AGRICULTURAL COOPERATIVES AND FOOD SECURITY AMONG SMALLHOLDER FARMERS IN CLIMATE-SENSITIVE FARMING SYSTEMS IN AFRICA: A SYSTEMATIC REVIEW

Consesa Richard Mauki
Department of Community Development and Gender, Moshi Co-operative University, P.O. Box 474, Moshi, Tanzania, email address: consesa.mauki@mocu.ac.tz ORCID: https://orcid.org/0000-0003-3956-2097

Abstract

Food insecurity faced by smallholder farmers in Sub-Saharan Africa stems from limited access to productive resources, weak institutional support, and increasing exposure to climate shocks. Although promoting agricultural cooperatives aims to improve food access and resilience, evidence of their effectiveness is limited, especially in climate-sensitive regions. This review fills that gap by examining how agricultural cooperatives influence food security outcomes for smallholder farmers across Africa. The study used a systematic review guided by the PRISMA framework. A structured search across six Databases-Emerald Insight, Taylor & Francis Online, Google Scholar, Africa Journals Online (AJOL), ScienceDirect, and CAB Direct-covered literature from 2000 to 2024. Out of 3,241 initial results, 154 titles were deemed relevant, and 35 studies were selected after abstract screening. The full-text review identified seven peer-reviewed studies that met the criteria, focusing on cooperative membership, food security outcomes, and relevance to smallholders in climate-vulnerable settings. Results from studies in Ethiopia, Malawi, Tanzania, and Ghana show that cooperative membership is linked to increased food availability, improved dietary diversity, and reduced food insecurity through better access to inputs, credit, training, markets, and extension services. Studies also highlighted contributions to climate resilience, including improved irrigation, income diversification, and community-based environmental management. Data were thematically synthesized to highlight key patterns and contextual differences. This review provides policymakers with insights into how to strengthen cooperative impact through better governance, stronger market linkages, and climate-adaptation strategies. The review recommends targeted support to improve cooperative governance, encourage climate-smart practices, and promote gender-inclusive participation, thereby maximizing their role in enhancing food security and resilience.

Keywords: Agricultural cooperatives, Food security, Smallholder farmers, Climate resilience, Africa

AJCDT, Vol. 9 No. 1 (December, 2025), pp. 66 –78, © 2025 Authors

INTRODUCTION

Food security remains a key development issue in Sub-Saharan Africa, where a large portion of the population relies on smallholder agriculture for both income and livelihood. The Food and Agriculture Organization (FAO, 2017) defines food security as a condition in which all people, at all times, have physical, social, and economic access to enough, safe, and nutritious food that satisfies their dietary needs and preferences for a healthy and active life. This idea is supported by four interconnected pillars: availability, access, utilization, and stability. However, in many rural parts of Africa, these pillars are constantly under pressure. Smallholder farmers, who produce up to 80% of the region's food, often face significant challenges, such as limited access to quality inputs, financial services, infrastructure, and reliable markets (FAO, 2021; IFAD, 2020). These structural obstacles are further worsened by climate variability, which disrupts planting seasons, raises production risks, and makes farming households more vulnerable to food insecurity (IPCC, 2022). The effects of climate change on African agriculture are becoming increasingly widespread, with unpredictable rainfall, extended droughts, floods, and changing growing conditions already disrupting food production systems across the continent (WFP, 2021; Ali, Shaheen, Baten, Kamruzzaman, & Islam, 2021). Climate change adaptation can mitigate negative impacts, protect the livelihoods of impoverished farmers, and increase the potential benefits they may experience (Magesa *et al*., 2023). For smallholder farmers with limited financial and technical resources, adapting to these disruptions is especially challenging. As Ali *et al.* (2021) note, many farmers turn to low-cost, knowledge-based practices such as adjusting planting calendars or using drought-tolerant crop varieties as practical alternatives to expensive solutions. This underscores the urgent need to expand accessible, community-led adaptation strategies. These issues are especially critical given Africa's slow progress toward reaching Sustainable Development Goal 2 (SDG 2), which aims to end hunger, ensure food security and better nutrition, and promote sustainable agriculture by 2030 (UN, 2015). In this context, Climate-Smart Agriculture (CSA) has emerged as a holistic approach that simultaneously boosts agricultural productivity, enhances resilience to climate change, and reduces greenhouse gas emissions (World Bank, 2023; Magesa *et al*., 2023; Abegunde, Sibanda, & Obi, 2019). According to FAO (2023), CSA offers a framework for transforming agri-food systems to become more sustainable and climate-resilient. Its practices, which include conservation agriculture, efficient irrigation, agroforestry, and improved crop genetics, provide practical solutions for developing resilient food systems. Nonetheless, the widespread adoption of CSA often depends on the presence of supportive institutions. Agricultural cooperatives are increasingly recognized as essential players in this area, assisting smallholders in accessing information, pooling resources, and deploying climate-smart technologies at scale (Guyalo & Ifa, 2023; UN, 2023; UNDESA, 2023). Beyond their role in climate resilience, agricultural cooperatives act as vital institutions for improving overall food security and livelihoods for smallholders. By organizing farmers into collective groups, cooperatives help lower transaction costs, broaden access to credit and inputs, enhance market participation, and promote peer learning (Mauki, Jeckoniah, & Massawe, 2023; Birchall, 2004; Wanyama, Develtere, & Pollet, 2009). In regions sensitive to

