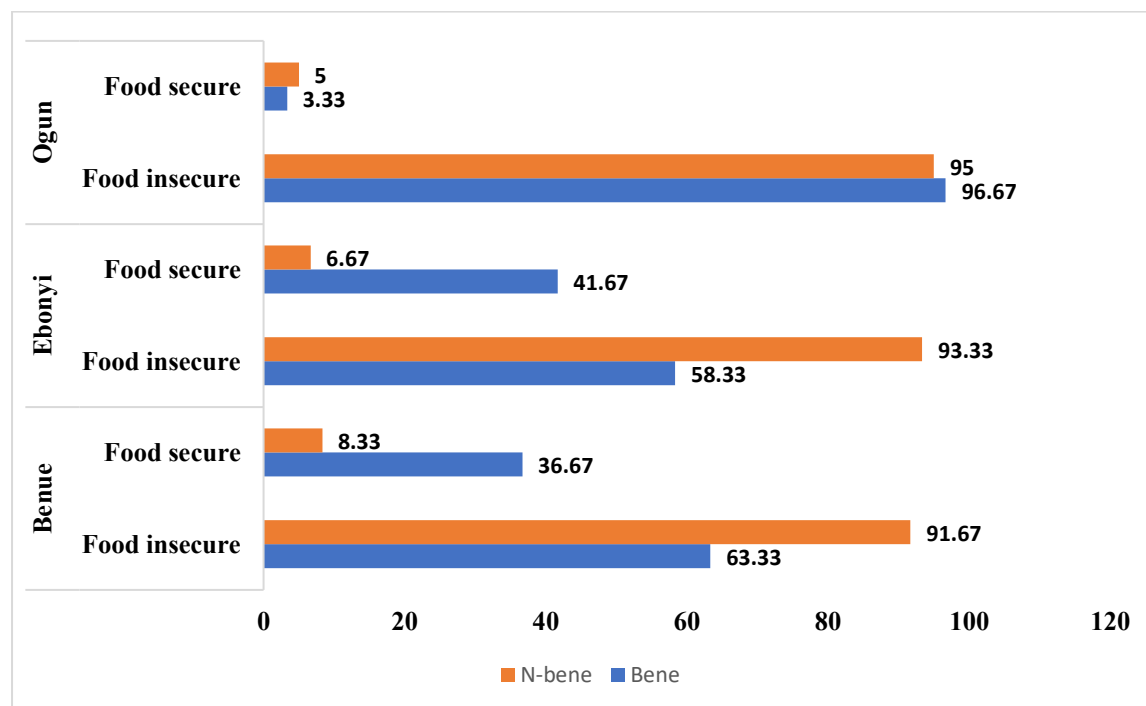
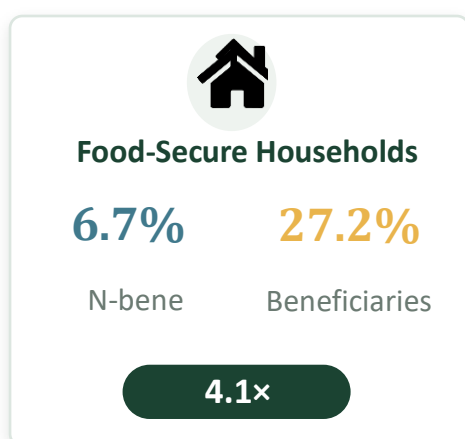


Figure 9: Food Security Status of Rural Women Farmers
Source: Field Survey Data (2026)

In Ebonyi State, a much larger difference was observed between the two groups. Food insecurity affected 93.33% of N-bene households, compared with 58.33% of Bene households. Conversely, food security was reported among only 6.67% of N-bene households, compared with 41.67% of Bene households. Thus, the Bene group recorded a considerably more favourable food-security status than the N-bene group in Ebonyi. The approximately 35% difference in food insecurity between the groups suggests that factors distinguishing the two groups may be associated with improved household food security in this state.



A similar pattern was observed in Benue State, where 91.67% of N-bene households were food insecure, compared with 63.33% of Bene households. Food security was correspondingly higher among Bene households (36.67%) than among N-bene households (8.33%). The difference of approximately 28 percentage points in food insecurity between the groups again indicates a relatively better food-security position among Bene households.

Across the three states, Ogun recorded the highest levels of food insecurity for both groups, while Ebonyi and Benue showed comparatively better outcomes among Bene households. Particularly noteworthy is the substantial improvement in food security among Bene households in Ebonyi and Benue, compared with their N-bene counterparts. However, the absence of a similar pattern in Ogun suggests that the relationship between group status and food security may be context-specific and influenced by state-level socioeconomic, agricultural, livelihood, or institutional factors.

4.11 Common-Support Sample for the Propensity-Score Matching Analysis

Of the 360 women farmers surveyed (120 each in Benue, Ebonyi, and Ogun States; 180 programme beneficiaries and 180 non-beneficiaries), 353 respondents (175 treated, 178 control) fell within the common-support region established by the propensity-score matching methodology and were retained for matching. The primary matched-pairs estimator (Method A) yielded 146 matched pairs; the with-replacement estimator (Method B) matched 174 treated units to 95 unique controls; and the Inverse Probability of Treatment Weighing (IPTW) estimator (Method C) retained all 353 common-support respondents, reweighted by the inverse of their estimated propensity of treatment. The quantitative PSM results below are read alongside the thematic qualitative evidence from the nine focus group discussions and thirteen key informant interviews conducted across Benue, Ebonyi, and Ogun States, organised around the study's three objectives.

4.12 Financial-Service Combinations Effect on Climate Resilience

To have a better understanding of the importance of digital technology in driving resilience, combinations including the use of mobile money and debit card were included with conventional financial products such as agricultural insurance, agricultural credit, account ownership, savings and informal savings, esusu. Of the 27 financial-service combinations tested individually against the Climate Resilience Index, 19 are statistically significant at the conventional $p < 0.05$ threshold, and 15 remain significant after the conservative Bonferroni correction for 27 simultaneous comparisons. Table 14 reports the combinations most strongly associated with climate resilience. Insurance-anchored combinations dominate the top of the ranking: Insurance + Esusu is associated with the single largest effect of any combination tested (+7.42 CRI points, $p < 0.05$), followed by Insurance + ATM/Debit (+6.89 points), Insurance +

Mobile money (+6.42 points), and Account + Insurance + Esusu (+6.39 points). Most of the combinations in Table 14 are significant at $p < 0.05$ and some survive the Bonferroni correction.

Table 14: Ten Financial-Service Combinations Most Strongly Associated with the Climate Resilience Index

Service combination	N	Effect on CRI	Sig.
Insurance + Esusu	181	7.417	***
Insurance + ATM/Debit	126	6.894	***
Insurance + Mobile money	121	6.418	***
Account + Insurance + Esusu	296	6.389	***
Account + Loan + Esusu	301	5.560	***
Loan + Insurance	115	5.496	***
Account + Esusu	293	5.191	***
Account + Insurance	262	4.356	***
Mobile money + Esusu	165	4.303	***
Account + Loan + Insurance	275	4.078	***
Loan + Esusu	157	3.899	***
Mobile money + ATM/Debit	101	3.884	***
Account + Loan	267	3.814	***
Account + ATM/Debit	257	3.712	***
Account + Mobile money	251	3.592	***
Esusu + ATM/Debit	59	3.301	**
Loan + Mobile money	80	3.099	**
Loan + ATM/Debit	104	2.916	***
Savings + Loan	261	-1.953	*
Savings + ATM/Debit	267	-2.466	**

Note. Effect = adjusted effect on the Climate Resilience Index (0–100 scale), controlling for propensity score and state fixed effects (HC3 robust SE). *** $p < 0.01$.

Source: Field Survey Data (2026)

At the opposite end of the ranking (Appendix B), combinations built around a standalone savings account without an accompanying insurance, esusu, or formal-account component perform markedly worse, several turning negative: Savings + ATM/Debit (–2.47 points, $p = 0.0232$), Savings + Loan (–1.95, $p = 0.0636$), and Savings + Esusu (–2.37, $p = 0.1616$, not significant) are illustrative. None of these lower-ranked combinations survives Bonferroni correction. The gap between the strongest and weakest combinations is therefore of a similar order of magnitude to the entire programme's average treatment effect on resilience, underscoring that how a financial-inclusion package is bundled matters as much as whether one exists at all.

