The Role of Co-operative Societies in Promoting Sustainable Agriculture in Kenya: A Systematic Review Schools

Mary Wanja[1] & Charles W. Kamau[2]

[1]*The Co-operative University of Kenya (mkaremeri@cuk.ac.ke)*

[2]*The Co-operative University of Kenya (ckamau@cuk.ac.ke)*

**Corresponding author: ckamau@cuk.ac.ke*

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Abstract

Sustainable agricultural practices are essential for responding to the twin pressure of climate change and rapid population growth in Kenya. Identifying mechanisms that accelerate the uptake of these practices remains a policy priority. Agricultural cooperatives societies (ACSs) have been proposed as a key institutional channel for supporting this transition. However, existing research on how ACSs influence the adoption of sustainable agriculture in Kenya is fragmented and significantly gaps persist regarding the consistency and strength of this relationship. This review synthesizes current empirical evidence and highlights methodological and theoretical limitations within the literature. A systematic search was conducted using google scholar, yielding 832 initial records. Studies were included if they examined Kenyan ACS and their relationship with sustainable or climate-smart agricultural practices, applied empirical methods, and were published in English. After screening, 22 studies met the inclusion criteria. Data were extracted on study characteristics, methodological approaches, and reported outcomes. Quantitative and qualitative findings were convergent. A majority of studies (86.4%) found that ACS membership was consistently associated with higher adoption rates of sustainable and climate-smart agricultural practices. Key mechanisms identified included improved access to information, collective resource mobilization, strengthened market structures, enhanced farmer inclusion, and support for innovation. Despite these benefits, several studies reported neutral or negative associations, often linked to governance weaknesses, limited technological capacity, and low farmer engagement. Additionally, 72.7% of the studies lacked a guiding theoretical framework, limiting explanatory depth and cross-study comparability. The evidence suggests that ACSs play a significant enabling role in advancing sustainable agriculture in Kenya, although their impact is uneven and context specific. Policymakers should prioritize strengthening CAS governance, investing in cooperative infrastructure, and promoting farmer participation. Future research should integrate robust theoretical frameworks to better explain causal pathways and variation in ACS effectiveness.

Keywords: Role of Co-operative Societies, Promotion, Sustainable Agriculture

Introduction

Agriculture remains central to Kenyans economy, contributing approximately 35% to national GDP and supporting the livelihoods of the majority of rural households (Kampmann & Kirui, 2021).However, the sector faces persistent productivity challenges arising from rain-dependent farming systems, low mechanization, and increasing exposure to climate-related stocks such as drought, floods and pest outbreaks (Mganga et al., 2024; Thongoh et al., 2021).In response, there is growing emphasis on the adoption of sustainable or climate-smart agriculture (CSA) practices including soil conservation, crop diversification, integrated pest management, fertilizer manure integration, water harvesting and the use of improved seed varieties to enhance resilience and reduce agricultures environmental footprint (Ngigi & Muange, 2022; Moraa & Mwangi, 2023).

Agricultural co-operative societies (ACSs) are widely recognized for supporting farers access to credit, information, input acquisition, and market through collective action (Ingutia & Sumelius, 2024). In Kenya, over 6300 agricultural co-operatives representing about 30% of all registered cooperatives play a significant role across value chains by lowering transaction costs, improving bargaining power, and facilitating technology uptake (Kenya National Bureau of Statistics , 2020; Miriro et al., 2023).Internationally, ACS have been associated with enhanced commercialization and innovation within the agriculture sector (Jordan, 2016; Candemir et al., 2021).

Despite these potential advantages, empirical evidence on specific contribution of ACSs to the adoption of sustainable or CSA practices in Kenya remains fragmented, methodologically diverse, and in many cases inconclusive. While some studies highlight the positive effects of cooperative membership such as improved access to information and collective resource mobilization others report limited or mixed outcomes due to governance challenges, infrastructural gaps, or low farmer engagement. Moreover, much of the existing literature lacks a coherent theoretical grounding, making it difficult to explain why ACSs succeed in some context but not others. This study therefor undertakes a systematic review to synthesize existing evidence on the relationship between ACSs and sustainable agricultural practices in Kenya, identify consistence's and contradictions across studies, and highlight gaps that can inform future research and policy interventions.

Statement of the Problem

Climate change poses a significant threat to agricultural productivity, food security, and nutritional wellbeing, particularly in sub-Saharan Africa. Projections indicate substantial declines in yields of key staple crops by 2050, maize 5%, rice 14% and wheat 22% placing already vulnerable populations at heightened risk of food insecurity (Gebre et al., 2023).In Kenya, this challenge is compounded by rapid population growth and persistent dependence on climate –sensitive production systems. Sustainable agriculture practices (SAPs) have therefore been widely promoted as a pathway for enhancing resilience, improving productivity, and reducing the environmental impact of the agriculture sector (Asule et al., 2024). Yet adoption rates remain low due to inadequate farmer awareness, limited technical capacity, and prohibitive costs associated with new technologies (Karaya et al., 2020).