climate change, cooperatives also support investments in shared water systems, early warning services, and sustainable land management practices (Markelova, Meinzen-Dick, Hellin, & Dohrn, 2009; Ali *et al.*, 2021). Importantly, cooperatives can serve as platforms for promoting gender inclusion and equity, especially when they are women-led or structured to encourage women's participation. For example, in Nigeria, women's cooperatives have been shown to improve both the availability and affordability of food by providing members with access to inputs, credit, and extension services (Okafor & Ngene, 2022). These cooperatives empower women, who play a key role in food production but often have limited access to productive resources, by facilitating bulk input procurement, offering technical training, and strengthening market links. In doing so, they support the four pillars of food security, both directly and indirectly. Despite this promising evidence, research on the role of agricultural cooperatives in food security remains fragmented and context-specific. While some studies highlight positive outcomes such as improved incomes, dietary diversity, and commercialization (Bernard & Spielman, 2009; Verhofstadt & Maertens, 2014), others point to limitations related to governance structures, exclusionary practices, and long-term sustainability (Ruben & Heras, 2012; Chamberlin & Jayne, 2013). Additionally, few reviews have synthesized findings across Africa with a specific focus on cooperatives in climate-sensitive smallholder systems. This systematic review addresses this gap by synthesizing empirical evidence from peer-reviewed literature published between 2000 and 2024 to examine how agricultural cooperatives contribute to food security among smallholder farmers across Africa. It focuses explicitly on climate-sensitive contexts to identify standard mechanisms, limitations, and actionable insights that can guide future research and policy efforts to increase resilience and food security in the region. Overall, the review is guided by the following question: To what extent do agricultural cooperatives improve food security among smallholder farmers in climate-sensitive agricultural systems across Africa? What mechanisms, challenges, and contextual factors impact the effectiveness of agricultural cooperatives in promoting food security and climate resilience?.

METHODS

Review Design: This study conducted a systematic review to synthesize peer-reviewed evidence on how agricultural cooperatives enhance food security for smallholder farmers in climate-sensitive areas across Africa. The review followed a clear set of steps: comprehensive searches, screening, selection, and synthesis of the literature. Throughout the process, the review was guided by two main research questions and followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards.

Search Strategy: Relevant review studies were identified through extensive searches across six electronic databases: Google Scholar, ScienceDirect, Taylor & Francis Online, Emerald Insight, Africa Journals Online (AJOL), and CAB Direct, using various keywords (Table 1). Additional searches were performed using Google Search for grey literature. Boolean operators (AND, OR), quotation marks, and parentheses were used to create search strings that combined keywords related to agricultural cooperatives, food security, smallholder farmers, climate change, and geographic terms (Africa, Sub-Saharan Africa, Tanzania). The search was also

limited to English-language publications from 2000 to 2024 and focused on African countries.

