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ENHANCING FOOD SECURITY THROUGH AGRICULTURAL COOPERATIVES: DISCOURSES OF CLIMATE CHANGE AND SMALLHOLDER FARMERS IN AFRICA. A SYSTEMATIC REVIEW

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ABSTRACT: The persistent food insecurity faced by smallholder farmers in Sub-Saharan Africa is driven by limited access to productive resources, weak institutional support, and increasing exposure to climate-related shocks. While agricultural cooperatives are promoted to enhance food access and resilience, systematically synthesized evidence on their role remains limited, especially in climate-sensitive contexts. This review addresses that gap by examining how agricultural cooperatives influence food security outcomes for smallholder farmers across Africa. The study employed a systematic review design, guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. A structured search was conducted across six databases - Emerald Insight, Taylor & Francis Online, Google Scholar, Africa Journals Online (AJOL), ScienceDirect, and CAB Direct, covering literature from 2000 to 2024. From 3,241 initial results, 154 titles were identified as relevant, and 35 studies were retained after abstract screening. Full-text screening yielded seven peer-reviewed studies meeting inclusion criteria, selected based on their focus on cooperative membership, food security outcomes, and relevance to smallholders in climate-vulnerable settings. Findings from studies in Ethiopia, Malawi, Tanzania, and Ghana reveal that cooperative membership is associated with improved food availability, dietary diversity, and reduced food insecurity. These outcomes were linked to enhanced access to inputs, credit, training, markets, and extension services. Some studies also reported contributions to climate resilience, including improved irrigation, income diversification, and community-based environmental management. The extracted data were synthesized thematically to identify key patterns and contextual variation. This review consolidates fragmented evidence on the role of cooperatives in food-insecure and climate-sensitive farming systems. It highlights the conditions under which cooperatives are most effective and offers practical insights for policymakers and development practitioners on how to strengthen their impact through improved governance, better market integration, and the incorporation of climate adaptation strategies into cooperative models.

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

INTRODUCTION

Food security continues to be a major development concern in Sub-Saharan Africa, where a large portion of the population depends on smallholder agriculture for both income and sustenance. The Food and Agriculture Organization (FAO, 2017) defines food security as a

state in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and preferences for a healthy and active life. This concept is underpinned by four interrelated pillars: availability, access, utilization, and stability. Yet across many parts of rural Africa, these pillars are under constant strain. Smallholder farmers, who produce up to 80% of the region's food supply, often face significant constraints such as limited access to quality inputs, financial services, infrastructure, and stable markets (FAO, 2021; IFAD, 2020). These structural barriers are further compounded by climate variability, which disrupts planting seasons, increases production risks, and leaves farming households more vulnerable to food insecurity (IPCC, 2022). The impacts of climate change on African agriculture are increasingly far-reaching, with erratic rainfall, prolonged droughts, floods, and shifting growing conditions already destabilizing food production systems across the continent (WFP, 2021; Ali *et al.*, 2021). Climate change adaptation may reduce its negative consequences, save the livelihoods of impoverished farmers, and enhance the potential benefits that a farmer may experience (Magesa *et al.*, 2023). For smallholder farmers with limited financial and technical resources, adapting to these disruptions is particularly difficult. As Ali *et al.* (2021) point out, many farmers resort to low-cost, knowledge-based practices such as adjusting planting calendars or adopting drought-tolerant crop varieties as practical alternatives to capital-intensive solutions. This highlights the urgent need to scale accessible, community-driven adaptation strategies. These challenges are especially pressing in light of Africa's slow progress toward achieving Sustainable Development Goal 2 (SDG 2), which calls for ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture by 2030 (UN, 2015). In this context, Climate-Smart Agriculture (CSA) has gained prominence as a holistic approach that aims to simultaneously increase agricultural productivity, enhance resilience to climate change, and reduce greenhouse gas emissions (World Bank, 2023; Magesa *et al.*, 2023; Abegunde *et al.*, 2019). According to FAO (2023), CSA provides a framework for transforming agri-food systems to be more sustainable and climate-resilient. Its practices, ranging from conservation agriculture and efficient irrigation to agroforestry and improved crop genetics, offer practical solutions for building resilient food systems. However, the widespread adoption of CSA often hinges on the presence of enabling institutions. Agricultural cooperatives have increasingly been recognized as key actors in this space, helping smallholders access information, pool resources, and implement climate-smart technologies at scale (Guyalo & Ifa (2023); UN, 2023; UNDESA, 2023). Beyond their role in climate resilience, agricultural cooperatives serve as critical institutions for enhancing the overall food security and livelihoods of smallholders. By organizing farmers into collective units, cooperatives help reduce transaction costs, expand access to credit and inputs, improve market participation, and foster peer learning (Mauki *et al.*, 2023; Birchall, 2004; Wanyama *et al.*, 2009). In climate-sensitive regions, cooperatives also facilitate investments in shared water systems, early warning services, and sustainable land management practices (Markelova *et al.*, 2009; Ali *et al.*, 2021). Notably, cooperatives can serve as platforms for gender inclusion and equity, particularly when they are women-led or structured to promote women's participation. In Nigeria, for instance, women's cooperatives have been shown to enhance both the availability and affordability of food by offering members access to inputs, credit, and extension services (Okafor & Ngene, 2022). These cooperatives empower women, who contribute significantly to food production yet have limited access to productive resources, by enabling bulk input procurement, technical training, and improved market