Agricultural cooperative societies (ACSs) are well positioned to address these barriers by enabling collective access to information, input, credit, and market, and by facilitating knowledge exchange among farmers. However, despite their prominence within Kenya's agricultural landscape, empirical evidence on

the extent to which ACSs actually promote the uptake of sustainable farming practices is scattered, methodologically inconsistent, and in some cases contradictory. Existing studies differ widely in their design, geographic focus, and conceptual frameworks, making it difficult to draw reliable conclusions about the overall effectiveness of cooperatives in advancing sustainable agriculture. This systematic review therefore addresses a critical knowledge gap by consolidating and analyzing existing empirical studies on the role of cooperative societies in promoting sustainable agriculture in Kenya. The review seeks to provide a coherent synthesis of current evidence, identify factors that explain variation in ACS effectiveness, and inform future research and policy interventions

Research Objectives

The review seeks to realize the following objectives:

- Assess the general characteristics of empirical studies on co-operatives and sustainable agriculture in Kenya.
- Synthesize evidence on how co-operatives influence adoption of sustainable agricultural practices.
- Identify key mediating and moderating factors shaping this relationship.

Literature Review

Theoretical Review

The study will be guided by the theory of social capital by Bourdieu (1985), who opined that social relationships and networks are a valuable asset that has productive benefits. The theory is founded on the premise that social networks provide value to individuals by allowing them to access social resources that are embedded in the network (Ridloah et al., 2024). This theory provides a viable explanation for how ACSs can reinforce sustainable agricultural practices. Agricultural co-operative societies can help farmers build social relationships and networks that would be a resource for use in the implementation of sustainable agricultural practices (Candemir et al., 2021).

The ACSs encourage the growth of social capital among farmers by promoting trust, reciprocity, cooperation, solidarity, equity, mutual assistance, and democracy among members (Candemir et al., 2021). The ACSs bring the farmers together, cultivate trust, strengthen their relationships, and encourage cooperation and joint actions on common issues like climate change. According to Punina et al. (2024), members of ACSs manifest social capital in the form of increased bargaining power, improved access to credit, enhanced efficiency, reduced transaction costs, improved technical knowledge, and innovation. The social network created by cooperatives also enables farmers to bargain for lower input prices and higher selling prices, access credit at affordable rates, and acquire information needed to change their farming practices (Ridloah et al., 2024). The social capital enabled the farmers to reduce their vulnerability and enhance their resilience.

Empirical Review

The term sustainable agricultural practices refers to farming approaches that meet the needs of current and future generations while guaranteeing profitability, social justice, and ecological health (Sharma et al., 2024). The term refers to agricultural practices that meet the three dimensions of sustainability: economically viable, environmentally responsible, and socially responsible. Asif and Panakaje (2023) observed that the notion of sustainable agriculture in Indian scholarly work focuses on agricultural practices

for maintaining life, optimal use of resources, conservation of biodiversity, and the use of ecological methods of restoring soil fertility. Oosetendrop et al (2019) noted that smallholder farmers in rural areas often lack adequate access to affordable financial services. This limits their capability to implement sustainable agricultural practices and respond to growing climate risks. There is a need for innovative models for closing this financial gap.

In the Kenyan dairy sector, Kilima et al. (2024) observed that international sustainability benchmarks were only observed in the formal dairy network, which accounts for less than 20% of the milk produced in the country. The authors called for the exploration of mechanisms that will cascade the sustainability standard to the informal markets that dominate the dairy sector. The authors identified the co-operative model as a viable mechanism for facilitating the adoption of sustainability standards in the informal dairy sector. Punina et al. (2024) noted that co-operatives have been an effective strategy for improving the living conditions of people through collaboration and joint work based on principles of solidarity, democracy, and equity.

Governments and development organizations have been using farmers' organizations, including co-operatives, as the preferred model for implementing agricultural projects and programmes (Wadesango & Mabunda, 2017). Zakaria et al. (2020) noted that in most studies focusing on ACSs, issues of sustainability are neglected. The authors advanced that the potential of co-operation to advance the sustainability agenda is severely underestimated and has attracted limited research. Hebert et al. (2016) observed that the vast majority of ACSs do not prepare sustainability reports despite this being a growing practice in other sectors. Attention towards the sustainability indicators of ACSs is limited when compared to other profit-oriented organizations.

In their study examining the ecological impact of cage farming on Lake Victoria, Nyakenya et al. (2022) observed that fishermen groups and cooperatives can play a role in addressing the ecological damages of cage fish farming in Lake Victoria. The author observed that cage fish farming had grown in the area to reach 6,000 cages in the year 2020, of which 37% were owned by groups. Nyakenya et al. (2022) recommended that the groups provide a platform for training cage fish farmers on proper site selection and management of chemicals and feeds used in cages. This review sought to determine whether the effect of cooperatives on the sustainability of cage fish farming has been empirically tested within the Kenyan context.

Opiyo et al. (2020), in their study examining food loss and waste in Kisumu County, recommended that farmers should organize themselves into cooperative societies to be able to aggregate their produce into sufficient quantities and deliver it to supermarkets that have storage and refrigeration facilities. The cooperative can also assist the farmers in accessing mobile funds for purchasing refrigeration and other storage facilities, leading to a reduction of food loss and waste. Opiyo et al. (2020) noted that reducing food loss and waste is one of the actions that could improve the sustainability of the local and global food systems by reducing environmental waste, minimizing the size of land being cleared for Agricultural production, reducing production cost, and increasing efficiency. This review sought to establish where the effect of cooperation in reducing food loss and waste in Kenya has been tested empirically.