Table 1: Database/search engine and keywords used

SN	Database/ search engine	Keywords/Search terms	Results
1	Emerald Insights	Agricultural cooperatives and food security among smallholder farmers in the context of climate change in Africa	214
2	Taylor and Francis Online	Agricultural cooperatives and food security among smallholder farmers in the context of climate change in Africa or Tanzania	92
3	Google scholar	"Agricultural cooperatives" AND "food security" AND "smallholder farmers" AND "climate change" AND ("Tanzania" OR "Sub-Saharan Africa" OR "Africa")	2283
4	Africa Journals Online (AJOL)	Agricultural cooperatives and food security among smallholder farmers in the context of climate change in Africa	585
5	Science direct	("agricultural cooperatives") AND ("food security") AND ("smallholder farmers") AND ("climate change") AND (" Africa" OR "Sub-Saharan Africa" OR "Tanzania")	60
6	CAB Direct	(agricultural cooperatives OR farmer cooperatives) AND (food security OR nutrition security) AND (climate change OR climate resilience) AND (smallholder farmers OR smallholder farming) AND (Africa OR Tanzania)	7

Screening and Selection of Reviewed Documents: The document's relevance for selection was ensured by screening titles, reviewing abstracts, and assessing full articles. The initial database search returned 3,241 records. These were first screened by title to assess their relevance to the review topic, which reduced the list to 154 potentially useful studies. A closer examination of the abstracts further narrowed the selection to 35 articles. After a thorough review of the full texts, only 7 studies met all inclusion criteria and were selected for the final analysis. One study (Damilola & Emanuela, 2022) was excluded at the final stage due to concerns about scientific rigor. However, articles that did not meet the selection criteria were excluded from the critical review. Some reasons for exclusion included irrelevant titles, duplication, incorrect geographic coverage (not conducted in Africa), and theses/dissertations that used data similar to that in other publications. Also, articles/documents that focused on non-agricultural cooperatives, were purely conceptual or theoretical, lacked empirical data, or did not link cooperative activity to food security were excluded from this review (Figure 1). The included studies were drawn primarily from a few countries in Eastern and Southern Africa, which may limit regional representativeness. Only English-language publications were considered, which may introduce potential language bias. In addition, the review relied on peer-reviewed articles, which may exclude relevant grey literature and contribute to publication bias.

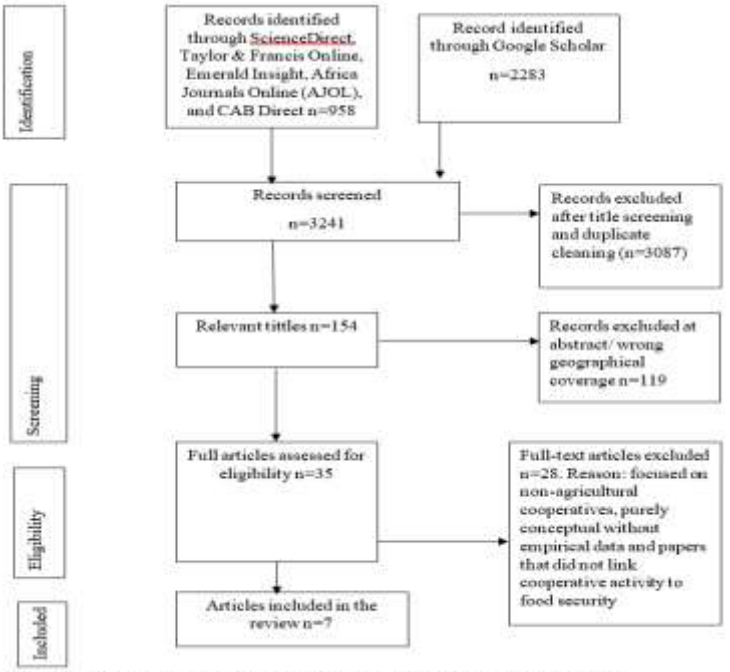

Figure 1: Flow diagram for selection and exclusion of the documents for review

FINDINGS AND DISCUSSION

This section presents the empirical findings from the seven studies included in this review. The results are organized around key themes derived from the research questions, focusing on how agricultural cooperatives influence food security and the factors that shape these outcomes. Table 2 summarizes the selected studies, highlighting their contexts, cooperative types, methodologies, and significant findings related to food security and climate resilience. This overview helps set the context for the evidence before examining the thematic results more closely.

Contribution of Agricultural Cooperatives to Food Security: Studies consistently demonstrate that agricultural cooperatives are crucial to enhancing food security for smallholder farmers across Africa. In Ethiopia, for instance, Gemechu *et al*. (2024) reported that membership in seed-producer cooperatives significantly increases farmers' involvement in market-oriented production, thereby improving household food availability. Similar findings were reported by Guyalo and Ifa (2023), who observed that cooperative membership is associated with higher daily calorie intake and a lower risk of food insecurity, underscoring improvements in both food availability and access.