linkages. In doing so, they directly and indirectly reinforce the four pillars of food security. 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 that gap by bringing together empirical evidence from peer-reviewed literature published between 2000 and 2024 to explore how agricultural cooperatives contribute to food security among smallholder farmers across Africa. In particular, it focuses on climate-sensitive contexts to identify common mechanisms, limitations, and actionable insights that can inform future research and policy interventions aimed at enhancing resilience and food security in the region. Generally, the review is guided by the following questions: To what extent do agricultural cooperatives contribute to improving food security among smallholder farmers in climate-sensitive agricultural systems across Africa? What mechanisms, challenges, and contextual factors influence the effectiveness of agricultural cooperatives in promoting food security and climate resilience?

METHODS

Review Design: This study employed a systematic review approach to bring together peer-reviewed evidence on how agricultural cooperatives contribute to improving food security among smallholder farmers in climate-sensitive agricultural settings across Africa. The review was carefully structured around a clear set of steps, beginning with comprehensive searches, followed by screening, selection, and synthesis of the literature. Throughout the process, the review was guided by two central research questions and aligned with the methodological standards set by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework.

Search Strategy: Relevant review studies were identified through comprehensive searches in six electronic databases: Google Scholar, ScienceDirect, Taylor & Francis Online, Emerald Insight, Africa Journals Online (AJOL), and CAB Direct by using various keywords (Table 1). Additional searches were conducted using Google Search for grey literature. Boolean operators (AND, OR), quotation marks, and parentheses were used to build search strings that combined keywords related to agricultural cooperatives, food security, smallholder farmers, climate change, and geographic terms (Africa, Sub-Saharan Africa, Tanzania). Moreover, the search was restricted to the years of publication between 2000 and 2024 in English language, 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	60

		"Tanzania")	
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

Source: Adapted from Wafeu *et al.* (2017)

Screening and Selection of Reviewed Documents: The document’s relevance for selection was ensured by screening the titles, reviewing the abstracts, and reviewing the full articles. The initial database search produced a total of 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 look at the abstracts helped narrow the selection further to 35 articles. After thoroughly reviewing the full texts, only 7 studies were found to fully meet the inclusion criteria and were therefore 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 a critical review of the same. Some of the reasons for exclusion included irrelevant titles, duplication, wrong geographical coverage (not conducted in Africa), theses/dissertations using similar data used in other publications. Also, articles/documents that focused on non-agricultural cooperatives, purely conceptual or theoretical, without empirical data and papers that did not link cooperative activity to food security were excluded in this review (Figure 1).