The study by Ruheni et al. (2024) also recommended that farmers in Laikipia County should form cooperatives to enhance their capacity to procure resources that they need to implement climate-smart

agricultural practices. Results of the study revealed that the farmers lacked competitiveness and bargaining power in the procurement of agricultural input because agri-dealers had established a monopoly in the area, as farmers lacked alternatives. There were also high costs involved in the transportation of input because the agro dealers were located far from the farmers. Ruheni et al. (2024) recommended that farmers should form cooperatives to leverage the value of economies of scale and increase their bargaining power.

Sharma et al. (2016) observed how the formation of a self-help group helped 150 women in India collect and sell neem seeds for processing into biofuel. The cooperation between the women enabled them to collect enough quantity of seeds that could be processed economically. Production of biofuel is a sustainable agricultural practice as it has the potential to reduce consumption of fossil fuels that emit greenhouse gases (Rial, 2024). This would, in turn, mitigate the global warming and climate change phenomena. Apart from contributing towards environmental sustainability, the formation of the self-help group also enhanced the women's economic sustainability as each woman earned an average of 30,000 rupees per year (Sharma et al., 2016).

Research Methodology

Articles Search

A systematic search was executed within the Google Scholar database to comprehensively identify literature pertaining to the role of collective action in agriculture sustainability in the Kenyan context. The search employed a Boolean logic string combining key words including cooperatives or farmers' groups or farmer organizations and sustainable agriculture or smart agriculture. The search was refined using the date filter that limited the search to articles published between 2016 and 2015 and the "type of article" filter that confined the search to only peer-reviewed articles. The search yielded 854 results.

Articles Appraisal

The quality of the 854 articles was appraised based on the following inclusion and exclusion criteria:

- Article must have been empirical
- Article must have been published in English
- Article must have been reporting a study conducted in Kenya
- The article presents evidence of how cooperatives contribute to sustainable agriculture.

The articles were appraised in three stages: title assessment, abstract assessment, and full paper assessment. Following the appraisal process, 832 articles were excluded because they were not reporting a study conducted in Kenya, were not empirical, were not published in English, or did not report evidence of how cooperatives contribute towards sustainable agriculture. Twenty-two studies met the inclusion criteria and were included in the review. Figure 3 summarizes the article appraisal process.

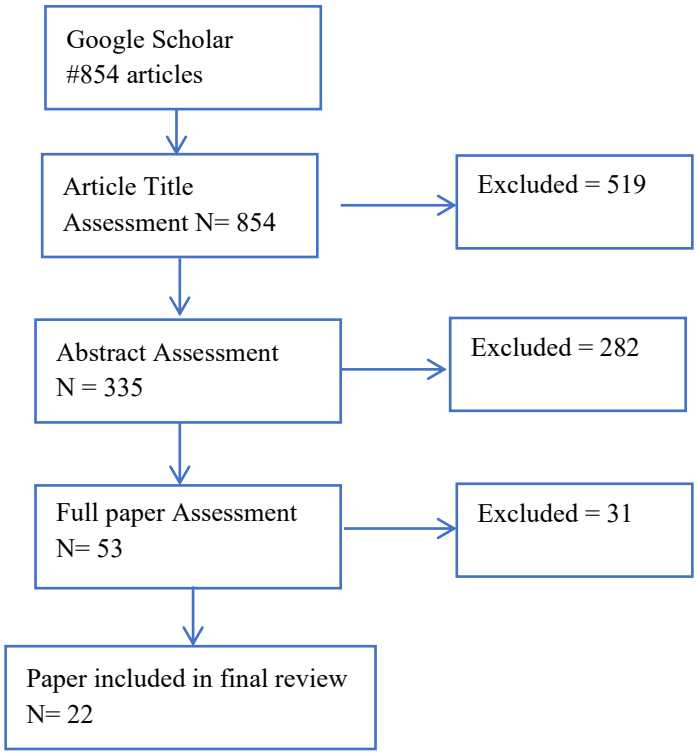

Figure 2: Articles Appraisal Process

Data Extraction

Data were extracted from the 22 articles that met the inclusion criteria using a custom-made Excel template. The template extracted information on article author and publication year, study objective, theory used, research approach, research design, target population, agricultural sub-sector, methods of data collection, methods of data analysis, and study findings.

Results

General Characteristics of Reviewed Studies

The first objective of the study was to assess the general characteristics of studies on the role of co-operative societies in promoting sustainable agriculture in Kenya. Table 1 summarizes these characteristics.