In Tanzania, Mapunda (2021) presented a more detailed set of results. While the Propensity Score Matching (PSM) approach showed only slight improvements in food security, the Endogenous Switching Regression (ESR) model indicated more significant positive effects on dietary diversity and overall food access. These differences demonstrate how methodological choices can influence the reported magnitude of cooperative impacts. In Ghana, Suraj *et al.* (2025) found that participation in Water User Associations (WUAs) led to notable improvements in food security outcomes, with members reporting higher dietary diversity, lower coping strategy scores, and more consistent access to nutritious foods throughout the year.

Table 2: Summary of Studies

SN	Author (Year)	Country	Cooperative type	Methodology	Food security impact/outcome	Climate element
1	Chivundu-Ngulube and Li. (2019)	Malawi	Agricultural producer cooperatives (rice)	Mixed methods (n=315), FGDs, KIIs, content analysis	Improved income, increased food availability and accessibility, and entrepreneurial skills development	Reported challenges from droughts, floods, and land degradation; coping via diversification, early maturing crops, and organic farming
2	Geffersa & Islam (2024)	Ethiopia	Rural agricultural cooperatives (maize)	Panel data (3 waves), CRE double-hurdle model, CF approach	Enhanced commercialization via increased market participation and sales intensity; greater access to inputs, higher yields, income, and profits	No direct climate adaptation focus, but cooperative mechanisms (e.g., access to improved seeds, fertilizer) support resilience and productivity
3	Gemechu, Abdulahi, & Bekele (2024).	Ethiopia	Seed-producer cooperatives (SPCs)	Household survey (n=425), ESR model, PSM techniques	Cooperative membership significantly increased the commercialization of tef and wheat outputs and inputs (seeds, fertilizers, herbicides, fungicides); members showed higher market participation and sales volume	Climate-related challenges (land degradation, low productivity) are acknowledged; resilience is indirectly addressed through improved input access and market linkages
4	Guyalo & Ifa (2023)	Ethiopia	Agricultural cooperatives (multi-purpose, rural)	Quasi-experimental; PSM, IPW, SEM, and ESR models (n=260)	Significantly improved daily calorie intake and reduced food insecurity levels (HFIAS); strong positive association with food availability and access	No explicit focus on climate change, but the study area is characterized by food insecurity and poor infrastructure, typical of climate-sensitive rural zones
5	Mapunda (2021)	Tanzania	Agricultural Marketing Cooperative Societies (AMCOS)	Cross-sectional (n=1400), PSM and Endogenous Switching Regression (ESR)	Mixed: PSM results indicated a slight improvement in food security (-0.039 HFIAS), but ESR showed increased food insecurity (TT=0.594); results suggest challenges in cooperative performance	No explicit modeling of climate factors, but food insecurity is linked to production risks, delayed marketing, and infrastructure constraints typical of climate-sensitive regions
6	Suraj, Abebrese, & Lamptey (2025)	Ghana	Water User Associations (WUAs)	Quasi-experimental design; OLS, IPW, IPWRA; survey (n=820)	WUA membership significantly improved household dietary diversity (HDDS), reduced the coping strategy index (CSI), and increased consumption of protein, vegetables, and fruits	Addresses food security in irrigation-based ecologies as a climate adaptation strategy; members are also more likely to participate in drought-index insurance and supplementary irrigation
7	Nugusse, Huylenbroeck , & Buysse (2013)	Ethiopia	Irrigation, beekeeping, and multipurpose cooperatives	Household survey (n=400), FGDs, KIIs, Heckman two-stage model	Cooperative membership increased income and expenditure; members were significantly more food secure (79%) than nonmembers (64%); members reported better access to services, markets, and employment opportunities.	The study area is drought-prone and climate-sensitive; cooperatives participated in environmental rehabilitation (soil and water conservation, reforestation), and supported members' income diversification.

In Malawi, Chivundu-Ngolube and Li (2019) found that farmer participation in rice producer cooperatives led to higher incomes, better food availability, and increased accessibility, driven by greater commercialization and entrepreneurial activity. In Malawi, Chivundu-Ngolube and Li (2019) found that farmer participation in rice producer cooperatives led to higher incomes, better food availability, and increased accessibility, driven by greater commercialization and entrepreneurial activity. Similarly, Geffersa and Islam (2024) found that rural agricultural cooperatives in Ethiopia improved farmers' ability to commercialize, resulting in higher yields, more market participation, and increased incomes, thus contributing to better food security. Among the seven studies reviewed, cooperative membership was linked to improvements in at least one aspect of food security. However, the extent and mechanisms of these improvements varied across countries, cooperative types, and research approaches.