The quantitative finding that insurance-anchored combinations occupy the top of the resilience ranking converges closely with what beneficiaries and institutional informants describe qualitatively. No FGD or KII participant reported relying on a single financial instrument in isolation; the dominant pattern across all three states was informal savings/credit (esusu/adashi)

layered with cooperative membership, with mobile-money or point-of-sale access added on top in Ebonyi specifically for safekeeping and transfers.

“We are using Esusu and Loan, Esusu from cooperative.”

— **FGD7, Ndieze, Izzi LGA, Ebonyi State**

“Adashe/esusu and multi-purpose cooperatives are most commonly used by rural women farmers.”

— **KII1, Women Leader, Tse Adagi, Benue State**

Institutional key informants corroborated the same bundling logic from the supply side. Where the qualitative and quantitative evidence sharpen each other most sharply is on insurance: participants across all three states with the exception of beneficiaries in Ebonyi state who receive counterpart funding of ₦205,000/ ha in kind for their farm inputs with agricultural insurance accounting for 6% of these funds for public insurance. Non-beneficiaries in Ebonyi state and most respondents in the other two states described a near-universal non-uptake of formal agricultural insurance, including a specific denied-claim experience recounted in the Ogun focus groups and a Women Farmer Leader's account of being "unsure how" to access it at all.

“We don't do it at all! We don't do it! What we even hear most is that they don't usually truly respond to farmers.”

— **FGD1, Odogbolu, Ogun State**

“Because they missed making the payment twice, they were not helped, since then he has quit.”

— **FGD1, Odogbolu, Ogun State**

“They should be guided on how to get their farms insured, as they are currently unsure how.”

— **KII7, Women Farmer Leader, Ikwo, Ebonyi State**

The quantitative results reveal the cost of this access gap directly. Insurance appears in every one of the four highest-performing combinations in Table 14, meaning the single most under-used instrument in the qualitative accounts is simultaneously the single most powerful ingredient in the quantitative resilience results. This is consistent with the theoretical expectation that insurance uniquely relaxes a risk constraint that savings or credit alone cannot (Karlán et al., 2014), and echoes the finding that group-based, informal risk-pooling mechanisms are a longstanding, gender-patterned response to exactly this kind of unmet risk-management need (Anderson & Baland, 2002).

The comparatively weak or negative performance of standalone-savings combinations lacking a group or insurance component (Appendix B) is similarly legible in the qualitative record, which documents recurring group-liquidity constraints, cooperative and esusu funds running short under first-come-first-served rationing and distrust of fund mismanagement, both of

which would be expected to blunt the protective value of savings held outside a pooled or insured structure.

“We have experienced a situation where the money contributed was not properly accounted for, the fund was not complete or not enough when it was needed.”

— FGD8, Noyo, Ikwo LGA, Ebonyi State

“Contributed funds are sometimes misused/embezzled by corrupt executives of the association or cooperative.”

— KII7, Women Farmer Leader, Ebonyi State

4.13 Financial Inclusion, Climate Resilience and Their Interaction on Livelihood and Welfare Outcomes

Objective 2 asks whether financial inclusion (FII), climate resilience (CRI), and their interaction (FIIxCRI) are associated with agricultural productivity, household income, and food security and, if so, through which specific service combinations. This section reports three complementary pieces of evidence: a joint regression model of FII, CRI and their interaction on each outcome a combination-by-combination scan of which of the 27 service bundles drive each outcome; and a robustness check using respondents' own perception of whether their income and productivity changed.

4.13.1 The FII × CRI Interaction Model on Productivity, Income and Food Security

Table 15 reports coefficients from regressing each outcome on FII, CRI, and their interaction term (FIIxCRI), controlling for the propensity score and state fixed effects (HC3 robust SE, N=360). This model asks a different question: among the full sample, does a higher raw FII or CRI score regardless of beneficiary status predict better outcomes?

Table 15: FII × CRI Model on Agricultural Productivity, Income and Food Security

Outcome	Predictor	Coefficient	p-value
Overall Total Factor Productivity	FII (0–100)	0.145	0.149
	CRI (0–100)	0.127	0.316
	FII × CRI	-0.004	0.107
Crop Total Factor Productivity	FII (0–100)	0.157	0.143
	CRI (0–100)	0.137	0.315
	FII × CRI	-0.004	0.106
Household income (NGN)	FII (0–100)	50,285	0.315
	CRI (0–100)	74,640	0.199
	FII × CRI	-1,205	0.233
Food security	FII (0–100)	-0.003	0.436
	CRI (0–100)	0.007	0.096*
	FII × CRI	0.0001	0.313

*Note. Each outcome ~ FII + CRI + FIIxCRI + propensity score + state fixed effects (HC3 robust SE). Log-transformed robustness checks for income and TFP show the same pattern of non-significance. * $p < 0.10$.*

Source: Field Survey Data, 2026

None of the FII, CRI or FIIxCRI coefficients reaches conventional significance for productivity or income, and only CRI's association with food security approaches significance ($p=0.096$). This is an important nuance alongside the matched ATT results: while becoming a programme beneficiary raises CRI by a large and highly significant margin, the raw level of CRI achieved does not, on its own, strongly predict higher productivity or income across the sample as a whole. In other words, the programme's resilience gain does not appear to operate primarily through a direct, linear “higher resilience score $\rightarrow$ higher output” channel; There is a likelihood that it instead operates through specific service bundles and through household coping/diversification behaviour that is not fully captured by the aggregate FII and CRI indices.

4.13.2 Which Service Combinations Drive Productivity, Income and Food Security?

Each of the 27 combinations was also tested individually against each of the seven outcomes. Table 16 summarises the single strongest combination for each outcome; the pattern that emerges is a striking divergence between food security on one hand and productivity/income on the other.

Table 16. Strongest Financial-Service Combination per Outcome

Outcome	Top combination	Coefficient	p-value	Sig.	Bonferroni survivors (/27)
Overall TFP	Insurance + ATM/Debit	-2.395	0.000	***	4
Crop TFP	Insurance + ATM/Debit	-2.505	0.000	***	4
Household income (NGN)	Insurance + Mobile money	-1,129,149	0.022	**	0
Food secure	Loan + Insurance	+0.302	<0.000	***	11
$\ln(1+\text{Household income})$	Insurance + ATM/Debit	-0.488	0.002	***	0
$\ln(1+\text{Overall TFP})$	Insurance + ATM/Debit	-0.443	<0.000	***	4
$\ln(1+\text{Crop TFP})$	Insurance + ATM/Debit	-0.460	<0.000	***	5

Note. Bonferroni survivors = number of the 27 combinations (within that outcome's family of 27 tests) that remain significant after Bonferroni correction (threshold $p<0.00185$).

Source: Field Survey Data (2026)

The same insurance-anchored combinations that most strongly raise the Climate Resilience Index (Table 14) show a robust, statistically significant negative association with Total Factor Productivity: Insurance + ATM/Debit is associated with 2.40 fewer points of Overall TFP ($p=0.000004$) and 2.50 fewer points of Crop TFP ($p=0.000001$), both surviving Bonferroni correction, alongside similarly negative and robust coefficients for Esusu + ATM/Debit and Insurance + Esusu. The same combinations are also associated with lower and not higher household income, though these income coefficients do not survive Bonferroni correction at the 0/27 rate shown in Table 16. By sharp contrast, insurance-anchored and account-centred

combinations show the programme's single strongest and most Bonferroni-robust association with food security: 11 of 27 combinations remain significant predictors of food security after correction, led by Loan + Insurance (+0.302 probability points, $p < 0.0001$) and Insurance + ATM/Debit (+0.281, $p < 0.0001$).

This apparent contradiction is that the same financial-service bundles that most improve climate resilience and food security simultaneously show a negative association with land-based crop productivity and this is directly explained by the qualitative record's account of livelihood diversification. Rather than intensifying crop-input use on the same plot, households with insurance, esusu and mobile-money access appear to be redirecting funds toward livestock, processing, trading and other non-crop income sources as a deliberate hedge against climate risk, which would mechanically lower a crop-input-based TFP ratio even as it raises overall welfare and food security.