Table 1: General Characteristics of Reviewed Studies

Characteristic	Categories	Frequency	Percent
Research approach	Mixed method	10	45.5
	Quantitative	7	31.8
	Qualitative	5	22.7
Research design	Cross-sectional survey	9	40.9
	Convergent parallel mixed method	8	36.4
	Case study	4	18.2
	Phenomenology	1	4.5
Theories	None	16	72.7

	Diffusion of innovation	2	9.1
	Adoption theory	1	4.5
	Neoclassical theory of cooperatives	1	4.5
	Sectoral system of innovation	1	4.5
	Social capital theory	1	4.5
	Theory of change	1	4.5
	Transactional theory	1	4.5
Agricultural subsector	Mixed sub-sectors	13	59.1
	Dairy	5	22.7
	Coffee	1	4.5
	Cassava	1	4.5
	Meat industry	1	4.5
	Pasture farming	1	4.5
	Vegetables	1	4.5
Data collection methods	Questionnaires	11	50.0
	Interviews	11	50.0
	Focus group discussions	8	36.4
Data analysis methods	Descriptive statistics	14	63.6
	Thematic analysis	8	36.4
	Pearson chi-square test	4	18.2
	Logistic regression	4	18.2
	Pearson correlation	3	13.6
	Linear regression	2	9.1
	Fisher's exact test	1	4.5
	Poisson regression	1	4.5
	Mann-Kendall test of significance	1	4.5
	Context analysis	1	4.5

Results in Table 1 show that 45.5% of the studies used a mixed-method approach, 31.8% used the quantitative approach, and 22.7% used the qualitative approach. The predominance of the mixed-method approach points to the complexities in studying the subject of sustainability. As Byomkesh et al. (2020) elucidate, sustainability is a complex and diverse issue that involves multiple factors that fit broadly in the economic, ecological, and social domains. The complexity of this subject may have compelled most scholars to integrate quantitative and qualitative methods to bring out the interplay between ACSs and sustainable agricultural practices.

Results in Table 1 also show that 40.9% of the studies utilized the cross-sectional survey design, 36.4% used the convergent parallel mixed-method design, 18.2% used the case study design, and one study (4.5%) utilized the phenomenology design. The prevalence of the cross-sectional survey design is likely attributed to the simplicity and cost-effectiveness of this design as it entails capturing data at a single point in time (Creswell & Creswell, 2023). The dominance of the convergent parallel mixed-methods design underscores the commitment of the researcher to integrate quantitative and qualitative methods to enrich the depth of their insights. On the other hand, case studies indicate an interest in exploring specific instances in depth while phenomenology highlights a focus on farmers' experiences (Marrais et al., 2024). The methodology diversity indicates the dynamism of the relationship between ACSs and sustainable agriculture.

Results in Table 1 further show that 16 studies accounting for 72.7% of the sample were not grounded on any theory. Diffusion of innovation theory featured in two studies (9.1%), while the other theories, adoption theory and neoclassical theory of cooperatives, each featured in one study. These results suggest that the majority of the studies lacked a theoretical framework, which could limit the depth and generalizability of their findings. In addition, the majority of the studies (59.1%) targeted a general population of farmers rather than a specific agricultural sub-sector, while 22.1% focused on the dairy sector. The coffee, cassava, meat industry, pasture farming, and vegetables sub-sectors featured in one study each. These results suggest that most of the research has captured broad trends and insights rather than specific sub-sectors, enhancing the generalizability of findings.

Questionnaires and interviews were the most prevalent methods of data collection, featuring in 50% of the studies, while focus group discussions were used in 36.4% of the studies. The combination of these data collection methodologies signifies balanced quantitative and qualitative insights (Creswell & Creswell, 2023). Diverse methods of data analysis have been used, but the most prevalent are descriptive statistics (63.6%), followed by thematic analysis (36.4%), Pearson chi-square (18.2%), and logistic regression (18.2%). The prevalence of descriptive statistics indicates a focus on identifying basic trends and patterns, while thematic analysis suggests the intention to delve into qualitative aspects (Marrais et al., 2024). The presence of advanced statistical methods like Pearson chi-square and logistic regression showcases an effort to test the relationship between CSAs and sustainable agriculture (Creswell & Creswell, 2023). The dominance of Pearson chi-square and logistic regression as the choice for inferential analysis indicates that most researchers view sustainable agriculture as a categorical outcome.

Synthesis of Study Findings

The second objective of the study was to synthesize findings of studies on the role of co-operative societies in promoting sustainable agriculture in Kenya. Table 2 presents a summary of the findings:

Table 2: Summary of Findings

Article	Key Findings
Asayehegn et al. (2017)	ACSs provided materials and input needed for innovation, platforms for farmers to engage with financial institutions and research institutes, access to markets, information, and knowledge to farmers, and technologies like new breeds and milk cooling machines.
Asule et al. (2024)	About 35% of the farmers belonged to a farmers' group. Group membership was negatively associated with awareness and adoption of crop rotation, cover cropping, and intercropping, but was positively associated with fertilizer-manure integration.
Autio et al. (2021)	Lack of proper marketing structures is one of the constraints that have hindered the adoption of CSA practices because it has exposed farmers to unexpected fluctuation in prices. Farmers have been discouraged from forming co-operatives to gain agglomeration benefits because of competition by large-scale farmers selling their produce, brokers exploiting the farmers, and poor management in the cooperatives.
Biswas (2024)	ACSs promote resource sharing, increased market access and bargaining power, enhance access to credit and financial stability, and facilitate knowledge sharing and training. These functions lead to reduced input costs, access to modern farming inputs, increased sales, reduced transaction costs, expanded market reach, support investment in productivity, enhance knowledge of best practices, improve yields, and increase sustainability.