Mechanisms Through Which Cooperatives Enhance Food Security: The results revealed several interconnected mechanisms through which agricultural cooperatives contribute to improved food security. One of

the most significant mechanisms was increased access to agricultural inputs. Farmers who belonged to cooperatives were more likely to obtain better seeds, fertilizers, and other essential inputs in a timely and affordable manner, primarily through collective procurement and distribution systems. These benefits were particularly emphasized in studies such as Gemechu *et al.* (2024) and Mapunda (2021), in which cooperative members consistently reported better access to inputs than non-members. Access to affordable credit also proved to be a vital tool. In studies from Malawi and Ethiopia, cooperative members had better access to credit facilities, allowing them to invest in essential farm inputs, adopt improved technologies, and manage seasonal production fluctuations. The studies further indicated that cooperatives serve as key platforms for spreading extension services and training opportunities. For instance, Guyalo and Ifa (2023) and Gemechu *et al.* (2024) noted that cooperatives provided training in modern farming methods, soil fertility management, and post-harvest handling, all of which directly contributed to improved household food supply and reduced losses. Improved marketing opportunities served as another key pathway. By pooling produce and bargaining collectively, cooperative members could secure better prices, lower transaction costs, and boost market participation. Geffersa and Islam (2024) demonstrated that this increased commercialization not only raised farmers' incomes but also improved their ability to buy food, thereby stabilizing food access. Although gender was not a primary focus in most of the reviewed studies, the case of women-led cooperatives in Nigeria (Okafor & Ngene, 2022) showed that cooperatives can strengthen women's access to credit, training, and inputs, ultimately making food more affordable and available at the household level. These findings collectively show that cooperatives improve food security through economic, technical, and social-institutional ways that address both production and consumption issues.

Climate Resilience and Climate-Smart Practices: Although only a few studies explicitly framed their findings within Climate-Smart Agriculture (CSA), several included elements that highlight the role of cooperatives in boosting climate resilience. In Malawi, Chivundu-Ngulube and Li (2019) reported that rice cooperatives helped farmers manage climatic shocks such as droughts, floods, and unpredictable rainfall. These cooperatives offered training and coordinated community-based strategies that helped distribute agricultural risks and decrease vulnerability to climate-related hazards. In Ethiopia, Gemechu *et al.* (2024) highlighted that seed-producer cooperatives improved farmers' access to improved and climate-resilient seed varieties. This access is vital for adapting crop production to changing weather patterns and deteriorating soils. Even in studies where climate resilience was not the primary focus, such as Guyalo and Ifa (2023) and Mapunda (2021), the results showed that cooperative activities occurred in climate-sensitive environments, where collective learning and resource pooling boosted adaptive capacity. Overall, although CSA concepts were not systematically studied, the evidence showed that cooperatives continued to contribute to resilience by enhancing access to climate-resilient technologies, promoting knowledge sharing, and strengthening collective responses to climate risks.

Challenges and Contextual Limitations: Despite the positive contributions highlighted in the reviewed studies, several challenges and contextual limitations were identified.

One of the most consistent issues involved cooperative governance and internal management. Studies such as those by Guyalo and Ifa (2023) document problems such as elite capture, weak leadership, and the exclusion of less influential members, which undermine both equity and the effectiveness of cooperative operations. Variability in the performance and efficiency of cooperatives was particularly evident in the Ethiopian cases examined by Geffersa and Islam (2024), where some cooperatives operated effectively, while others struggled with coordination and accountability. Another limitation involved the geographic concentration of available evidence. Many of the reviewed studies were conducted in Ethiopia, raising concerns about how well their findings apply across Africa's diverse agro-ecological, institutional, and socio-economic settings. Although studies from Malawi, Tanzania, Ghana, and Nigeria helped expand understanding of cooperative impacts, the evidence base remains uneven. Furthermore, while climate resilience was implicitly addressed in several studies, only a few explicitly discussed climate-smart practices, highlighting a gap in empirical research on how cooperatives can systematically support climate adaptation. These challenges emphasize the need for stronger governance structures, broader regional coverage in future research, and a more deliberate integration of climate resilience into cooperative efforts.