“When we are unable to plant, we diversify into rearing livestock, or adding value to some of our produce to generate more income.”

— FGD8, Noyo, Ikwo LGA, Ebonyi State

“It helps women to diversify into trading and not just depend on farm income only.”

— KII4, Women Leader, Benue State

“Improved investment in Climate-Smart Agriculture (Irrigation system), asset diversification, risk mitigation, and digital financial services.”

— KII10, Women Leader, Owode, Ogun State

This diversification account is also consistent with the descriptive TFP patterns already noted where Ebonyi's beneficiaries recorded lower raw Crop TFP than non-beneficiaries (2.89 vs 4.20) alongside the state's largest CRI and FII gains, the same households whose resilience and inclusion are rising fastest appear least likely to be raising land-specific crop productivity, because a meaningful share of their coping strategy runs through non-crop enterprises instead.

4.13.3 Respondents' Perceived Change in Income and Agricultural Productivity

Because household-level TFP and income ratios are noisy and can mask genuine welfare gains occurring through channels the index does not capture, the survey also asked respondents to compare their own last income and agricultural productivity to the previous production cycle. Table 17 reports the raw (unmatched) distribution of responses by treatment status and the matched ATT on the same perception measures using the identical PSM design (Methods A/B/C) as the rest of the analysis.

Table 17: Direction of Perceived Change, by Treatment Status (Raw, Unmatched)

Perceived change	Control (%)	Treatment (%)
Income — Increased	13.9	27.2
Income — Decreased	73.3	67.8
Income — No change	12.8	5.0
Productivity — Increased	8.3	31.1
Productivity — Decreased	77.8	65.0
Productivity — No change	13.9	3.9

Note. Chi-square test of independence: income change, $\chi^2=14.30$, $df=2$, $p=0.0008$; productivity change, $\chi^2=35.86$, $df=2$, $p<0.0001$.

Source: Field Survey Date (2026)

Table 18: Matched ATT on Perceived Change (Method A, Matched Pairs)

Perceived change category	N	Treated share	Control share	ATT (pp)	p-value
Income increased	146	0.295	0.130	+0.164	0.001
Income decreased	146	0.671	0.733	-0.062	0.235
Income unchanged	146	0.034	0.137	-0.103	0.002
Productivity increased	146	0.342	0.068	+0.274	<0.0001
Productivity decreased	146	0.616	0.788	-0.171	0.001
Productivity unchanged	146	0.041	0.144	-0.103	0.002

Note. ATT (pp) = percentage-point difference in the share reporting that category, beneficiaries' vs matched non-beneficiaries. Consistent in sign and significance across Methods B (with replacement) and C (IPTW). On magnitude, beneficiaries additionally report +5.7 percentage points higher perceived income change ($p=0.003$) than matched non-beneficiaries.

Source: Field Survey Data (2026)

The perception evidence points in a direction opposite to the objective TFP and income ATT results reported (Table 18). Beneficiaries are 16.4 percentage points more likely to report an income increase ($p=0.001$) and 27.4 percentage points more likely to report a productivity increase ($p<0.0001$) than their matched non-beneficiary counterparts, even though the matched ATT on objective Overall TFP is a statistically insignificant +0.38 points and on household income a statistically insignificant –NGN 668,766. This divergence is a genuine and important finding rather than a contradiction to be explained away: perceived income and productivity change move very strongly together (Pearson $r=0.70$ on magnitude, Spearman $\rho=0.82$ on direction, with 91.7% of respondents reporting the same direction of change for both Cramer's $V=0.80$), so the perception measures are internally consistent and are very unlikely to be pure noise.

Rather, they most plausibly reflect the same diversification dynamic identified: beneficiaries may genuinely feel and to some extent be better off overall (through livestock, trading, or processing income, or through avoided losses relative to a worse counterfactual) without this showing up in a narrowly crop-input-based TFP ratio or in the specific income components captured by the survey. It may also partly reflect optimism or social-desirability effects among

programme participants, or a relative-to-expectations judgement rather than an absolute one; the data available here cannot fully adjudicate between these explanations, and this divergence between objective and perceived welfare change is flagged as a priority for future, more granular measurement (e.g., separately tracking crop vs livestock vs off-farm income) rather than resolved definitively.

“VCDP! They really helped us a lot! — they don't take money from us; they give it to us for free.”

— **FGD1, Odogbolu, Ogun State**

“Use of climate adaptive technologies (such as solar-powered irrigation pumps), improved seed varieties (drought resistance), and trainings conducted by VCDP personnel have led to increased productivity, income diversification, and improved decision-making.”

— **KII10, Women Leader, Owode, Ogun State**

“Access to financial services (loan) create huge income and climate-resilient crop and produce.”

— **KII13, Extension Agent (ADP), Ogun State**

This same synthesis is echoed directly in the thematic coding framework's cross-objective analysis: where financial inclusion is present, participants explicitly attribute increases in cultivated area, farm investment, and household welfare to access to funds. For example, one Ebonyi focus group attributed an expansion of cultivated area from 1–2 ha to 2–4 ha directly to loan access while institutional informants reinforce the same causal chain from the supply side, and in sites with minimal financial infrastructure, participants report no improvement in income or resilience at all.

“It really affected our time of planting, reduce yield and quality of the seed and also affect our income.”

— **KII11, POS Operator, Odogbolu, Ogun State**

“Climate change has reduced productivity; altered the months of farming because of unexpected dry spells, which has in turn reduced household income and food availability in all seasons.”

— **KII12, Lead Farmer, Odogbolu, Ogun State**

4.14 Programme Effectiveness — The ATT Triangulation

Table 19 reports the Average Treatment effect on the Treated for the three outcomes examined, using the primary matched-pairs estimator (Method A). The headline result is that programme beneficiaries score 9.305 points higher than matched non-beneficiaries on the Climate Resilience Index ($p < 0.0001$) and are 17.8 percentage points more likely to be food secure

($p < 0.0001$). Effects on the Financial Inclusion Index itself are smaller and not statistically distinguishable from zero under Method A.

Table 19: Programme Average Treatment Effect on the Treated (ATT), Method A (Matched Pairs, No Replacement)

Outcome	N pairs	ATT	p-value	Sig.
Financial Inclusion Index (0–100)	146	+3.196	0.2380	n.s.
Climate Resilience Index (0–100)	146	+9.305	<0.0001	***
FII × CRI interaction	146	+524.358	0.0003	***

Note. n.s. = not significant; *** $p < 0.01$.

Source: Field Survey Data (2026)

Case Study 1: From One Hectare to a Millionaire's Harvest



When Mrs. Nweze Felicia joined the Value Chain Development Programme (VCDP) in the Ndieze community of Izzi Local Government Area, Ebonyi State, her farming potential was strictly capped. Like many smallholder farmers in her community, she was constrained to a single hectare of land, burdened by late planting cycles due to unpredictable climate patterns, and hindered by a lack of capital.

The turning point came when Mrs. Felicia engaged with VCDP's integrated agricultural support. Beyond receiving practical training on proper land management and seed selection, she was provided with quality fertilizers and introduced to early-planting strategies and basic irrigation methods. These techniques effectively shielded her rice crops from climate volatility and

guaranteed better germination.

The intervention also unlocked vital financial tools. Through VCDP, Mrs. Felicia accessed a ₦1,000,000 loan with minimal administrative charges, allowing her to scale her operations easily. Complementing this, she joined a structured weekly esusu (savings) group, contributing ₦2,000 every week to build long-term capital and collect annual proceeds.

Today, as the Chairperson of the Ndieze Women Network, Mrs. Felicia has doubled her enterprise from one hectare to two hectares. "The VCDP made me to be a millionaire," she says, noting that the combination of credit, climate adaptation, and inputs transformed her livelihood and brought pride back to her community. Her journey highlights how targeted financial inclusion and climate-smart agriculture can empower rural women to move from subsistence farming to thriving commercial enterprise.