Gebre et al. (2023)	About 33% of the sampled farmers were members of an input supply cooperative. Being a member of an input supply cooperative is positively associated with the adoption of the crop diversification strategy and high income. Adopting two CSA practices increases food security status by 11-14%
Ingutia & Sumelius (2024)	Only 39% of rural female farmers were members of ACSs, with membership fees being an entry barrier. More than 50% of the cooperatives were involved in advocating for female land rights, only 30.7% were involved in the provision of water for irrigation, 69% provided members access to cheaper inputs, and only 15.3% provided access to modern technology, 23% provided training, and none were effective in providing access to cheap credit. Farmers who were members of ACSs had significantly higher crop intensity than non-members.
Karaya et al. (2020)	Members of the farmers' organization had greater access to credit and extension services. More group members admitted having knowledge, skills, and labour required to implement sustainable land management practices. More group members than non-group members recognize climate change as a challenge, indicating high awareness levels. Group members adopted more SLIM practices than non-members. The high adoption among group members can be attributed to higher access to labour through reciprocal labour sharing in groups, access to information, and access to credit.
Kipchumba et al. (2025)	About 70% of the respondents reported having benefited from participating in a local farmers' group by enhancing their knowledge of CSA practices.
Kiptot & Franzel (2019)	The donor-supported farmer-to-farmer extension programme, which was the case being studied, became sustainable because they were provided through the dairy management groups (DMGs). Initially, the DMGs were formed to facilitate training of farmers on dairy feeds and feeding methods but diversified their operations to include the sale of heifers, buying of water tanks for group members, milk transportation, milk trading, and fodder production over time.
Kirina et al. (2022)	Groups were used by various projects in East Africa as one of the strategies to scale CSA practices. The groups facilitated the dissemination of information and sharing of knowledge among the farmers. Some groups grew and were registered as co-operatives.
Koyi (2020)	The most prevalent services offered by ACS in the dairy sub-sector include milk marketing, milk collection, and artificial insemination in that order, while the least prevalent were cow insurance, credit services, and value addition. Benefits conferred to members include assured market, improved incomes, assured payment, upgrade of breeds, training, and better prices. Weaknesses include a lack of adequate infrastructure to process diverse milk products, a lack of diverse benefit packages, low knowledge on dairy farming among members, and the side selling of milk. Despite the weakness, the ACSs have played a role in enhancing the sustainability of the dairy sub-sector.
Kurgat et al. (2018)	Being a member of a farmers' group was positively associated with the use of organic manure and soil fertility.
Meiguran et al. (2016)	About 75% of the sampled farmers belonged to a farmers' group. Farmers who were members of a group were more likely to engage in greenhouse farming and artificial insemination than their counterparts. However, no difference was noted between members and non-members in terms of use of certified seeds, crop value addition, banana tissue culture technology adoption, and dairy goat farming (livelihood diversification).
Mganga et al. (2024)	Co-operatives presented an opportunity for farmers to upscale pasture farming by providing them with quality inputs, high-quality markets, higher prices, and more reliable contracts. They also assisted farmers in exporting native grass seeds and reduced costs by pooling investments. This led to a more sustainable pasture farming sub-sector.

Moraa & Mwangi (2023)	About 47.7% of the farmers obtained information on climate change and CSA from farmers' groups.
Mwambi et al. (2021)	Household membership in ACSs increased women's independent decision-making concerning buying and selling of cows, the amount of loan to be borrowed, and on loan. It also increased women's probability of receiving dairy income and participation in making decisions on the market outlet for selling milk but did not increase women's ownership of livestock and land. Input ACSs had a significant effect on men's and women's decision-making on buying and selling of cows and their ownership of cows, but processing ACSs had a non-significant effect. There is stronger women's empowerment when the woman in the household is a member of the ACSs. Women's membership in bargaining ACSs results in greater empowerment, in terms of ownership of cows, than women's membership in processing ACSs.
Ndung'u et al. (2023)	The most adopted CSA technologies by smallholder farmers in Kakamega County were agroforestry, composting, and soil and water conservation structures. CSA adoption rates were higher among farmers in groups (43.9%) than among those who were not (6.3%). Active group members had higher adoption rate (48%) than passive group members (35.6%). Groups facilitated training, demonstration, and capacity building of CSA farmers.
Ngala (2022)	Domineering culture by older men, challenges in allocation of resources, absence of succession planning, and negative attitude towards agriculture were among the factors that impeded youth participation in coffee cooperative societies in Machakos County. Addressing these challenges will turn cooperatives into effective platforms for promoting the inclusion of youths in Agriculture.
Ngigi & Muange (2020)	Belonging to a mixed-gender group was associated with greater access to seasonal forecasts for husbands and advisory services for both spouses. Wives who were members of mixed-gender groups were also more likely to adopt climate-smart agricultural practices like agro-forestry, crop rotation, and soil conservation.
Opondo et al. (2023)	The impact of groups was minimal because most cassava farmers' groups in Siaya County lacked adequate rules and regulations for guiding their operations. Most of the groups were initiated by development organizations that wanted to work with farmers as groups, with most farmers joining the groups just to benefit from the development organizations' initiatives. Most groups were informal without detailed information about the role and rights of members. Group leaders treated the groups as their own property and acted as brokers between other members and the development organizations, with the aim of benefiting more. As a result, most of the projects started through these partnerships, like the cassava processing plants in Alego-Usonga, Sega, and Boro, stalled.
Thongoh et al. (2021)	One of the barriers to the adoption of CSA in the red meat value chain is the lack of associations like co-operative societies to facilitate the exchange of information and ideas, as well as to advocate and drive the implementation of CSA practices. Cooperatives can help disseminate information that would address challenges like indiscriminate use of antibiotics and livestock drugs, and the use of counterfeit drugs that lead to disease resistance.
Wambu & Gichuki (2024)	Co-operatives have enabled dairy farmers in Meru County to access feeds and fodder by subsidizing their prices, giving them credit, bulk buying of super napper and selling to farmers, and producing seeds for fodder. Access to feeds and fodder has enhanced the economic sustainability of dairy farming. It has also made the farmers more resilient to environmental shocks.