DISCUSSION

The findings from the seven reviewed studies collectively underscore the vital role of agricultural cooperatives in improving food security among smallholder farmers in Africa. Evidence from Ethiopia, Malawi, Ghana, and Tanzania shows that cooperative membership enhances food availability, access, and utilization through various pathways (Gemechu *et al.,* 2024; Guyalo & Ifa, 2023; Suraj *et al.,* 2025; Chivundu-Ngulube & Li, 2019). These results support the broader understanding that cooperatives serve as essential institutional mechanisms for strengthening rural livelihoods. The mixed outcomes from Mapunda (2021), where improvements in food security varied depending on econometric approaches, further indicate that cooperative impacts are influenced by contextual factors such as governance, infrastructure, and local market conditions. Several mechanisms identified across the studies align with the broader literature on cooperative benefits. Improved access to agricultural inputs documented in Ethiopia and Tanzania (Gemechu *et al.,* 2024; Mapunda, 2021) reflects the cooperative advantage of reducing transaction costs and increasing farmers' access to timely and affordable services. Similarly, improved access to credit reported in Malawi and Ethiopia (Chivundu-Ngulube & Li, 2019; Nugusse *et al.,* 2013) supports longstanding arguments about cooperatives' role in overcoming financial constraints among smallholders. The training and extension services shown in studies such as Guyalo and Ifa (2023) and Gemechu *et al.* (2024) demonstrate how cooperatives act as knowledge-sharing platforms, helping farmers adopt improved agronomic and post-harvest practices. The evidence from Nigeria about women-led cooperatives (Okafor & Ngene, 2022) further highlights the importance of inclusive cooperative models that address gender-specific barriers in agriculture. Although few studies have directly examined climate-smart agriculture, several findings indicate that cooperatives can strengthen climate resilience. For example, cooperatives in Malawi and Ethiopia helped communities access climate-resilient seed varieties and supported joint responses to

climatic shocks like droughts and irregular rainfall (Chivundu-Ngulube & Li, 2019; Gemechu *et al.,* 2024). Similarly, the climate-sensitive situations described in Guyalo and Ifa (2023), Mapunda (2021), and Suraj *et al.* (2025) suggest that cooperative efforts are already part of environments where building resilience is essential. However, the limited explicit focus on climate-smart practices in these studies highlights a gap and emphasizes the need for more intentional integration of climate resilience goals into cooperative programs. The identified challenges, particularly governance weaknesses, elite capture, and uneven cooperative performance, mirror broader critiques found in cooperative development scholarship. Issues discussed in Ethiopia and Tanzania (Guyalo & Ifa, 2023; Geffersa & Islam, 2024; Mapunda, 2021) demonstrate how governance quality directly affects cooperative inclusiveness, efficiency, and sustainability. Additionally, because most studies focus on Ethiopia, regional evidence is limited, underscoring the need for more research from underrepresented regions to reflect Africa's diverse cooperative landscapes better. Overall, the evidence reviewed shows that agricultural cooperatives are crucial for improving food security and hold significant potential to enhance climate resilience. However, their effectiveness can be strengthened through better governance, increased gender inclusion, clearer integration of climate-smart agriculture, and expanded research across different settings.

Research Gap: The review has uncovered a significant gap in understanding how agricultural cooperatives influence the more complex facets of food security, especially the pillars of utilization and stability. Most studies tend to emphasize immediate outcomes, such as food availability and access, while paying much less attention to utilization aspects, such as nutrition and dietary diversity, as well as stability, which relates to the consistency and reliability of food access over time. Without this broader outlook, our grasp of cooperatives' full potential to enhance food systems remains limited. Another clear gap exists in the link between cooperatives and climate-smart agriculture. While many studies acknowledge climate variability, very few specifically explore how cooperatives help farmers adopt climate-resilient practices such as conservation farming, drought-tolerant seeds, or access to climate information. Given the growing threats posed by climate change, this area needs more in-depth research. There is also a noticeable geographic imbalance in current studies, with much of the evidence coming from Ethiopia. This means insights from other African regions, such as West, Central, or North Africa, are lacking, which limits our ability to draw broad conclusions across the continent, since cooperative models and agricultural systems differ widely between countries and regions. Therefore, more research is needed to understand better how cooperatives function across diverse agricultural and climatic contexts and how effectively they can support food security and climate adaptation across Africa.