Table 20 compares the ATT for the two main outcomes, FII and CRI, across all three matching/weighting estimators. The Climate Resilience Index effects are consistent in sign, magnitude, and statistical significance across all three methods, indicating the result is not an artefact of any single matching or weighting choice. The Financial Inclusion Index effect, in contrast, is small under every method and its sign is unstable, turning negative under the with-replacement estimator (Method B) and it is not statistically significant in any of the three methods. The VCDP is genuinely, causally improving climate resilience and food security, but this effect does not appear to operate mainly through raising the formal Financial Inclusion Index itself. The finding aligns closely with Negera et al. (2025), an Ethiopian evidence that financial inclusion's contribution to climate resilience depends heavily on which sub-dimension of inclusion (access, availability, or usage) is activated, rather than on aggregate inclusion scores, and with Eissler and Heckert (2024) qualitative evaluation of the same VCDP programme in other Nigerian states, which similarly found that the programme's strongest, most consistently reported benefits to participants ran through non-financial components: cooperative structure, input access, infrastructure and training rather than through the financial-inclusion component narrowly defined, and that access to suitable financing remained a persistent, unresolved challenge for beneficiaries even after years of programme operations.

Table 20: Cross-Method Consistency of the ATT for Three Headline Outcomes

Outcome	Method A (matched pairs)	Method B (with replacement)	Method C (IPTW)
Climate Resilience Index (CRI)	9.305 (<0.000)***	9.040 (<0.000)***	9.448 (<0.000)***
Financial Inclusion Index (FII)	3.196 (0.2380)	-0.958 (0.6853)	4.037 (0.1165)

*Note. Values are ATT (p-value); *** $p < 0.01$.*

Source: Field Survey Date (2026)

Table 21 disaggregates the CRI ATT by state. All three states show a statistically significant, positive programme effect on climate resilience, but the magnitude varies considerably: the effect is largest in Benue (+14.760 points, $p < 0.0001$), intermediate in Ebonyi (+9.061 points, $p < 0.0001$), and smallest though still significant in Ogun (+4.844 points, $p = 0.0030$). This is consistent with the state's already relatively high baseline financial inclusion. Ogun records the highest South-West financial-inclusion rates nationally, with EFInA's national A2F survey showing the South-West region recording the country's highest formal-inclusion rate at 95 percent (EFInA, 2023), such that additional programme-driven inclusion has diminishing marginal returns on resilience in that state. The qualitative record supports a complementary explanation: farmers in Ogun reported that produce prices had fallen sharply between planting seasons, pointing to output-market and price frictions rather than a lack of financial access as the more binding constraint on welfare gains in that state. This reinforces a recurring theme in the development-finance literature: financial inclusion is a necessary but insufficient condition for resilience where market, price and infrastructural frictions dominate (Arowolo et al., 2024).

Table 21: State-Level Programme ATT on the Climate Resilience Index (Method A)

State	N matched pairs	ATT (CRI)	p-value	Sig.
Benue (North Central)	44	+14.760	<0.0001	***
Ebonyi (South East)	51	+9.061	<0.0001	***
Ogun (South West)	51	+4.844	0.0030	***
Pooled (all states)	146	+9.305	<0.0001	***

Note. *** $p < 0.01$.

Source: Field Survey Data (2026).

4.14.1 State-Level Heterogeneity for Programme Effectiveness

This state-level pattern, a programme effect that is statistically significant in all three states but more than three times larger in Benue than in Ogun initially appears counter-intuitive when set against the qualitative cross-case evidence. The qualitative record rates Benue's "effectiveness of existing initiatives" theme comparatively low, reflecting a concentration of "no programme support" responses in one Benue community and independent corroboration from a Benue extension agent that no active financial-inclusion programme operated there beyond an unrelated input-distribution scheme.

“Not at all, nothing from them, nothing.”

— FGD4, Kwande, Benue State

“There is no formal financial services in the community; however, we have informal financial services such as BAM and local cooperatives.”

— KII2, Extension Agent, Benue State

Benue's qualitative data also describe an unusually sharp internal split strong programme presence and positive appraisal in one community, set directly against total absence of any programme, or of financial infrastructure at all, in others, the coping response described was purely philosophical.

“There is nothing we can do because it's natural; we only reduce food consumed by the family.”

— FGD5, Tarka, Benue State

“VCDP is highly effective, we have access to agricultural input, and as women the cooperative helps us to save money.”

— KII3, Women Leader, Obagaji, Benue State

A state with this kind of stark within-state contrast between well-served and entirely unserved communities is likely to produce a larger beneficiary–non-beneficiary gap than a state where programme reach is more evenly and moderately distributed, which is closer to the pattern described in Ogun. In other words, Benue's comparatively low qualitative prevalence rating on the effectiveness theme is driven by genuine non-coverage in specific communities, and it is precisely that non-coverage which leaves an unusually under-served comparison group that produces the largest measured treatment effect where the programme is, in fact, present. This

same mechanism is visible quantitatively where Benue's Social Safety Nets component nearly doubles between non-beneficiaries and beneficiaries.

Case Study 2: A Women Champion Driving Resilience



When Mrs Esther Mbam joined the Value Chain Development Programme (VCDP) in the Noyo Cluster of Ikwo Local Government Area, Ebonyi State, she stepped into roles that would transform not only her own life but her entire community. Serving as the Chairperson of Women Networking in Nkwo LGA, Treasurer of the Okpoduma Multipurpose Cooperative and Vice President of the State Women Networking, Esther was trained as a Gender Action Learning System (GALS) champion, a role through which she has systematically dismantled traditional barriers for women in agriculture.

Prior to the program, cultural norms limited women's participation in decision-making and business. Through GALS training, Esther began advocate-teaching in her community, showing families that financial cooperation between spouses strengthens households. She encouraged men to support domestic workloads and empowered women to gain financial independence.

The true test of this financial and social empowerment came during severe environmental shocks. In 2020, major flooding destroyed Esther's rice crops. Rather than suffering total financial ruin, her involvement with VCDP enabled a swift recovery:

Micro-Credit Recovery: Esther accessed a ₦150,000 emergency loan directly from her Okpoduma Cooperative, allowing her to replant and rebuild her farm without delay.

Disciplined Savings (*Isusu*): Guided by VCDP financial literacy principles—dividing income into business reinvestment, personal earnings, and secondary investments—Esther relies on a structured *isusu* model. Members contribute capital and earn interest payouts (₦1,000 interest per ₦10,000 borrowed) distributed annually to cushion against unexpected losses.

Asset Accumulation: By saving farm yields and program travel stipends, Esther purchased a Honda motorcycle in 2022 to facilitate agricultural transport, while enabling fellow women in her group to acquire assets of their own.

Esther's journey demonstrates how pairing targeted gender-equity frameworks like GALS with community-driven financial inclusion equips rural women with the financial security and confidence needed to withstand climate shocks and lead local economic development.

Today, all 37 members of her women's group actively run their own micro-enterprises. Furthermore, her mentorship challenged local prejudices against educating female children, inspiring families to support education for all their youth.

Ogun's smaller, though still statistically significant, ATT (+4.844, $p=0.0030$) has a different and more concerning qualitative explanation. Ogun is the state where informants surface open dissent on programme design rather than simple absence: one lead farmer was the only key informant, of all thirteen interviewed, to attribute limited effectiveness specifically to loan-product design short tenure, high interest rates, and inadequate grace periods rather than to access alone, and a women's leader separately flagged data scarcity and limited access to large-scale climate finance as an institutional-level gap.

“Rural women have access to financial services same as men, but the challenge is the relatively higher interest rate charge and collateral.”

— **KII12, Lead Farmer, Odogbolu, Ogun State**

“Critical gaps remain, such as limited access to large-scale climate finance, data scarcity, and evaluation.”

— **KII10, Women Leader, Owode, Ogun State**

Several Ogun informants also raised low literacy, limited technical know-how, and poor record-keeping as a barrier distinct from the documentation and collateral demands raised elsewhere.

“Knowledge gap; no proper record keeping.”

— **KII12, Lead Farmer, Odogbolu, Ogun State**

“Low level of literacy.”

— **KII13, Extension Agent (ADP), Ogun State**

Altogether, Ogun's comparatively muted quantitative effect looks less like a state where the programme is simply absent, as in parts of Benue, and more like a state where the programme is present but underperforming on design and targeting grounds, a distinction with direct implications for whether the appropriate policy response is expanding coverage (Benue) or redesigning loan terms and strengthening farmer-side capacity support (Ogun). This same design-versus-coverage distinction is visible in the descriptive TFP results: Ogun's modest crop-productivity gain sits alongside a comparatively strong Basic Services score but the weakest Asset and Social Safety Nets scores among beneficiaries, suggesting infrastructure alone is not translating into resilience or productivity gains at the same rate as in Benue and Ebonyi.