The study findings of the reviewed literature fall into three main main categories: the direct relationship between ACSs and sustainable agriculture, and the mediating and moderating variables influencing the relationship between ACSs and sustainable agriculture.

Relationship between ACSs and Sustainable Agriculture

Out of the 22 studies, 19 (86.4%) had findings that suggest that ACSs have a positive influence on the adoption of sustainable agricultural practices. For instance, Ndung'u et al. (2023) observed that the CSA adoption rate in Kakamega County was 43.9% among farmers in groups and 6.3% among those not in groups. Ingutia & Sumelius (2024) observed that farmers who were members of ACSs had significantly higher crop intensity than non-members. Moraa & Mwangi (2023) observed that about 47.7% of the farmers obtained information on climate change and CSA from farmers' groups.

Three out of the 22 studies (13.6) found some negative association between ACS and sustainable agriculture. The study by Asule et al. (2024) found that group membership was negatively associated with awareness and adoption of crop rotation, cover cropping, and intercropping but was positively associated with fertilizer-manure integration. These findings imply that ACS membership can be both a barrier and an enabler of sustainable agricultural practices. Autio et al. (2021) found that adoption of CSA practices was hampered by the lack of proper marketing structures because farmers had been discouraged from forming co-operatives by competition from large-scale farmers selling their produce, brokers exploiting the farmers, and poor management in the cooperatives. Opondo et al. (2023) found that all initiatives that were started through farmers' groups to improve the sustainability of cassava farming in Siaya had stalled due to group factors like a lack of clear rules and structures.

Two studies (9.1%) had findings that suggested that ACSs do not have a notable influence on sustainable agriculture. Meiguran et al. (2016) observed that while ACSs in Nyamusi Sub-County in Nyamira County had a positive influence on the adoption of greenhouse farming and artificial insemination, they did not have a significant influence on the adoption of the use of certified seeds, crop value addition, banana tissue culture technology, and diversification strategies like dairy goat farming. Mwambi et al. (2021) observed that household membership in dairy ACSs did not have a significant influence on women's ownership of cows and land. These two studies suggest that ACSs are effective in promoting some sustainable agricultural practices, but not all of them.

Factors That Mediate the Relationship Between Acss and Sustainable Agriculture

The reviewed studies also highlight some of the factors that mediate or can explain how ACSs assist farmers in adopting sustainable agricultural practices. These factors include providing information, resource mobilization, creating marketing structures, promoting equality and inclusion, and supporting innovation.

Providing Information

Farmers' knowledge and awareness of sustainable agricultural practices are foundational to the successful adoption of these practices. Moraa & Mwangi (2023) found that 44.7% of farmers learnt about climate change and climate CSA in farmers' groups. Specifically, the study found that since it was practically impossible for extension officers to train all farmers in the study area, the officers provided training to group leaders who would then teach their members what they had learnt. This implies that the groups enabled the

extension officers to execute the train-the-trainer and cascade model to fast-track the dissemination of knowledge about climate change and CSA.

Asayehegn et al. (2017) also found that CSAs played a role in providing information and knowledge to farmers through training. Biswas (2024) further observed that ACSs facilitated the sharing of knowledge among farmers and the delivery of training that enhanced the farmers' knowledge of sustainable agricultural practices, leading to improved yields and greater sustainability. Karaya et al. (2020) also found that more farmers who were members of a group in Lake Baringo Basin knew about the climate change phenomena and its challenges to the agriculture sector, as well as the knowledge needed to implement sustainable land management practices, than non-members. In the study by Kipchumba et al. (2025), 70% of the respondents said that they had gained knowledge on CSA practices. Mganga et al. (2024) observed that dairy management groups (DMGs) provided platforms for a donor-supported farmer-to-farmer extension programme to provide training to farmers on dairy feeds and feeding methods.

