World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(Review Article)

The role of microfinance in promoting climate-smart agricultural practices among smallholder farmers

Nasiru Liman Zuru * and Nafisa Usman

[1] *Faculty of Management Science, Usmanu Danfodiyo University Sokoto, Nigeria.*
[2] *Salford Business School, University of Salford, Manchester, UK.*

World Journal of Advanced Research and Reviews, 2026, 31(01), 368–373

Publication history: Received on 20 March 2026; revised on 22 May 2026; accepted on 25 May 2026

Article DOI: https://doi.org/10.30574/wjarr.2026.31.1.1138

Abstract

This paper explores the impact of microfinance on the adoption of climate-smart agriculture (CSA) technologies among smallholder farmers. Evidence indicates that access to microcredit strongly facilitates the activity of sustainable farming practices, such as drought-resistant seeds, flood control measure and effective irrigation. By easing financial constraints, microfinance enables farmers to invest in technologies that enhance productivity while mitigating environmental risks. Findings suggest a very strong relationship between microfinance access and CSA adoption. Policy recommendations emphasize the need for targeted financial products, technical support, and capacity-building initiatives to maximize the benefits of microfinance in promoting climate-smart agriculture.

Keywords: Microfinance; Climate-Smart Agriculture; Smallholder Farmers; Technology Adoption; Sustainable Agriculture

1. Introduction

Climate change has become one of the most significant threats to agricultural productivity and rural livelihoods in developing economies. Increasing temperature variability, unpredictable rainfall patterns, and frequent extreme weather events continue to undermine agricultural output, particularly among smallholder farmers who rely heavily on rain-fed agriculture. According to the Intergovernmental Panel on Climate Change (IPCC, 2022), climate variability is expected to further intensify food insecurity in Sub-Saharan Africa if adaptive measures are not widely adopted.

In response, Climate-Smart Agriculture (CSA) has emerged as a globally recognized framework designed to achieve three interlinked objectives: (i) sustainably increasing agricultural productivity, (ii) enhancing resilience and adaptation to climate change, and (iii) reducing greenhouse gas emissions where possible (FAO, 2013). CSA technologies include drought-resistant crop varieties, conservation agriculture, precision irrigation systems, agroforestry practices, and improved soil and water management techniques.

Despite its potential, the adoption of CSA practices remains limited among smallholder farmers due to structural and financial constraints. The high upfront cost of CSA technologies, coupled with limited access to formal financial services, constrains investment decisions in rural agricultural systems. The World Bank (2020) and IFAD (2021) consistently report that access to finance remains one of the most binding constraints to agricultural modernization in developing regions.

Within this context, microfinance institutions (MFIs) play a critical role in bridging financial gaps for rural households. By providing microcredit, savings mobilization, and in some cases micro-insurance services, MFIs enable resource-

* Corresponding author: Nasiru Liman Zuru

constrained farmers to invest in productivity-enhancing and climate-resilient technologies. The theoretical foundation for this role is grounded in credit constraint theory, which posits that imperfect capital markets prevent efficient investment in productive assets, particularly among low-income households (Stiglitz & Weiss, 1981).

Empirical and policy discussions increasingly suggest that microfinance may not only improve income generation but also serve as an enabling mechanism for climate adaptation. However, the extent to which microfinance directly influences the adoption of CSA practices remains underexplored in many developing country contexts, particularly in Sub-Saharan Africa.

This study therefore examines the role of microfinance in promoting the adoption of climate-smart agricultural practices among smallholder farmers. Specifically, it investigates how access to microcredit influences farmers' investment decisions in CSA technologies and the resulting implications for productivity and climate resilience.

2. Literature review

Climate-Smart Agriculture (CSA) has emerged as a globally recognized approach aimed at transforming agricultural systems in response to climate variability. It integrates three core objectives: increased productivity, enhanced resilience, and reduced greenhouse gas emissions (FAO, 2013). Recent global assessments confirm that smallholder farmers remain the most vulnerable group to climate shocks due to their dependence on rain-fed agriculture and limited access to adaptive technologies (IPCC, 2022; World Bank, 2024).