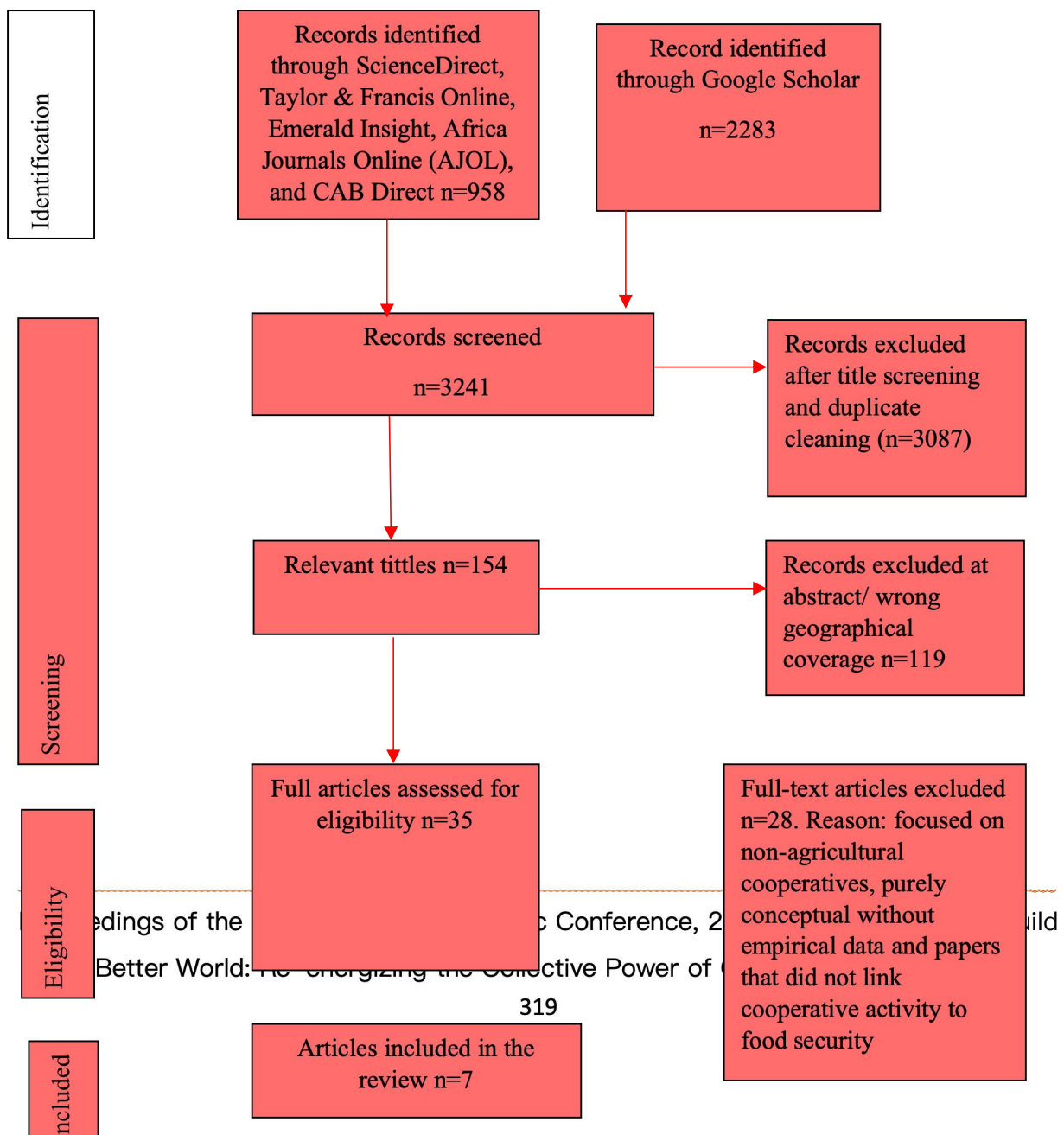




Figure 1: Flow diagram for selection and exclusion of the documents for review

RESULTS AND DISCUSSION

This section brings together insights from the seven studies selected for this review, with key findings summarized in **Table 2**. The section is organized thematically to highlight common patterns, differences, and contextual nuances that respond to the two research questions guiding this review. Specifically, the section explores how agricultural cooperatives contribute to food security among smallholder farmers, the mechanisms through which they deliver these benefits, their role in supporting climate resilience, and the challenges that affect their performance. This thematic approach allows for a more meaningful interpretation of the evidence across different countries and farming systems in Africa.

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 <i>et al.</i> (2024)	Ethiopia	Seed-producer cooperatives (SPCs)	Household survey (n=425), ESR model, PSM techniques	Cooperative membership significantly increased 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) acknowledged; resilience indirectly addressed through improved input access and market linkages
4	Guyalo & Ifa (2023)	Ethiopia	Agricultural cooperatives (multi-purpose, rural)	Quasi-experimental; PSM, IPW, CEM, and ESR models	Significantly improved daily calorie intake and reduced food insecurity levels	No explicit focus on climate change, but the study area is characterized by food

SN	Author (Year)	Country	Cooperative type	Methodology	Food security impact/outcome	Climate element
				with n=260	(HFIAS); strong positive association with food availability and access	insecurity and poor infrastructure, typical of climate-sensitive rural zones
5	Mapunda (2021)	Tanzania	Agricultural Marketing Cooperative Societies (AMCOS)	Cross-sectional survey (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 linked to production risks, delayed marketing, and infrastructure constraints typical of climate-sensitive regions
6	Suraj <i>et al.</i> (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 <i>et al.</i> (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 (e.g., soil and water conservation, reforestation), and supported members' income diversification