Resource Mobilization

Implementation of sustainable agricultural practices requires resources like finances, labour, technology, and natural resources like water. Asayehegn et al. (2017) observed that cooperatives provided farmers in the dairy and coffee sub-sectors with financial and credit services that enabled them to obtain the financial resources that they needed to implement sustainable agricultural practices. Ngala (2022) also observed that ACSs can enable youths to mobilize resources and start agribusiness projects. This author noted that the agriculture sector in Kenya was dominated by older people, with the average age of a Kenyan farmer being 60 years. The youth have been locked out of the sector because they lack critical resources like land and capital. Forming cooperatives can help the youth to overcome these barriers and ensure continuity in the agricultural sector. Biswas (2024) also found that ACSs promote resource sharing and enhance access to credit among farmers, which enables them to access modern farming inputs and technologies. Karaya et al. (2020) observed that farmers in the Lake Baringo Basin who were members of groups have greater access to labour needed to implement sustainable land management practices, as the group facilitates reciprocal labour sharing. These results imply that ACSs not only play a role in mobilizing funds but also help farmers to mobilize non-monetary resources like labour.

Creating Marketing Structures

Creating a robust marketing structure is crucial to the realization of sustainable agriculture because it enables better pricing, reduces waste, and ensures the economic viability of sustainable agricultural practices. Autio et al. (2021) found that a lack of proper marketing structure was a major barrier hindering smallholder farmers from adopting CSA practices because it exposed the farmers to unexpected fluctuation in prices. The price fluctuations compelled some farmers to hold on to their commodities, leading to losses and wastage. Asayehegn et al. (2017) found cooperatives in the dairy and coffee sector played a role in linking farmers to markets, leading to better prices for produce and a reduction in food waste. The market guaranteed fast offtake of the farmers' produce, reducing spoilage incidents. Biswas (2024) also found that ACS gave farmers greater market access and stronger bargaining power that enabled them to get better prices for their produce. Better prices gave the farmers the financial muscle that they needed to implement sustainable agricultural practices. Mganga et al. (2024) observed that ACSs provided farmers in Kitui

County with more reliable contracts for their pasture, leading to stable and higher prices that made pasture farming more sustainable.

Promoting Equality and Inclusion

The sustainability of the agriculture sector in Kenya is often undermined by the exclusion of a significant section of the population, specifically women and the youth. The study by Ngala (2022) found that ACSs can promote the inclusion of the youth in Agriculture by assisting them to access mobile resources, as well as by increasing agricultural yields and supporting the incorporation of technology, making agriculture attractive to the youth. Inclusion of the youth enhances sustainability by bringing new ideas and energy that lead to innovation, efficiency, and increased productivity. Mwambi et al. (2021) observed that household membership in dairy ACSs increased women's involvement in making key decisions within the households, like buying and selling of cows, how much to borrow, and how to use the borrowed. It also empowered women by enabling them to own cows. Inclusion of women in agriculture increases productivity, promotes diversification, enhances innovation, and increases household income.

Supporting Innovation

Innovation is important to the realization of sustainable agriculture because it drives improvement in farming techniques, practices, and technologies. Asayehegn et al. (2017) observed that CSA contributed towards sustainable agriculture practices by providing farmers with materials and inputs that they needed to innovate. They also provided platforms through which farmers can engage research institutes like the Kenya Agricultural and Livestock Research Organization (KALRO), leading to the diffusion of innovation. The study also found that CSA in the dairy sector helped farmers to adopt new breeds that enhanced their production and acquire milk cooling facilities that minimize the loss of the products.

Factors That Moderate the Relationship Between ACS and Sustainable Agriculture

The reviewed studies further shed light on factors that moderate or shape the contribution of ACSs towards the adoption of sustainable agricultural practices. These factors include ACSs' functions and activities, ACSs' governance, ACSs' member composition, farmers' proactiveness, and ACSs' infrastructure and technology.

Activities and Functions of the ACS

ACSs engage in a wide range of activities, including input acquisition, marketing, lobbying and advocacy, processing of produce, credit services, and training, among others. These activities vary from one ACS to another. The study by Ingutia and Sumelius (2024) found that 69% of women ACSs in rural areas of Kakamega provided access to cheaper input, 50% were involved in advocating for female land rights, 30.7% were involved in the provision of water for irrigation, 23% provided training, and 15.3% provided access to modern technology.

Mganga et al observed that initially, the dairy management groups (DMGs) were enlightening farmers on dairy feeds and feeding methods by providing a structure for the donor-funded programme to provide training. Over time, the DMGs diversified their operations to include the sale of heifers, the buying of water tanks for group members, milk transportation, milk trading, and fodder production. With the additional roles, the DMGs enabled members to network, obtain credit, exchange information, organize field trips,

organize capacity building initiatives, receive technical support from extension workers, and receive training materials. The additional roles enhanced the DMG's contributions towards the creation of a sustainable dairy sub-sector.

Koyi (2020) found that the most prevalent services offered by the ACSs in the Kenyan dairy sub-sector include milk marketing, milk collection, and artificial insemination in that order, while the least prevalent were cow insurance, credit services, and value addition. The study further revealed that the failure to provide a diverse benefit package was one of the weaknesses that hampered the contribution of the ACSs towards the sustainability of the dairy sub-sector. The study by Mwambi et al. (2021) also suggests that women's empowerment is affected by the functional characteristics of POs. Women's empowerment is a pillar of sustainable economic development.