4.15 Sensitivity Analysis: Bonferroni Correction for Multiple Testing

Because testing many outcomes and many service combinations raises the risk of identifying statistically significant results by chance, a Bonferroni correction was applied to two families of tests. Of 40 ATT significance tests spanning ten outcomes and up to four matching/weighting methods, 12 are significant at the conventional $p<0.05$ threshold and 11 remain significant after Bonferroni correction. Of the 27 individual financial-service-combination regressions on the CRI (Objective 1), 19 are significant at $p<0.05$ and 15 remain

significant after correction. The results that survive Bonferroni correction are: the Climate Resilience Index; the FII×CRI interaction (synergy); and food security.

4.15.1 Average Treatment on the Treated Battery (40 Tests)

Family-wise error correction was applied across all 40 ATT significance tests reported in Table 22 (10 outcomes x up to 4 test statistics per outcome: paired t-test and Wilcoxon for Method A, plus Method B and Method C). The Bonferroni-adjusted significance threshold is $p < 0.00125$ on the raw p-value scale ($0.05/40$). Of the 40 tests, 12 are significant at the conventional raw $p < 0.05$ threshold, and 11 remain significant after correction.

The results that survive Bonferroni correction and should therefore be treated as the headline, best-evidenced findings of this study are: the Climate Resilience Index (all four tests survive, adjusted $p < 0.0001$ throughout); food security (all four tests survive, adjusted $p \leq 0.0016$); and the FII×CRI interaction under Methods A (paired t and Wilcoxon, adjusted $p = 0.014$ and 0.017) and Method C (adjusted $p = 0.0007$) though notably not under Method B, whose raw $p = 0.0054$ becomes a non-significant 0.216 once corrected, illustrating exactly the kind of borderline result multiple-testing correction is designed to catch. All other outcomes the Financial Inclusion Index on its own, Overall and Crop TFP, household income, and all three log-transformed robustness checks are not significant even before correction. Findings significant only before correction should be read as suggestive rather than confirmed.

Table 22: Bonferroni-Surviving Combinations by Outcome

Outcome	Survivors (/27)	Most robust combination(s)
Overall Total Factor Productivity	4	Insurance + ATM/Debit (negative)
Crop Total Factor Productivity	4	Insurance + ATM/Debit (negative)
Household income (NGN)	0	(no combination survives)
Food secure (fs_score)	11	Insurance + ATM/Debit; Loan + Insurance (positive)
$\ln(1 + \text{Household income})$	0	(no combination survives)
$\ln(1 + \text{Overall TFP})$	4	Insurance + ATM/Debit (negative)
$\ln(1 + \text{Crop TFP})$	5	Insurance + ATM/Debit (negative)

Note. Bonferroni-adjusted threshold $p < 0.00185$ ($0.05/27$), applied within each outcome's own family of 27 tests.

Source: Field Survey Data (2026)

4.15.2 Impact of Financial-Service Combinations on Climate Resilience

Family-wise error correction was applied across the 27 individual combination-vs-CRI regressions underlying Table 14. The Bonferroni-adjusted significance threshold is $p < 0.00185$ ($0.05/27$). Of the 27 combinations, 15 remain significant after correction. The 15 combinations that survive Bonferroni correction and should be prioritised as the best-evidenced service bundles for building climate resilience are: Insurance + Esusu; Insurance + Mobile money; Insurance + ATM/Debit; Account + Insurance + Esusu; Loan + Insurance; Mobile money + Esusu; Account + Loan + Esusu; Account + Insurance; Account + Esusu; Loan + Esusu; Account + Loan + Insurance; Mobile money + ATM/Debit; Account + Loan; Account + ATM/Debit; and Account + Mobile money (Table 23).

Table 23: Bonferroni-Surviving Combinations by Outcome

Service combination	N	Effect on CRI	Bonferroni p	Sig.
Insurance + Esusu	181	7.42	0.000	***
Insurance + Mobile money	121	6.42	0.000	***
Insurance + ATM/Debit	126	6.89	0.000	***
Account + Insurance + Esusu	296	6.39	0.000	***
Loan + Insurance	115	5.50	0.000	***
Mobile money + Esusu	165	4.30	0.000	***
Account + Loan + Esusu	301	5.56	0.000	***
Account + Insurance	262	4.36	0.000	***
Account + Esusu	293	5.19	0.000	***
Loan + Esusu	157	3.90	0.001	***
Account + Loan + Insurance	275	4.08	0.003	***
Mobile money + ATM/Debit	101	3.88	0.005	***
Account + Loan	267	3.81	0.010	***
Account + ATM/Debit	257	3.71	0.010	**
Account + Mobile money	251	3.59	0.012	**

Source: Field Survey data (2026)

Taken together, the three sensitivity checks in this section converge on a consistent, conservative headline: the programme's best-evidenced, multiple-testing-robust effects are on climate resilience and food security, delivered substantially through insurance-, esusu- and account-centred service bundles.

5. Conclusion

This study set out to examine what bundled financial services drive resilience and establish not simply whether a financial-inclusion programme “worked,” but a more specific and policy-relevant question: what role does financial inclusion itself — measured as an aggregate index (FII), as specific combinations of financial services, and as an interaction with climate resilience (FIIxCRI) — actually play in driving rural women farmers' climate resilience, food security, agricultural productivity and income, and which of these outcomes it drives most reliably. The triangulated quantitative evidence, read alongside the qualitative record, supports a clear and consistent answer: financial inclusion's demonstrated role in this sample is predominantly as a resilience- and food-security-building instrument, and this role depends far more on how financial services are bundled than on how much aggregate access exists.

Considered on its own, the Financial Inclusion Index is a strikingly weak and unstable determinant of every outcome (productivity, income and food security) examined. As a raw, continuous predictor across the full sample, FII does not significantly predict Overall or Crop Total Factor Productivity (TFP), household income, or food security. As a programme effect, the average treatment effect on the treated (ATT) on FII itself is small, not statistically significant, and actually reverses sign across matching methods (+3.20 under Method A, -0.96 under Method B, +4.04 under Method C); at the state level, it is negative in Benue and strongly positive in Ogun. By almost any measure, “becoming more formally financially included,” in the aggregate sense the FII is built to capture, is not where this study finds a confident, direction-stable effect.

Specific combinations of financial services tell a completely different story. Nineteen of the 27 combinations tested are significantly associated with the Climate Resilience Index, 15 of them surviving conservative Bonferroni correction, and insurance-anchored bundles: Insurance + Esusu, Insurance + ATM/Debit, Insurance + Mobile money, Account + Insurance + Esusu — occupy the top of that ranking by a wide margin. The FIIxCRI interaction term itself is one of only three results in the entire ATT battery to survive Bonferroni correction under multiple methods, meaning financial inclusion and climate resilience genuinely reinforce one another as a joint effect to enhance household income, agricultural productivity and food security. The implication is that financial inclusion's causality in this population occurs when bundled: which two or three services a woman holds together — rather than through the volume an aggregate index summarises. A policy or evaluation framework built around raising the FII score in general risks missing the specific, high-leverage bundles that are actually doing the work.

Based on the Bonferroni test, the most robust finding in this study is that financial inclusion through a financial inclusion initiative and through specific service bundles alike raises climate resilience (ATT +9.31 points, $p < 0.0001$, robust across all three methods) and food security (ATT +17.8 percentage points, $p < 0.0001$, likewise robust, and the outcome with the most Bonferroni-surviving combination evidence of all, 11 of 27. Agricultural productivity and

household income show no such pattern. The Overall and Crop TFP ATTs are small, and not statistically significant, household income's ATT is consistently negative but never statistically significant, and either raw or log-transformed income survives Bonferroni correction.

This is not evidence that financial inclusion “fails” on productivity and income; it is evidence that it operates through a different channel than crop intensification. The qualitative record explains the mechanism directly: households with insurance, esusu and mobile-money access describe redirecting funds toward livestock, processing, and trading as a deliberate hedge against climate risk, rather than toward more intensive use of inputs on the same plot.