Empirical evidence shows that CSA adoption is increasingly being promoted as a key pathway to sustainable food systems in developing economies. For example, the World Bank reports that climate-smart interventions have supported millions of farmers globally in adopting improved agricultural technologies, resulting in measurable gains in productivity and resilience across multiple countries (World Bank, 2024).

A large body of literature establishes that access to finance is a critical determinant of agricultural technology adoption. According to IFAD (2021), rural financial exclusion remains a major barrier to agricultural transformation in developing regions. Microfinance institutions (MFIs) play a key role in addressing this constraint by providing small-scale credit that enables farmers to invest in productivity-enhancing inputs.

From a theoretical standpoint, this aligns with credit constraint theory, which argues that imperfect financial markets prevent efficient investment by resource-constrained households (Stiglitz & Weiss, 1981). Empirical studies across Africa and Asia consistently confirm this relationship.

In Sub-Saharan Africa, studies in countries such as Nigeria, Kenya, and Ghana show that access to microcredit increases the likelihood of adopting improved seeds, irrigation systems, and soil conservation techniques. Similarly, in South Asia, microfinance participation has been associated with diversification of cropping systems and adoption of integrated soil fertility management practices (Hossain & Bayes, 2021; FAO & World Bank, 2015).

However, a key insight emerging from recent literature is that microfinance does not operate in isolation. Its impact is often mediated by access to extension services, climate information, and institutional support systems (FAO, 2017).

Empirical studies in Africa consistently demonstrate that CSA adoption remains uneven and constrained by financial, informational, and institutional barriers. A systematic review of CSA adoption in African countries shows that financial capacity, education level, and access to advisory services are among the strongest determinants of adoption behavior among smallholder farmers (Silva et al., 2024; FAO, 2022).

Country-level evidence further supports this pattern. In Nigeria and Senegal, farmers with better access to financial services and agricultural extension support are significantly more likely to adopt CSA practices such as crop rotation, conservation tillage, and improved water management systems (Ariom et al., 2022; Ewulo et al., 2025). These findings reinforce the argument that financial inclusion mechanisms, particularly microfinance, play a catalytic role in enabling climate adaptation at the farm level.

Recent FAO assessments further emphasize that CSA adoption in Africa is strongly influenced by access to affordable financing mechanisms and locally adapted technologies, highlighting the importance of integrating financial and technical interventions (FAO, 2024).

In Asia, particularly in India, Bangladesh, and Vietnam, microfinance and rural credit programs have demonstrated strong effects on agricultural modernization and climate adaptation. Studies show that farmers with access to rural credit are more likely to invest in irrigation infrastructure, high-yield varieties, and climate-resilient farming systems.

For instance, large-scale agricultural development programs supported by multilateral institutions have shown that combining finance with technology dissemination significantly increases adoption rates and productivity outcomes among smallholder farmers (World Bank, 2024). In Vietnam, climate-smart rice farming supported by financial and technical interventions has resulted in substantial improvements in yield and resource efficiency.

Comparatively, Asian countries tend to exhibit higher CSA adoption rates due to stronger integration of financial systems, extension services, and government-led agricultural modernization programs. In contrast, many African contexts still face fragmented systems where financial access, technology dissemination, and advisory services are not well integrated.

This study is anchored on three complementary theoretical perspectives: Credit Constraint Theory, Diffusion of Innovation Theory, and the Sustainable Livelihoods Framework. These theories jointly explain how microfinance influences the adoption of climate-smart agricultural (CSA) practices among smallholder farmers.

Credit Constraint Theory, rooted in the work of Stiglitz and Weiss (1981), posits that imperfections in financial markets lead to credit rationing, particularly for low-income households who lack sufficient collateral, credit history, or formal financial documentation. As a result, productive but capital-constrained individuals are unable to access funds needed for investment.

In the context of smallholder agriculture, this theory is highly relevant because farmers often operate under liquidity constraints that limit their ability to invest in modern agricultural technologies. Climate-smart agriculture technologies—such as drip irrigation systems, improved seed varieties, and soil conservation infrastructure require significant upfront investment.