CONCLUSION

This review highlights the crucial role agricultural cooperatives play in enhancing food security in climate-sensitive farming systems across Africa. The evidence indicates that cooperatives improve access to vital inputs, credit, training, and markets, thereby increasing the reliability of production and household income. However, the extent of these benefits varies with cooperative governance, institutional support, and local operating conditions, which, in some cases, can limit their capacity to address food insecurity and respond effectively to climate-

related challenges. The review also highlights key gaps in current research. Most studies focus on food availability and access, with limited attention to food utilization, such as nutrition and dietary quality, and food stability over time. Similarly, although climate change increasingly threatens smallholder agriculture, few studies have explored in depth how cooperatives support climate adaptation or promote climate-smart agricultural practices. Evidence remains concentrated in a few countries, leaving large parts of Africa underrepresented. Overall, the findings show that agricultural cooperatives have significant potential not only as tools for food security but also as platforms for enhancing resilience in climate-vulnerable farming systems. Addressing these gaps will support policy efforts to position agricultural cooperatives as vehicles for climate adaptation and improved rural food security.

RECOMMENDATIONS

Building on the findings of this review and the gaps identified in the existing literature, several recommendations arise to strengthen the role of agricultural cooperatives in improving food security and climate resilience among smallholder farmers in Africa. First, there is a need to enhance cooperative governance so that members benefit fairly from inputs, credit, training, and market access. Transparent leadership, better accountability systems, and stronger institutional support can help cooperatives operate more efficiently and reach their most vulnerable members. Additionally, cooperatives should be encouraged to incorporate climate-smart agricultural practices into their work. This includes promoting climate-resilient seed varieties, supporting the adoption of water-efficient irrigation technologies, improving knowledge sharing on climate adaptation, and coordinating collective responses to climate shocks. These efforts would enable cooperatives to function not only as economic entities but also as platforms for climate adaptation. Given the gendered aspects of food insecurity and resource access, policies and development programs should also promote more gender-inclusive participation within cooperatives. Ensuring that women and other marginalized groups have equitable representation and access to cooperative services can substantially improve household food security and resilience. Strengthening market integration is equally vital, as better market linkages can stabilize incomes and reduce smallholder farmers' vulnerability to climate-related production fluctuations. Future research should address the significant knowledge gaps identified in this review. There is a particular need for more studies examining how cooperatives influence food utilization and stability dimensions that remain underexplored despite their importance for nutrition and long-term food access. Research should also focus on underrepresented regions such as West, Central, and North Africa to capture the diversity of cooperative experiences across the continent. Expanding the evidence base will help ensure that contextually relevant insights inform cooperative policies. Overall, promoting well-governed, inclusive, and climate-smart cooperatives is a practical, policy-relevant approach to strengthening rural food security and resilience in Africa.

REFERENCES

Abegunde, V.O., Sibanda, M., & Obi, A. (2019). The Dynamics of Climate Change Adaptation in Sub-Saharan Africa: A Review of Climate-Smart Agriculture among Small-Scale Farmers. *Climate, 7*(132). https://doi.org/10.3390/cli7110132

Ali, S., Shaheen, S., Baten, M. A., Kamruzzaman, M., & Islam, S. M. F. (2021). Farmers' climate change adaptation strategies for reducing the risk of rice production: Evidence from Rajshahi District in Bangladesh. *Agronomy, 11*(3), 600. https://doi.org/10.3390/agronomy11030600

Bernard, T., & Spielman, D. J. (2009). Reaching the rural poor through rural producer organizations in Ethiopia. *Food Policy, 34*(1), 60–69.

Birchall, J. (2004). Cooperatives and the Millennium Development Goals. International Labour Organization.

Chamberlin, J., & Jayne, T. S. (2013). Unpacking the meaning of "market access": Evidence from rural Kenya. *World Development, 41*, 245–264. https://doi.org/10.1016/j.worlddev.2012.06.004

Chivundu-Ngulube, C. D., & Li, X. (2019). Agricultural cooperatives, entrepreneurship and food security. *Journal of Entrepreneurial and Organizational Diversity, 8*(1) 95–117.

FAO. (2017). The State of Food Security and Nutrition in the World 2017: Building resilience for peace and food security. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/I7787EN/i7787en.pdf

FAO. (2021). The State of Food Security and Nutrition in the World 2021. Food and Agriculture Organization of the United Nations.

Geffersa, A. G., & Islam, M. M. (2024). Beyond subsistence? The role of rural cooperatives in driving smallholder commercialization in Ethiopia. *Agribusiness*, 1–25.