This diversification account is corroborated by the perception evidence. Beneficiaries are far more likely than matched non-beneficiaries to report that their income and productivity have improved (+16.4% and +27.4% respectively, both highly significant), even though the second objective on the effect of the association between financial inclusion and climate resilience on raw TFP and actual household income measures show no such gain. Rural women’s perceived income increase and perceived productivity increase move together strongly ($r=0.70$, $p=0.8$). It is more likely that welfare is genuinely improving through non-crop channels than a crop-input-based TFP and a narrowly defined income measure do not fully capture this change.

It is therefore concluded that, first, financial inclusion builds climate resilience mainly when services are bundled rather than accessed individually or as an index. Combinations anchored around a formal account, agricultural insurance and esusu-type cooperative thrift consistently and robustly outperform single-product or informal-savings-only combinations in raising the Climate Resilience Index. Second, climate resilience, climate resilience and financial inclusion index interaction (FIIxCRI) rather than the formal Financial Inclusion Index in isolation is the primary channel through which welfare is improved. Third, the matched-comparison (PSM) analysis confirms that any financial inclusion initiative designed such as the VCDP has the potential to genuinely and causally raise resilience and food security among its beneficiaries, but this effect is unevenly distributed geographically: strongest in Benue and Ebonyi and weakest in Ogun and appears to operate mainly through the cooperative structure, input, infrastructure and training components rather than through the formal financial-inclusion index per se.

A further, cross-cutting conclusion concerns agricultural insurance specifically: it is the single most consistent driver of both resilience and food-security gains across virtually every model specification, yet it remains almost universally unused outside donor-subsidised pockets such as Ebonyi, where 6 percent of any counterpart funding allocated to beneficiaries in 2025 covers insurance.

6. Policy Implications and Recommendations

The recommendations follow directly from the study's finding: financial inclusion's demonstrated value for these rural women farmers lies chiefly in building climate resilience and food security through the right combination of services, not in expanding access in the aggregate or in expecting it, alone, to raise crop productivity or income. They are organised around how to act on that relationship rather than around whether the existing programme succeeded.

1. Design and Fund Financial-Inclusion Packages Around Proven Combinations, Not Aggregate Access Targets

Programme design and M&E frameworks that target “percentage of women with a financial service” or an aggregate FII score risk investing in access that does not translate into resilience. The 15 Bonferroni-robust combinations most strongly associated with the Climate Resilience Index identified and no single-service rollout should be the object of programme targets and budgets. Concretely:

- Prioritise insurance-anchored bundling. Insurance appears in every one of the four highest-performing combinations (Insurance + Esusu, Insurance + ATM/Debit, Insurance + Mobile money, Account + Insurance + Esusu). Closing this specific gap through simplified enrolment, clear claims processes, and paired financial-literacy support is the highest-leverage single action available to programme designers.
- Build on, rather than displace, existing informal structures. Esusu/cooperative membership appears in most top-performing combinations and is already the dominant financial behaviour across all three states; formalising a savings account or mobile-money product alongside an existing cooperative is a lower-friction path to a proven bundle than introducing an entirely new formal-sector product.
- Address the specific fund-mismanagement risk in group-based savings, since this is the qualitative account for why standalone-savings combinations lacking an insurance or account anchor underperform in Table 14 (several turning negative). Independent oversight, transparent record-keeping and, where feasible, digital tracking of group funds would let cooperative-anchored bundles retain their strong resilience association without the leakage risk informants describe.

2. Do Not Expect Financial Inclusion Alone to Raise Productivity or Income- Pair it with Production-Side Investment

Because insurance-anchored financial inclusion is robustly associated with lower, not higher, land-based Total Factor Productivity, any initiative whose objective includes raising crop yields or farm income should not rely solely on financial-service access as its primary instrument. It is important that:

- Where raising crop productivity is a genuine financial inclusion initiative goal, pair financial inclusion with direct production-side investment: input subsidies, irrigation infrastructure, and climate/weather advisory services rather than expecting savings or insurance access to substitute for them. This is precisely what farmers and institutional informants converge on requesting.
- Where diversification into livestock, processing, or trade is instead the household's revealed strategy for managing climate risk, programmes should support that strategy explicitly through processing/value-addition equipment and access to livestock inputs rather than treating a falling crop-TFP ratio as a policy failure.

3. Build Resilience and Inclusion Together, Not Sequentially - Leverage the FIIxCRI Synergy

The FIIxCRI interaction term is one of the few results in the entire ATT battery to survive Bonferroni correction under multiple methods, indicating that financial inclusion and climate resilience are genuinely complementary: their combined effect exceeds what either delivers alone. This argues against a sequenced approach (“first expand financial access, then separately build climate resilience”) in favour of jointly bundled interventions that build both at once, which is, in practice, the VCDP/IFAD model already operating with the strongest qualitative endorsement in this study, combining input/training support with cooperative savings access in a single package.

Scaling this bundled model rather than a stand-alone financial-product rollout is the most direct way to act on the FIIxCRI finding.

4. Differentiate the Financial-Inclusion Strategy by State Context

The result has shown that “more financial inclusion” means something different in each state, and the policy response should differ accordingly:

- Benue: the resilience gain here travels through training, inputs and cooperative savings, largely independent of formal-account access, and specific communities remain entirely unserved. The priority is expanding coverage of the existing bundled (VCDP/IFAD-style) model to those communities, not deepening formal financial products where the model already reaches.
- Ogun: formal financial access (FII) is already the strongest of the three states and rising fastest under the programme, yet climate-resilience and food-security gains are the smallest food security's point estimate is the only negative one in the sample. The priority here is conversion, not access: redesigning loan terms (tenure, interest rate, grace periods) that Ogun's own lead farmer identifies as the binding constraint, and pairing existing formal access with the literacy and record-keeping support that three of Ogun's four newly incorporated key informants independently flag as missing.

- Ebonyi: both CRI and FII rise strongly, but Overall TFP falls significantly, the clearest single-state case of the diversification-away-from-crop-productivity pattern. Programming here should explicitly recognise and support diversification (processing, livestock) as a legitimate adaptation outcome rather than treating the TFP decline as an unintended failure, while ensuring input access remains available for households that wish to continue intensifying crop production.

5. Redirect Monitoring, Evaluation and Future Research Toward Combinations and Disaggregated Welfare

- Track combination-level indicators, not just the aggregate FII, in routine M&E. An aggregate index that rose or fell would not, on its own, tell a programme manager whether the underlying combinations shifting were the resilience-building ones or the productivity-depressing ones both can move an aggregate FII in the same direction while having opposite implications for welfare.
- Disaggregate income and productivity measurement by source (crop, livestock, processing, off-farm trade) in future data collection. The objective/perceived divergence is most plausibly a measurement artefact of a crop-input-based TFP ratio and an income measure that may not fully capture diversification income; disaggregated tracking would let future evaluations distinguish a genuine null productivity effect from a channel the current instruments cannot see.
- Retain insurance as a tracked indicator even where uptake is low, rather than dropping it for low variance. Its outsized association with both climate resilience and food security, despite near-universal non-uptake in the qualitative record, makes it the single highest-priority variable to monitor and expand, not the most dispensable one.
- Reach women directly rather than through intermediaries prone to delay or fund mismanagement, a recommendation raised independently by farmer and institutional informants alike, and one that speaks directly to the fund-mismanagement risk.

6. Mobile Money Companies and DFIs Should Integrate Insurance into their Product Packages

This study finds that Insurance + Mobile Money is among the strongest combinations for raising both climate resilience (+6.42 points on the CRI, $p < 0.001$) and food security (coefficient = 0.26, $p < 0.001$), yet actual uptake of this specific combination remains modest outside Ebonyi, and mobile money penetration itself is markedly uneven across states (from 2.08 percent among Ebonyi beneficiaries to 54.90 percent among Ogun beneficiaries). This gap between demonstrated impact and actual uptake represents a substantial, low-hanging opportunity.

- Mobile money operators, fintech providers and Development Finance Institutions (DFIs) serving rural and agricultural markets should integrate insurance directly into their core

product offering rather than treating it as a stand-alone, separately marketed add-on. Mobile network operators and mobile-money platforms already possess the distribution rails, agent networks, transaction data and customer trust needed to embed micro-insurance products at the point of a savings deposit, loan disbursement or input purchase precisely the model that has driven scale in comparable markets, where mobile-enabled index insurance has been shown to sharply lower the historically prohibitive distribution and claims-verification costs that have kept indemnity-based agricultural insurance out of reach for smallholder farmers.