Contribution of Agricultural Cooperatives to Food Security: The reviewed studies consistently point to the important role that agricultural cooperatives play in improving food security among smallholder farmers across Africa. In Ethiopia, for example, Gemechu *et al.* (2024) found that farmers who belonged to seed-producer cooperatives were more likely to engage in market-oriented production and had better access to food at the household level. Likewise, findings by Guyalo & Ifa (2023) showed that cooperative membership significantly boosted household calorie intake and reduced the chances of food insecurity, demonstrating positive effects on both food availability and access. The case from Tanzania offered more nuanced insights. Mapunda (2021) applied different statistical approaches to assess impact, finding only a modest food security improvement using Propensity Score Matching (PSM). However, their Endogenous Switching Regression (ESR) results revealed stronger benefits, particularly in enhancing dietary diversity and access to food. This contrast underlines how research methods can shape our understanding of cooperative impacts. In Ghana, Suraj *et al.* (2025) found that membership in farmer associations significantly improved household food

security, with cooperative members reporting higher food consumption scores and more stable access to food throughout the year. In Malawi, Chivundu-Ngulube and Li (2019) focused on rice-producing cooperatives and found that participation led to better household incomes and improved food availability, largely driven by collective entrepreneurship and shared investment. Similarly, Geffersa and Islam (2024) in Ethiopia reported that cooperatives enhanced farmers' ability to commercialize their produce, which translated into greater household earnings and improved food security. Taken together, the seven studies reviewed reported improvements in at least one dimension of food security, whether availability, access, or utilization, as a result of cooperative membership. While the extent and nature of the benefits varied by country and type of cooperative, the overall evidence strongly supports the idea that cooperatives are important institutions for advancing food security in Africa's smallholder farming systems.