Gemechu, D., Abdulahi, M., & Bekele, D. (2024). Impact of membership in agricultural cooperatives on commercialization of smallholder crop production in Ethiopia. *African Journal of Agricultural and Resource Economics* 19(1) 54–84.

Guyalo, D. K., & Ifa, B. T. (2023). Impact of agricultural cooperatives on the food security status of smallholder farmers in Western Ethiopia: Evidence from inverse-probability weights and coarsened exact matching approaches. *Cogent Economics & Finance, 11*(1)

IFAD. (2020). Rural Development Report 2020: Fostering inclusive rural transformation. International Fund for Agricultural Development.

IPCC. (2022). Climate Change 2022: Impacts, Adaptation, and Vulnerability. Intergovernmental Panel on Climate Change.

Magesa B. A., Mohan, G., Matsuda, H., Melts, I., Kefi, M., & Fukushi, K. (2023). Understanding the farmers' choices and adoption of adaptation strategies, and plans to climate change impact in Africa: A systematic review. *Climate Services 30*

Mapunda, F. M. (2021). Do grassroots institutions promote household food security? Evidence from cooperative membership in the Southern Highland Regions of Tanzania. *An International Journal of Basic and Applied Research,* 1(1), 218–233.

Markelova, H., Meinzen-Dick, R., Hellin, J., & Dohrn, S. (2009). Collective action for smallholder market access. *Food Policy, 34*(1), 1–7. https://doi.org/10.1016/j.foodpol.2008.10.001

Mauki, C., Jeckoniah, F., and Massawe, G. (2023). Smallholder rice farmers' profitability in Agricultural Marketing Co-operative Societies in Tanzania: A case of Mvomero and Mbarali districts. *Heliyon, 9*(2023), 1-15.

Nugusse, W., Huylenbroeck, G. V., & Buysse, J. (2013). Determinants of rural people's participation in cooperatives in Northern Ethiopia. *International Journal of Social Economics, 40*(12), 1098–1117.

Okafor, U. F., & Ngene, J. A. (2022). Effects of women cooperative society on ensuring food security in Ogbaru Local Government Area of Anambra State. *Journal of Gender and Rural Development, 1*(1), 19–30.

Ruben, R. and Heras, J. (2012). The performance of producer-owned marketing cooperatives in Ethiopia. *Annals of Public and Cooperative Economics, 83*(4), 463–484. https://doi.org/10.1111/j.1467-8292.2012.00473.x

Suraj, R. A., Abebrese, S. O., & Lamptey, R. B. (2025). Membership in farmer associations and household food security in Ghana: Evidence from endogenous switching regression. *Journal of Agriculture and Food Security, 10*(1), 1–16.

UNDESA. (2023). Agricultural Cooperatives as Platforms for Climate Action. Retrieved from: https://capacity.desa.un.org/node/5193?utm

United Nations (2023). UN hails cooperatives as drivers of a sustainable future. Retrieved from: https://www.un.org/en/desa/un-hails-cooperatives-drivers-sustainable-future?utm

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. United Nations General Assembly. https://sdgs.un.org/2030agenda

United States Environmental Protection Agency EPA (2023). Agriculture and Climate. Retrieved from: https://www.epa.gov/agriculture/agriculture-and-climate?utm_source. Retrieved on 01th May 2025

Verhofstadt, E., & Maertens, M. (2014). Cooperative membership and agricultural performance: Evidence from Rwanda. *Food Policy, 44*, 1–14.

Wafeu, G.S., Tankeu, A.T., Endomba, F.T.A., Nansseu, J.R., Kaze, A.D., Bigna, J.J., & Noubiap, J.J. (2017). Prevalence and associated factors of active smoking among individuals living with hypertension and/or diabetes in Africa: A systematic review and meta-analysis protocol. *BMJ Open*, *7*(10). https://doi.org/10.1136/bmjopen-2016-015444

Wanyama, F. O., Develtere, P., & Pollet, I. (2009). Reinventing the wheel? African cooperatives in a liberalized

economic environment. *Annals of Public and Cooperative Economics, 80*(3), 361–392. https://doi.org/10.1111/j.1467-8292.2009.00390.x

WFP. (2021). Hunger Hotspots: FAO-WFP early warnings on acute food insecurity. World Food Programme.

World Bank. (2023). Climate Smart Agriculture. Retrieved from https://www.worldbank.org/en/topic/climate-smart-agriculture. Retrieved on 11th April 2025