- Embedding a low-cost, opt-out (rather than opt-in) climate-index insurance product into mobile money wallets, agricultural loan disbursements, or DFI-backed value-chain financing packages with premiums deducted automatically from transaction flows or loan proceeds would directly extend the resilience-boosting insurance-bundle effect identified in this study to the much larger population of rural women who already transact via mobile money but currently hold no insurance.
- Given that women farmers frequently cite spousal-authorisation requirements and physical distance to bank branches as barriers to formal credit, a mobile-first, digitally embedded insurance product also sidesteps specific access barriers identified as gendered constraints.

References

- Abraham, T. W. and Fonta, W. M. (2018). Climate change and financing adaptation by farmers in Northern Nigeria. *Financial Innovation*, 4(11).
<https://link.springer.com/article/10.1186/s40854-018-0094-0>
- Adegbite, O. O. (2020). Bridging the financial inclusion gender gap in smallholder agriculture in Nigeria. *World Development*, 130, 104935.
- Adegbite, O. O., & Machethe, C. L. (2020). Bridging the financial inclusion gender gap in smallholder agriculture in Nigeria: An untapped potential for sustainable development. *World development*, 127, 104755. DOI: 10.1016/j.worlddev.2019.104755.
- Agarwal, B. (2022). Gender equality, food security, and the sustainable development goals. *Current Opinion in Environmental Sustainability*, 53, 101–108.
<https://doi.org/10.1016/j.cosust.2022.101108>
- Arowolo, A. O., Aminu, R. O., Ibrahim, S. B., & Emmanuel, A. E. (2024). Does financial inclusion influence the adoption of climate change adaptation strategies among smallholder farmers? Evidence from Oyo State, Nigeria. *UNIZIK Journal of Agricultural Economics and Extension*, 1(2), 296–304.
- Aterido, R., Beck, T., & Iacovone, L. (2013). Access to finance in Sub-Saharan Africa: Is there a gender gap? *World Development*, 47, 102–120.
<https://doi.org/10.1016/j.worlddev.2013.02.013>
- Ayanlade, A., Oladipo, F. O., & Olaniyan, O. (2023). Climate change impacts and adaptation strategies among rural farmers in Nigeria. *Environmental Development*, 45, 100799.
<https://doi.org/10.1016/j.envdev.2022.100799>
- Ayanlade, A., Radeny, M., & Morton, J. F. (2017). Comparing smallholder farmers' perception of climate change with meteorological data: A case study from southwestern Nigeria. *Weather and Climate Extremes*, 15, 24–33.
<https://doi.org/10.1016/j.wace.2016.12.001>
- Ayanlade, A., Radeny, M., & Morton, J. F. (2023). Gender dimensions of climate change adaptation among smallholder farmers in Sub-Saharan Africa. *Environmental Research Letters*, 18(4), 045002. <https://doi.org/10.1088/1748-9326/acb27b>
- Ayinde, O. E., Olatunji, O. O., & Olabode, A. D. (2023). Determinants of weather index insurance adoption among smallholder farmers in Nigeria. *Journal of Development and Agricultural Economics*, 15(2), 79–88. <https://doi.org/10.5897/JDAE2023.1371>
- Bakare, A. Y. (2023). Impacts of microcredit access on climate change adaptation and yields among rice farmers. *Climate and Development*.
- Begho, T. (2025). Agricultural resource access, decision-making and climate-smart practice adoption. *Frontiers in Sustainable Food Systems*.

Boka, G. T. (2017). Measuring resilience to climate change in Ethiopian. African Development Bank Working Paper, 268.

Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. Institute of Development Studies (IDS Discussion Paper 296).

Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). John Wiley & Sons.

Cornwall, A. (2016). Women's empowerment: What works? *Journal of International Development*, 28(3), 342–359. <https://doi.org/10.1002/jid.3210>

Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19. World Bank.

Dercon, S., Hill, R. V., Clarke, D., Outes-Leon, I., & Seyoum Taffesse, A. (2014). Offering rainfall insurance to informal insurance groups: Evidence from a field experiment in Ethiopia. *Journal of Development Economics*, 106, 132–143. <https://doi.org/10.1016/j.jdeveco.2013.09.006>

DFID. (1999). *Sustainable Livelihoods Guidance Sheets*. Department for International Development.

Dibakoane, M., Antwi, M., & Oladele, O. (2022). Gendered access to resources and climate change adaptation strategies in sub-Saharan Africa: A review. *Climate and Development*, 14(7), 639–651. <https://doi.org/10.1080/17565529.2021.1928071>

Dibakoane, M., Nhamo, G., & Mpandeli, S. (2022). Gender, climate change and agricultural productivity in South Africa. *Sustainability*, 14(10), 5896. <https://doi.org/10.3390/su14105896>

Dogan, E., Madaleno, M., & Taskin, D. (2021). Which households are more energy vulnerable? Energy poverty and financial inclusion in Turkey. *Energy Economics*, 99, 105306. <https://doi.org/10.1016/j.eneco.2021.105306>

Eissler, S., & Heckert, J. (2024). Evaluation of the value chain development program in Nigeria: Qualitative findings (IFPRI Discussion Paper 2234). International Food Policy Research Institute. <https://hdl.handle.net/10568/137795>

Ellis, F., & Freeman, H. A. (2004). Rural livelihoods and poverty reduction strategies in four African countries. *Journal of Development Studies*, 40(4), 1–30. <https://doi.org/10.1080/00220380410001673175>

Enhancing Financial Innovation & Access - EFInA. (2023). *Access to financial services in Nigeria 2023 survey – Key highlights report*.

Enhancing Financial Innovation & Access (EFInA). (2019). *EFInA Access to Financial Services in Nigeria 2018 survey: Key findings*. EFInA. <https://a2f.ng>

Enhancing Financial Innovation and Access [EFInA]. (2023). *Access to Financial Services in Nigeria (A2F) 2023 Survey: Unlocking insights to accelerate financial and economic inclusion*. EFInA.

- FAO. (2024). *The unjust climate: Gendered impacts of climate change on rural households*. Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization (FAO). (2021). The state of food and agriculture 2021: Making agri-food systems more resilient to shocks and stresses. FAO.
- Food and Agriculture Organization of the United Nations (FAO). (2016). *RIMA-II: Resilience Index Measurement and Analysis – II*. FAO. <https://www.fao.org/3/i5665e/i5665e.pdf>
- Food and Agriculture Organization of the United Nations [FAO]. (2023). The status of women in agrifood systems. FAO. <https://doi.org/10.4060/cc5343en>
- Food and Agriculture Organization of the United Nations. (2011). *The state of food and agriculture 2010–2011: Women in agriculture—Closing the gender gap for development*. FAO. <https://www.fao.org>
- Ibrahim, S., Omonitan, M., Aminu, R., Oyawole, F., Arowolo, A., & Ayinde, I. (2022). Adaptive capacity to climate change and food security among farm households in Southwest Nigeria. *Economics of Agriculture*, 69(3), 777–791. <https://doi.org/10.5937/ekoPolj2203777S>
- Ifeanyi-obi, C.C., Abuta, C.M., Onwusika, A.I., Oghenekaro, L.U., Adesope, O.M., Obafemi, A.A (2022). Strengthening climate change adaptive capacity of rural women crop farmers through reduced social exclusion in Nigeria. Policy Brief No. 1.
- Intergovernmental Panel on Climate Change (IPCC). (2022). Sixth assessment report: Impacts, adaptation, and vulnerability. Cambridge University Press.
- Karlan, D., Osei, R., Osei-Akoto, I., & Udry, C. (2014). Agricultural decisions after relaxing credit and risk constraints. *Quarterly Journal of Economics*, 129(2), 597–652. <https://doi.org/10.1093/qje/qju002>
- Karlan, D., Osei, R., Osei-Akoto, I., & Udry, C. (2014). Agricultural decisions after relaxing credit and risk constraints. *The Quarterly Journal of Economics*, 129(2), 597–652. <https://doi.org/10.1093/qje/qju002>
- Klapper, L., El-Zoghbi, M., & Hess, J. (2022). Financial inclusion and women’s resilience in Sub-Saharan Africa. World Bank.
- Klapper, L., Saniya A., Jake H., and Dorothe S. (2019). Sub-Saharan Africa Series: Identification, Financial Inclusion and Development in Sub-Saharan Africa. World Bank Findex Note 4.
- Madaki, M. Y., Kaechele, H., & Bavorova, M. (2023). Agricultural insurance as a climate risk adaptation strategy in developing countries: A case of Nigeria. *Climate Policy*, 23(6), 747–762. <https://doi.org/10.1080/14693062.2022.2140102>
- National Bureau of Statistics (NBS), & World Bank. (2019). *Nigeria General Household Survey-Panel (GHS-Panel) 2018/2019, Wave 4* [Data set]. World Bank Living Standards Measurement Study. <https://doi.org/10.48529/1hgw-dq47>

National Bureau of Statistics (NBS). (2023). Labour force and agriculture sector contribution report. Abuja, Nigeria.