Mechanisms through Which Cooperatives Enhance Food Security: Across the studies reviewed, several recurring mechanisms explain how cooperatives contribute to better food security outcomes for smallholder farmers. One of the most frequently cited benefits was improved access to essential agricultural inputs such as seeds, fertilizers, and farming tools. Cooperatives often organized group-based input purchases, helping members access supplies at lower costs and on time (Gemechu *et al.*, 2024; Mapunda, 2021). This collective approach not only reduced financial burdens but also ensured consistency in production practices. Access to credit emerged as another key mechanism. According to Chivundu-Ngulube and Li (2019) and Nugusse *et al.* (2013), cooperative members were more likely to obtain credit than non-members, enabling them to invest in inputs and technologies that boosted productivity. Beyond financial services, cooperatives also played a role in facilitating extension and training. Guyalo & Ifa (2023), along with Gemechu *et al.* (2024), highlighted how training sessions organized through cooperatives improved members' knowledge of modern farming techniques, soil management, and post-harvest handling skills that directly enhance household food supply and reduce waste. Marketing was another area where cooperatives added value. By pooling produce and negotiating collectively, farmers were able to fetch better prices and reduce post-harvest losses. Geffersa and Islam (2024) noted that this increased commercialization strengthened members' income streams, which in turn stabilized food access and purchasing power. Although most of the studies did not focus explicitly on gender, one exception stood out. Okafor and Ngene (2022) provided a compelling case from Nigeria, where women-led cooperatives helped improve food affordability and availability. These groups offered credit, training, and inputs tailored to women farmers, many of whom are typically underserved in rural economies. In doing so, they empowered women not just economically, but also in household decision-making, contributing indirectly to better food utilization and dietary outcomes. Together, these findings reveal that cooperatives enhance food security through a combination of economic, technical, and social support mechanisms, making them valuable institutions in the fight against rural hunger and malnutrition.

Climate Resilience and Climate-Smart Practices: Although only a few of the reviewed studies explicitly addressed Climate-Smart Agriculture (CSA), several included elements that point to the important role cooperatives can play in helping farmers adapt to a changing climate. In Malawi, for instance, Chivundu-Ngulube and Li (2019) observed that cooperatives supported their members in managing the risks posed by droughts, floods, and erratic rainfall. This was achieved through training initiatives and collective strategies that helped spread and reduce individual exposure to climate shocks. In a similar vein, Gemechu

et al. (2024) found that seed-producing cooperatives in Ethiopia enabled smallholder farmers to access improved crop varieties that were better suited to shifting weather patterns. By facilitating access to climate-resilient technologies, these cooperatives indirectly strengthened local adaptation efforts. Other studies, while not directly modeling CSA outcomes, also pointed to the climate-related benefits of cooperative membership. Mapunda (2021) and Guyalo & Ifa (2023) acknowledged the exposure of smallholder farming systems to climate variability and noted that cooperatives played a supportive role in building resilience. This came through the sharing of knowledge, pooling of resources, and coordination of collective responses to agricultural challenges. Even though CSA was not the main focus of most studies, the evidence suggests that cooperatives are well-positioned to become effective platforms for climate resilience. Their ability to organize training, distribute drought-tolerant inputs, and facilitate community-level adaptation makes them valuable allies in the effort to strengthen the sustainability and stability of smallholder agriculture in climate-sensitive regions.