Governance of the ACS

The term governance refers to the manner in which the ACSs are managed and controlled. It is concerned with issues of accountability, transparency, and fairness in the management of the ACSs. Asayehegn et al. (2017) found that ACSs in the dairy sub-sector were more transparent than CSAs in the coffee sub-sector. Autio et al. (2021) found that many smallholder farmers were discouraged from forming CSAs that would have given them agglomeration benefits because they perceive that most CSAs are poorly managed. Opondo et al. (2023) also observed that most of the projects initiated through farmers' groups to make cassava farming in Siaya County more sustainable had stalled because the groups lacked adequate rules and regulations, and group leaders acted as the go-between brokers between group members and the development organizations. The leaders controlled the groups' decisions rather than making the decision-making process participatory.

ACSs' Member Composition

Another theme that emerged was that the composition of ACS members in terms of characteristics like age or gender can also shape how ACS contributes to sustainable agriculture. Ngigi and Muage (2020) observed that couples in Embu, Nakuru, Nyeri, and Siaya who belonged to a mixed-gender group had greater access to seasonal forecasts for husbands and advisory services for both spouses. Members of mixed-gender groups were also more likely to adopt climate-smart agricultural practices like agro-forestry, crop rotation, and soil conservation than members of single-gender groups. This implied that mixed groups provide a platform for farmers of different genders to interact and share climate information, leading to improved access to climate information services.

Farmer's Proactiveness within the ACS

Farmers' proactiveness refers to the farmers' willingness to anticipate and adapt to changes rather than respond to them. Ndung'u et al. (2023) found that the adoption of CSA practices by farmers in Kakamega was 48% among farmers who were active group members and 35.6% among farmers who were passive group members. These results suggest that CSA adoption is higher among farmers who are proactive farmers than passive farmers. Opondo et al. (2023) also observed that one of the reasons that hampered the effectiveness of groups in improving cassava farming in Siaya County was the fact that the groups were not formed by the farmers but by the development organizations. Farmers were motivated to join the groups for the sole reason of benefiting from the initiatives being launched by the development organization. The

study further noted that most farmers were not active participants in the groups because the decision-making process was controlled by the group leaders.

Infrastructure and Technology

ACSs need infrastructure and technology to facilitate activities and functions like storage, logistics, communication, information management, sales and marketing, training and capacity building, and value addition. Koyi (2020) noted that the lack of adequate infrastructure and technology to process diverse milk products hampered the contribution of ACSs towards making the Kenyan dairy sector more sustainable. Due to the limited infrastructure and technology, the ACSs in the dairy sector were involved in the production of a limited range of products like fresh milk and yoghurt. Advanced infrastructure and technology would enable the ACSs to make products like milk powder, butter, cheese, and ghee that have higher prices and longer shelf life.

Conclusions and Recommendations

Conclusions

Sustainable agriculture is essential in ensuring that the country is able to meet present nutritional needs amidst challenges like climate change, without compromising the ability of future generations to meet their nutritional needs. Consequently, there is a need to identify mechanisms and strategies for fast-tracking the adoption of sustainable agricultural practices. This review has established a positive impact of ACSs on sustainable agriculture, but with a caveat. The majority of the studies show that ACS membership correlates with the adoption of ACS practices through the provision of information, resource mobilization, creation of marketing structures, promotion of equality and inclusion, and support for innovation. The studies also indicate that ACSs have the potential to promote inclusion, particularly for marginalized groups such as women and youth.

On the other hand, some studies indicate a negative impact; others suggest no impact, while others show a dual impact on sustainable practices. These studies show that the effectiveness of ACSs can be undermined by aspects like poor governance, inadequate infrastructure and technology, and lack of proactiveness on the part of the farmers. Literature on the role of ACSs in sustainable agriculture is quite diverse in terms of methods used, sub-sectors targeted, and the target population. This diversity has a positive implication on the generalizability of findings. However, the absence of a theoretical framework in 72.7% of the studies points to a potential gap that may hinder depth in understanding the relationship between ACSs and sustainable agriculture.

Recommendations

To facilitate the adoption of sustainable agricultural practices in Kenya, policymakers in the national and county governments should sensitize farmers on the benefits of forming or joining cooperatives. This will enable them to enjoy agglomeration benefits like access to information and resources, leading to the adoption of sustainable practices. Policymakers should also formulate policies and programmes for strengthening the governance of ACSs and enhancing their infrastructure and technology. Plausible interventions may entail training ACS managers on governance issues and providing credit to the ACSs to advance their infrastructure and technology. In addition, future research should incorporate established theoretical frameworks to enhance the understanding of the mechanisms through which ACSs influence

sustainable agriculture practices. This systematic review was not without limitations, including exclusive use of the Google Scholar database that might have left out studies in other databases, limiting the search to peer-reviewed articles that may have discarded useful grey literature, and focusing on articles published in English that could have excluded useful studies published in other languages. Future reviews may consider addressing these limitations.

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