Negera, M., Alemu, T., Hagos, F., & Hailelassie, A. (2025). Does financial inclusion enhance farmers' resilience to climate change? Evidence from rural Ethiopia. *Sustainable Development*, 33(2), 3008-3022. <https://doi.org/10.1002/sd.3277>

Notta, S. (2023). Bolstering women's climate resilience and financial inclusion: Evidence from Nigeria. Consultative Group to Assist the Poor (CGAP) Working Paper.

Panman, A., Madison, I., Kimacha, N. N., & Falisse, J.-B. (2022). Saving up for a rainy day? Savings groups and resilience to flooding in Dar es Salaam, Tanzania. *Urban Forum*, 33(1), 13–33. <https://doi.org/10.1007/s12132-021-09424-w>

Pienaaah, C. K. A., & Luginaah, I. (2024). The impact of village savings and loan associations as a financial and climate resilience strategy for mitigating food insecurity in Northern Ghana. *Risks*, 12(4), 58. <https://doi.org/10.3390/risks12040058>

Razavi, S., & Miller, C. (1995). *From WID to GAD: Conceptual shifts in the women and development discourse*. UN Research Institute for Social Development.

Scoones, I. (1998). Sustainable rural livelihoods: A framework for analysis. *Institute of Development Studies Working Paper* 72.

Sochas, M., Mafogo, M., Sibanda, F., & Essa, N. (2024, November 8). How savings groups help build climate resilience. *OG Research & Conservation*. <https://ogresearchconservation.org/how-savings-groups-help-build-climate-resilience/>

Statista, 2023. <https://www.statista.com/topics/6729/agriculture-in-nigeria/#topicOverview>
Tanner, T., Lewis, D., Wrathall, D., Bronen, R., Cradock-Henry, N., Huq, S., ... Thomalla, F. (2015). Livelihood resilience in the face of climate change. *Nature Climate Change*, 5(1), 23–26. <https://doi.org/10.1038/nclimate2431>

USDA (2006). Food Security in the U.S. – Measurement. <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/measurement>

Women's World Banking. (2024). *Insights for action: Building rural women's financial resilience towards climate change*. <https://www.womensworldbanking.org/insights/insights-for-action-building-rural-womens-financial-resilience-towards-climate-change/>

World Bank (2019). *Agriculture Finance Diagnostic: Zambia*. 2019: World Bank.

World Bank. (2022). *The global finindex database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19*. World Bank. <https://www.worldbank.org>

World Bank. (2022). The Global Finindex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19. World Bank.

World Bank. (2023). World Bank report on gender gap and access to financial services]. Retrieved from <https://www.worldbank.org/en/home> ([#2, #7, #9, #15, #19])

World Bank. (2023). Gender equality and development report 2023. World Bank.

World Bank. (2025). The Global Findex Database 2025: Connectivity and financial inclusion in the digital economy. World Bank. <http://hdl.handle.net/10986/43438>

Wuddasie, D. B. (2023). Enhancing farmers' resilience to climate change-induced impacts through financial inclusion in Sidama region, southern Ethiopia. *Climate and Development*, 15(9), 1–13. <https://doi.org/10.1080/17565529.2023.2203675>

Zetterli, P. (2023). “Climate Adaptation, Resilience, and Financial Inclusion: A New Agenda.” Focus Note. Washington, D.C.: CGAP. <https://www.cgap.org/research/publication/climate-adaptation-resilience-and-financial-inclusion-new-agenda>.

Appendices

Appendix A. Determinants of Account Ownership among Women in Nigeria

Table A presents the determinants of account ownership among women in Nigeria.

Table A. Determinants of Account Ownership among Women in Nigeria

Account ownership	Coef.	St.Err.	Sig
Household size	1.01	0.021	
House ownership	1.125	0.100	
Marital status	-0.699	0.055	***
Educational Level (years)	1.071	0.007	***
<u>Reasons for no banking/ formal financial inclusion</u>			
Interest earned	1.146	0.270	
High loan interest	1.094	0.275	
Expensive to operate	1.025	0.160	
Minimum balance is high	0.652	0.195	
Too much documentation	0.997	0.166	
Charges or fees are high	0.874	0.210	
High cost	-0.796	0.092	**
Distance to bank	-0.781	0.073	***
Lack of trust	0.874	0.146	
Corruption	0.708	0.211	
No ID document	1.035	0.140	
No literacy	0.968	0.128	
Fraud	1.039	0.295	
Mobile phone use	1.245	0.102	***
Bank branch close to home	1.021	0.231	
Service agents close to home	1.699	0.126	***
ATMs close to home	1.009	0.261	
Regional dummies			
North Central	1.053	0.146	
North East	0.933	0.136	
North West	0.915	0.125	
South East	0.822	0.144	
South South	1.076	0.159	
Mean dependent var	0.33	SD dependent var	0.469
Pseudo r-squared	0.06	Number of obs	4187
Chi-square	300.67	Prob > chi2	0.000
Akaike crit. (AIC)	5045.77	Bayesian crit. (BIC)	5216.94

Source: Access to Finance Survey, 2026

Appendix B. Extended Ranking of Financial-Service Combinations Tested Against the Climate Resilience Index

Table B extends Table 14 by reporting the ten lowest-ranked financial-service combinations of the 27 tested against the Climate Resilience Index (Objective 1), illustrating the negative end of the distribution in Table 15. The remaining seven combinations tested are omitted here for brevity but are consistent in pattern with those shown.

Table B. Ten Lowest-Ranked Financial-Service Combinations by Effect on the Climate Resilience Index

Service combination	N	Effect on CRI	p-value	Survives Bonferroni?
Esusu + ATM/Debit	59	+3.30	0.0142	No
Loan + Mobile money	80	+3.10	0.0138	No
Loan + ATM/Debit	104	+2.92	0.0098	No
Savings + Mobile money	205	+1.43	0.1341	No
Savings + Loan + Insurance	279	−0.94	0.3910	No
Account + Savings	305	−0.46	0.7453	No
Savings + Insurance	266	−1.61	0.1254	No
Savings + Esusu	314	−2.37	0.1616	No
Savings + ATM/Debit	267	−2.47	0.0232	No
Savings + Loan	261	−1.95	0.0636	No

Note. Sorted from highest to lowest effect within this subset. None of these ten combinations survives Bonferroni correction. Source: Author's analysis of the full 27-combination screening underlying the PSM Methodology and Results Report.

Appendix C. Key Variable Definitions

Variable	Definition
Climate Resilience Index (CRI)	Composite 0–100 index of a respondent's self-reported capacity to cope with and adapt to climate-related shocks.
Financial Inclusion Index (FII)	Composite 0–100 index of financial-service penetration, availability, and usage, following Sarma (2012).
FII × CRI	Interaction term capturing the joint/synergistic association of financial inclusion and climate resilience with an outcome.
Overall/Crop Total Factor Productivity (TFP)	Efficiency-adjusted measure of agricultural output relative to combined inputs, calculated for overall farm output and for crop output specifically.
Household income	Sum of remittances, wage/salary earnings, and total farm revenue (Nigerian Naira, NGN).
Food secure (fs_score)	Binary indicator equal to 1 if the household is classified as food secure.
Average Treatment effect on the Treated (ATT)	The average difference in an outcome between programme beneficiaries and their statistically matched non-beneficiary counterparts.