frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 14 July 2025
DOI 10.3389/fsufs.2025.1607329

OPEN ACCESS

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RECEIVED 07 April 2025
ACCEPTED 13 June 2025
PUBLISHED 14 July 2025

CITATION
Suh J, Ji S and Nindi-Chigwe TC (2025) Collective action under risk and uncertainty: assessing impacts on smallholder farmers' income and food security in Malawi. *Front. Sustain. Food Syst.* 9:1607329. doi: 10.3389/fsufs.2025.1607329

Collective action under risk and uncertainty: assessing impacts on smallholder farmers' income and food security in Malawi

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Introduction: Smallholder farmers in Sub-Saharan Africa face increasing challenges, compounded by risks such as climate change, global conflicts, and food insecurity. Collective action has been promoted as a strategic mechanism to strengthen smallholder farmers' livelihoods, yet limited empirical evidence exists on its effectiveness under recent and compounding risks in Malawi. To address this gap, this study examines the impact of smallholder farmers' participation in collective action on household income and food security in Kasungu District, Malawi, during a period marked by climate shocks and market instability.

Methods: Data were collected through both qualitative and quantitative methods. Ten focus group discussions were conducted to identify the perceived benefits of participation in cooperatives, followed by a household survey with 475 farmers, including both cooperative members and non-members. Quantitative analysis applied difference-in-differences, entropy balancing, and doubly robust estimation to assess the causal effects.

Results: The findings suggest that cooperative membership significantly increased household income and improved dietary diversity, even amid deteriorating food security conditions in the region. However, results varied by gender. While male-headed households experienced improvements in both income and food security, female-headed households did not see significant improvement in dietary diversity despite the increase in income. The study also finds that support from non-governmental organizations played a key mediating role in facilitating farmers' participation in collective action.

Discussion: These results highlight the potential of collective action to enhance resilience and rural livelihoods under uncertain conditions, while also emphasizing the need for gender-responsive and institutionally supported strategies to ensure equitable outcomes.

KEYWORDS

collective action, cooperative, food security, gender, difference-in-differences, entropy balancing, doubly robust difference-in-differences, Malawi

1 Introduction

Despite a notable reduction in the global population living in poverty, a large proportion of the population in Sub-Saharan Africa (SSA) continues to grapple with poverty and undernutrition (Adeyeye et al., 2023; Gassner et al., 2019; Paloma et al., 2020). This issue is more evident in rural areas of SSA, where 52% of the population is in extreme poverty, according to the Food and Agriculture Organization

(FAO et al., 2014). Furthermore, 82% of the poor in SSA live in rural areas, most of whom rely on agricultural activities and income for their livelihoods (Beegle et al., 2016). This indicates that progress in eliminating poverty falls short of the ambitious goals of global society.

In this context, smallholder farmers are recognized as key players in improving the livelihoods of the poor in SSA. Although smallholder farmers cultivate only 12% of the world's farmland, they are responsible for 80% of the food in SSA and Asia (Lowder et al., 2014). Notably, the agricultural activities of smallholder farmers support the livelihoods of two billion people worldwide (FAO et al., 2014). Most importantly, given that most smallholder farmers are located in rural areas, they play a pivotal role in reducing poverty and enhancing the livelihoods of rural people, particularly in SSA.

However, smallholder farmers face numerous challenges and barriers preventing them from taking responsibility. In particular, challenges related to low productivity, limited market access, and weak market competitiveness have hindered the improvement of rural people's livelihoods through smallholder farmers. Most smallholder farmers in SSA lack essential agricultural inputs such as improved seeds and fertilizers, which are necessary to increase crop productivity (Paloma et al., 2020). For instance, the adoption of improved seeds remains limited among smallholder farmers in Africa, despite their pivotal role in enhancing crop productivity. The average adoption rate of improved maize varieties in Africa is only 28%, which is significantly lower than that in other continents (Langyintuo et al., 2010). The average quantity of fertilizer used, at ~16 kg/ha, is also much lower than the 331 kg/ha in East Asia and 160 kg/ha in South Asia (World Bank, 2024). This low adoption rate can be attributed to several factors, including the high price of improved seeds, limited financial resources, and lack of knowledge about their utilization, often stemming from inadequate access to agricultural extension services (Paloma et al., 2020).

In addition, as both buyers and sellers in the market, these farmers face financial constraints (Abdul-Rahaman and Abdulai, 2020; Mojo et al., 2017). Smallholder farmers must pay high transaction costs to access markets. These costs include the expenses related to researching potential markets, buyers, prices, and investments necessary to meet the quality standards demanded by market actors (Shiferaw et al., 2011). Owing to weak bargaining power and a lack of market information, many smallholder farmers are compelled to sell their products to middlemen at low prices, either at the farm gate or at local markets (Fafchamps and Hill, 2005).

Importantly, these challenges are likely to continue because of the increasing diversity of risks and lack of institutional support in most rural areas of SSA (de Janvry et al., 1991; Paloma et al., 2020; Otekunrin et al., 2019). The increasing challenges posed by climate-related events, the COVID-19 pandemic, wars, and conflicts have become major threats to smallholder farmers putting them at risk (Hatab, 2022; Onyeaka et al., 2022; Wineman et al., 2024).