Microfinance institutions (MFIs) reduce these constraints by providing small, accessible loans without traditional collateral requirements. By easing liquidity barriers, microfinance enables farmers to reallocate financial resources toward productivity-enhancing and climate-resilient investments.

Thus, Credit Constraint Theory provides the foundational explanation for how access to microcredit (IV) directly influences investment decisions in CSA technologies (DV).

The Diffusion of Innovation Theory, developed by Rogers (2003), explains how new ideas, technologies, and practices spread within a social system over time. Adoption is influenced by factors such as perceived advantage, compatibility, complexity, trialability, and observability.

Climate-smart agricultural practices represent innovations that require behavioral and technical change. However, adoption among smallholder farmers is often slow due to perceived risks, lack of awareness, and limited financial capacity.

Microfinance plays a dual role in this process:

- Financial Enablement: It provides the capital needed to reduce the economic barrier to adoption.
- Indirect Behavioral Influence: Many microfinance programs operate through group lending mechanisms, peer interaction, and training, which enhance information sharing and trust.

Through these channels, microfinance accelerates the diffusion process by increasing both the ability and willingness of farmers to adopt CSA technologies.

Therefore, from this perspective, microfinance influences CSA adoption not only through financial access but also through innovation diffusion dynamics.

The Sustainable Livelihoods Framework (SLF), developed by the UK Department for International Development (DFID, 1999), provides a holistic approach to understanding how households utilize different forms of capital—financial, human, social, physical, and natural—to achieve livelihood outcomes.

Within this framework, smallholder farmers face vulnerability due to climate shocks, market instability, and resource limitations. CSA practices contribute to strengthening natural and physical capital, while microfinance strengthens financial capital.

The interaction between microfinance and CSA can therefore be understood as a livelihood enhancement mechanism:

- Financial Capital (Microfinance): Enables access to credit and savings
- Physical Capital (CSA tools): Irrigation, improved seeds, farm equipment
- Natural Capital (Environment): Improved soil health, water efficiency
- Human Capital: Skills and knowledge from training programs
- Livelihood Outcome: Increased productivity and resilience

Thus, SLF provides a comprehensive lens for understanding how microfinance contributes to sustainable agricultural transformation beyond income generation.

2.1. Conceptual Integration of the Frameworks

When integrated, the three theories provide a robust explanatory model for this study:

- Credit Constraint Theory explains why farmers cannot adopt CSA without financial support
- Diffusion of Innovation Theory explains how adoption behavior spreads and accelerates
- Sustainable Livelihoods Framework explains the broader livelihood impact of combining microfinance and csa

Across both African and Asian contexts, the literature converges on several key findings:

- Financial access is a binding constraint to CSA adoption among smallholder farmers.
- Microfinance increases the likelihood of adopting agricultural innovations by easing liquidity constraints.
- Technology adoption is not purely financial, but also depends on information access, institutional support, and farmer capacity.
- Integrated systems (finance + extension + technology) produce stronger and more sustainable outcomes than standalone interventions.
- Thus, microfinance should not be viewed solely as a credit mechanism but as part of a broader agricultural transformation system that enables climate adaptation and productivity enhancement.

Despite extensive literature on microfinance and agricultural technology adoption, several gaps remain:

- First, most existing studies treat microfinance and CSA adoption in isolation, with limited attention to their integrated impact.
- Second, there is a lack of empirical evidence specifically linking microfinance access to CSA adoption outcomes in many Sub-Saharan African contexts.
- Third, few studies adopt a comparative lens that contrasts African and Asian experiences in order to draw transferable policy lessons.

Finally, existing research often focuses on adoption rates rather than deeper outcomes such as productivity gains and resilience improvements.

This study addresses these gaps by examining the role of microfinance in promoting CSA adoption among smallholder farmers, with a focus on its implications for agricultural resilience and sustainability.