Challenges and Contextual Limitations: While the evidence from the reviewed studies highlights many positive contributions of agricultural cooperatives, it also reveals several challenges and limitations that affect their performance and impact. One key issue is the variation in cooperative effectiveness across different regions and organizational contexts. Geffersa and Islam (2024), for instance, noted that while some cooperatives in Ethiopia operated efficiently and delivered clear benefits to members, others struggled with coordination, member engagement, and internal accountability. Governance emerged as a recurring concern. In their study, Guyalo & Ifa (2023) highlighted problems related to elite capture and weak leadership, which led to the exclusion of less influential members from cooperative benefits. Such governance gaps not only undermine equity within cooperatives but also reduce their credibility and long-term sustainability. Mapunda (2021) similarly stressed the importance of transparent and accountable management structures to ensure that cooperatives operate in the interests of all members, especially the most vulnerable. Another limitation lies in the uneven geographical distribution of evidence. A significant number of the reviewed studies were concentrated in Ethiopia, which limits the generalizability of findings across Africa's diverse agro-ecological and institutional settings. While the insights from countries like Malawi, Tanzania, Ghana, and Nigeria help broaden the picture, more research is needed from underrepresented regions to capture the full spectrum of cooperative experiences. Finally, although climate resilience was an implicit concern in several studies, few addressed it directly or examined the capacity of cooperatives to promote climate-smart practices systematically. This represents a missed opportunity, especially given the growing importance of climate adaptation in smallholder agriculture. Taken together, these limitations underscore the need for stronger governance, wider geographic coverage in research, and more deliberate integration of climate resilience goals into cooperative programming and evaluation.

Research Gap: The review has shown that there's a real dearth of knowledge on how agricultural cooperatives influence the more nuanced dimensions of food security, particularly the pillars of **utilization** and **stability**. Most studies tend to focus on more immediate outcomes such as food availability and access, while much less attention is given to the aspects of utilization, like nutrition and dietary diversity or stability, which relates to how consistent and reliable food access is over time. Without this broader perspective, our understanding of cooperatives' full potential in strengthening food systems remains limited.

Another clear gap lies in the connection between cooperatives and climate-smart agriculture. While climate variability is acknowledged across several studies, very few explicitly examine how cooperatives are helping farmers adapt through climate-resilient practices such as conservation farming, the use of drought-tolerant seeds, or access to climate information. Given the increasing threats posed by climate change, this is a critical area that warrants deeper exploration. There is also an evident geographic imbalance in the existing research. A significant portion of the evidence comes from Ethiopia, which means insights from other African regions, such as West, Central, or North Africa, are underrepresented. This limits our ability to draw general conclusions across the continent, as cooperative models and agricultural systems vary widely between countries and regions. Hence, the need for further studies to provide a good understanding of how cooperatives operate in diverse agricultural and climatic settings, and the extent to which they can sustainably support food security and climate adaptation across the African continent.

CONCLUSIONS AND AREA FOR FURTHER RESEARCH

This review highlights the important role that agricultural cooperatives are playing in improving food security for smallholder farmers across Africa. In many of the studies reviewed, cooperatives helped farmers gain better access to essential inputs, credit, training, and markets, factors that directly contribute to more reliable food production and household income. However, the extent of these benefits varied widely depending on how well cooperatives were governed, the level of support they received from institutions, and the local context in which they operated. In some cases, these differences limited the cooperatives' ability to reach all members equally or to respond effectively to broader challenges like climate stress or market instability. What also became clear is that most of the research so far has focused on only two pillars of food security: availability and access. Much less is known about how cooperatives influence food utilization, including nutrition and dietary quality, as well as stability, which refers to the ability of households to consistently access food over time. Similarly, while climate change is a growing threat to smallholder agriculture, few studies have looked in depth at how cooperatives are helping farmers adapt through climate-smart practices. To move forward, there is a clear need for more grounded, context-specific research that explores these overlooked dimensions. Future studies should extend beyond surface-level impacts to explore how cooperatives influence nutrition, assist households in managing through lean seasons, and enhance the effectiveness of their climate-related services. There is also a need for more research from parts of Africa that are currently underrepresented, particularly West, Central, and North Africa. Filling these gaps will help ensure that policies and programs aimed at supporting cooperatives are informed by evidence that reflects the diversity of farming systems and challenges across the continent. With better data and broader understanding, cooperatives can be positioned not only as tools for agricultural development but as key partners in building resilient, inclusive, and food-secure rural communities.

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