In this context, collective action of smallholder farmers is recognized as a strategic approach to overcome the challenges they face, offering various benefits in empowering smallholder farmers in SSA. Collective action takes place across various stages of agricultural activities, including production, postharvest management, and marketing. Previous studies have documented the benefits of participation in collective action at each stage particularly in enhancing crop productivity and market access (Abdul-Rahaman and Abdulai, 2020; Markelova et al., 2009; Naziri et al., 2014; Reardon et al., 2009). However, as the frequency and severity of global shocks, such as the COVID-19 pandemic, conflicts, and climate change, continue to increase, it has become increasingly important to consistently generate empirical evidence on the effectiveness of collective action under conditions of growing uncertainty. In addition, it is necessary to examine the heterogeneous effects of collective action, as several studies have identified gender-based differences in the benefits of participation (Grashuis and Su, 2019; Opata et al., 2020; Wekwete, 2014).

This study aims to investigate the impact of smallholder farmers' participation in collective action on their livelihoods in unstable situations, such as the COVID-19 pandemic and global conflicts, with particular attention to gender-based differences in outcomes. The analysis focuses specifically on cooperatives in Kasungu District, Malawi. Malawi is a relevant case for this study because it depends heavily on smallholder agriculture, has recently experienced food security crises, and lacks sufficient empirical evidence on the role of collective action in improving smallholder livelihoods (MVAC, 2023; World Bank, 2018). Three specific research questions were formulated prior to conducting the study, as follows:

- To what extent did participation in collective action contribute to an increase in household income among smallholder farmers between 2021 and 2023, amid worsening food security conditions in Malawi?
- How did participation in collective action influence the food security status of smallholder farmers?
- Were there gender-differentiated effects of participation in collective action?

To address these questions, this study conducted qualitative and quantitative analyses based on field interviews with 10 focus groups and household surveys with 475 households. Through data collection and analysis, this study identified impacts of collective action on farmers' household income and food security status in Malawi, with particular attention to heterogeneous effects. The findings of this study will contribute to the literature by providing empirical evidence on how participation in collective action influences household income and food security among maize-dependent smallholder farmers in Malawi, particularly in the context of increasing uncertainties.

2 Background

2.1 Review of existing literature on collective action and its impact

Numerous studies indicate that collective action among smallholder farmers in developing countries provides significant advantages, particularly by enhancing productivity, improving market access, and improving livelihoods (Abdul-Rahaman and Abdulai, 2020; Markelova et al., 2009; Naziri et al., 2014; Reardon et al., 2009). By organizing into cooperatives, farmer associations,

and unions, smallholders can collectively purchase agricultural inputs such as seeds, fertilizers, and pesticides, reducing costs and improving access to high-quality resources (Bizikova et al., 2020; Wassie et al., 2019). Moreover, collective action enables farmers to access vital market information, including price trends, potential buyers, and distribution channels, allowing them to secure appropriate market outlets and negotiate better prices (Naziri et al., 2014; Shiferaw et al., 2011). By aggregating their production, farmer groups also enhance their bargaining power, increasing competitiveness in both local and international markets (Abdul-Rahaman and Abdulai, 2020; Markelova et al., 2009; Mutonyi, 2019).

In addition to economic benefits, collective action plays a crucial role in strengthening farmers' intangible assets and resilience to external shocks such as climate change and market volatility. Research has shown that participation in farmer organizations strengthens farmer-buyer relationships and fosters knowledge exchange, both of which contribute to long-term sustainability (Adger, 2003; Aguilar et al., 2022; Kangogo et al., 2020). Collective action, functioning as social capital, helps smallholder farmers establish strategic networks that facilitate risk management and adaptation strategies (Adger, 2003). For example, Aguilar et al. (2022) found that smallholder farmers involved in collective action exhibited greater adaptive capacity in managing water insecurity. These findings highlight the role of collective action as both an economic enabler and a social mechanism for resilience-building among smallholder farmers.

2.2 Risks from climatic shocks and economic situation faced by smallholder farmers in Malawi

In Malawi, smallholder farmers, who constitute 80% of the total population, have encountered numerous challenges in sustaining their livelihoods (World Bank, 2018). Despite producing ∼80% of all the food consumed in Malawi, they struggle with low productivity and poverty due to limited access to agricultural inputs and markets. Most smallholder farmers in Malawi rely on low-input and low-output rain-fed subsistence farming (Benson, 2021). The yield of maize has stagnated at ∼2 t/ha over 10 years (USDA, 2024), which could be attributed to the low adoption rate of improved seeds and fertilizers. The adoption rate of certified maize seeds in Malawi is ∼30% (Hunga et al., 2023) and the fertilizer consumption per hectare is ∼96 kg (World Bank, 2024). While fertilizer consumption dramatically increased by more than three times in 2020, the quantity is still far below the average of countries on other continents (World Bank, 2024).