3. Conclusion

This study has demonstrated that microfinance plays a critical and transformative role in promoting the adoption of climate-smart agricultural (CSA) practices among smallholder farmers. By easing liquidity constraints, microfinance enables farmers to access and invest in productivity-enhancing and climate-resilient technologies such as improved seed varieties, irrigation systems, and sustainable soil management practices. The synthesis of global evidence from Africa and Asia confirms a strong and consistent relationship between access to microcredit and increased uptake of CSA innovations. Beyond financial access, microfinance also strengthens farmers' adaptive capacity by enhancing risk management, improving information flow through group lending systems, and supporting gradual behavioural shifts toward more sustainable agricultural practices.

Overall, the findings suggest that microfinance should be viewed not merely as a financial inclusion tool, but as a strategic instrument for climate adaptation and rural development. However, despite the strong conceptual and empirical insights from existing literature, there remains a clear need for further empirical investigation at the micro-level to validate and contextualize these relationships within specific local farming systems. In particular, future studies should employ primary data to quantitatively assess the magnitude and causality of the relationship between microfinance access and CSA adoption, as well as explore mediating factors such as farmer education, institutional support, and climate variability. Such empirical evidence will be essential for strengthening policy design and ensuring more targeted and effective interventions in promoting climate-smart agriculture.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Adeoti, A. I., Ogunleye, K. Y., & Olagunju, F. I. (2018). Microcredit access and adoption of improved rice technologies in Nigeria. African Journal of Agricultural Research, 13(5), 215–224.

[2] Ariom, T., Okoro, J., & Musa, H. (2022). Determinants of climate-smart agriculture adoption among smallholder farmers in Nigeria. Journal of Agricultural Extension and Rural Development, 14(3), 45–58.

[3] Armendáriz, B., & Morduch, J. (2010). The economics of microfinance (2nd ed.). MIT Press.

[4] Binswanger, H. P., & McIntire, J. (1987). Behavioral and material determinants of production relations in land-abundant tropical agriculture. Economic Development and Cultural Change, 36(1), 73–99.

[5] DFID (Department for International Development). (1999). Sustainable livelihoods guidance sheets. UK Government.

[6] Ewulo, B. S., Akinbile, L. A., & Sadiq, M. A. (2025). Financial inclusion and climate-smart agriculture adoption in West Africa. Climate and Development Journal, 17(1), 88–102.

[7] FAO. (2013). Climate-smart agriculture sourcebook. Food and Agriculture Organization of the United Nations.

[8] FAO. (2017). The state of food and agriculture: Leveraging food systems for inclusive rural transformation. FAO.

[9] FAO. (2022). Climate-smart agriculture in Africa: Evidence and policy insights. FAO Regional Office for Africa.

[10] FAO. (2024). Climate-smart agriculture and sustainable food systems report. FAO.

[11] FAO & World Bank. (2015). Agricultural finance and rural development in developing countries. World Bank Group.

[12] Hossain, M., & Bayes, A. (2021). Rural finance and agricultural transformation in South Asia. Asian Development Review, 38(2), 55–78.

[13] IFAD. (2021). Rural finance and agricultural investment report. International Fund for Agricultural Development.

[14] IPCC. (2022). Sixth assessment report: Impacts, adaptation and vulnerability. Intergovernmental Panel on Climate Change.

[15] Kihoro, E. M., Wafula, J., & Njoroge, R. (2020). Microfinance and adoption of irrigation technologies among horticultural farmers in Kenya. Journal of Development Studies, 56(4), 601–618.

[16] Rogers, E. M. (2003). Diffusion of innovations (5th ed.). Free Press.

[17] Silva, R., Mensah, A., & Dlamini, T. (2024). Determinants of climate-smart agriculture adoption in Sub-Saharan Africa: A systematic review. Agricultural Systems, 210, 103–118.

[18] Stiglitz, J. E., & Weiss, A. (1981). Credit rationing in markets with imperfect information. American Economic Review, 71(3), 393–410.

[19] World Bank. (2020). Agricultural finance and rural transformation in developing economies. World Bank.

[20] World Bank. (2024). Climate-smart agriculture and food security: Global evidence report. World Bank Group.

[21] UNEP. (2023). Financing climate resilience in agriculture. United Nations Environment Programme.

[22] UN Women. (2022). Digital financial inclusion and women's economic empowerment. UN Women.