Furthermore, market instability emerges as one of the most pressing challenges. The price of maize per kilogram surged from 145 MWK in 2021 to 615 MWK in 2023, highlighting significant price volatility (MVAC, 2021, 2023). This volatility, while allowing farmers to sell maize at higher prices, also led to increased costs for maize production and household food consumption, ultimately posing a threat to household livelihoods.

Consequently, food insecurity remains a major challenge for smallholder farmers in Malawi. As of September 2023, over three million people, comprising 15% of the total population in Malawi, had experienced high acute food insecurity, with 90% residing in rural areas (MVAC, 2023). This indicates that a significant proportion of smallholder farmers cannot meet their basic and essential food requirements. The situation has worsened significantly since the end of 2021, when 1.4 million people were affected by acute food insecurity (MVAC, 2021). This indicates that the number of people experiencing food insecurity doubled over the course of 2 years.

According to the MVAC (2023), these challenges are attributed to climatic shocks, high staple prices, and economic decline in Malawi. Climatic shocks, such as droughts, cyclones, and floods, have had negative impacts on crop production and the economic situation, exacerbated by the effects of the war in Ukraine. In 2023, cereal crop production was reduced to ∼3.8 million tons, which is 3% lower than the average of the previous 5 years (FAO, 2023). In particular, the quantity of maize production decreased due to decreased yields and damage from flooding caused by Cyclone Freddy in the Southern area in March 2023. El Niño was also one of the factors causing a decrease in crop production, leading to drier weather conditions. Furthermore, access to agricultural inputs, including fertilizers, was limited because of high prices, which contributed to a decrease in crop production. These factors have exacerbated the challenges faced by smallholder farmers in Malawi, particularly those vulnerable to risk as individual farmers.

2.3 Empirical evidence on collective action in Malawi and research gaps

Given these persistent challenges, several studies have explored the potential of collective action as a mechanism to support smallholder farmers in Malawi. Existing research on collective action in the country has primarily focused on how cooperatives and farmer organizations enhance smallholders' access to inputs and markets, thereby improving rural livelihoods. For example, Matchaya and Perotin (2013) analyzed the National Smallholder Farmers' Association of Malawi (NASFAM) in Kasungu District and found that participation in this cooperative significantly increased members' fertilizer use, access to credit, and household incomes compared to non-members. Similarly, Olumeh and Mithöfer (2024) examined baobab collector cooperatives in Malawi and reported that cooperative membership raised crop-specific incomes and improved food security indicators, such as household dietary diversity and food consumption scores.

Despite these findings, a significant empirical gap remains. Few quantitative studies have systematically assessed the actual impact of collective action on Malawi's maize smallholders, who represent the country's predominant farming group. Much of the existing literature is descriptive or focuses on other crops and localized cases, rather than directly examining maize producers (Borda-Rodriguez and Vicari, 2014; Matchaya and Perotin, 2013; Mudege et al., 2015; Olumeh and Mithöfer, 2024). Given that maize is Malawi's staple crop, understanding how collective action supports maize-producing smallholder farmers is critical for developing evidence-based agricultural policies and interventions to improve national food security. Moreover, there is limited research on the

effects of collective action under recent conditions of heightened risk and uncertainty in Malawi. This gap underlines the necessity of the present study, which provides empirical evidence on how collective action influences household income and food security among maize-dependent smallholders in Malawi. In doing so, it addresses a critical gap in the literature and informs policy recommendations to strengthen farmer organizations as a means of improving food security and rural livelihoods, particularly amid rising risks.

3 Data collection and methodology

3.1 Study area

This study was conducted in Kasungu District, located in central Malawi (Figure 1). The majority of smallholder farmers in this region primarily cultivate maize as their main crop during the rainy season (Thangata et al., 2002). However, the area has frequently experienced severe climate shocks, posing significant challenges to agricultural productivity. According to MVAC (2021, 2023), the number of people experiencing severe food insecurity in Kasungu District tripled, rising from 45,000 in 2021 to 143,000 in 2023.

To address these challenges, a project known as the Smallholder Farmer Support Program (SFSP) was implemented in the study area with support from Good Neighbors International (GNI) and the Korea International Cooperation Agency (KOICA). This project aimed to enhance the capacity of agricultural cooperatives by providing smallholder farmers with agricultural input loans, capacity-building programs for collective marketing, and training in agricultural techniques and climate-smart agriculture (CSA) practices. The project, carried out by Good Neighbors Malawi (GNM) with funding from KOICA and GNI, was implemented in two phases (phase 1 and 2) over a 6-year period (2018–2023), supporting smallholder farmers in the study area.

3.2 Qualitative data collection and analysis

To collect qualitative data, 10 focus group interviews were conducted, comprising members of the project team, social enterprises, and agricultural extension workers from local governments, cooperative member farmers, and non-members, from August 28–31, 2023. The interviewees were selected with the consideration of representatives of each stakeholder group and gathered with the support of the local government and village leaders. Interviews with farmers were conducted separately for

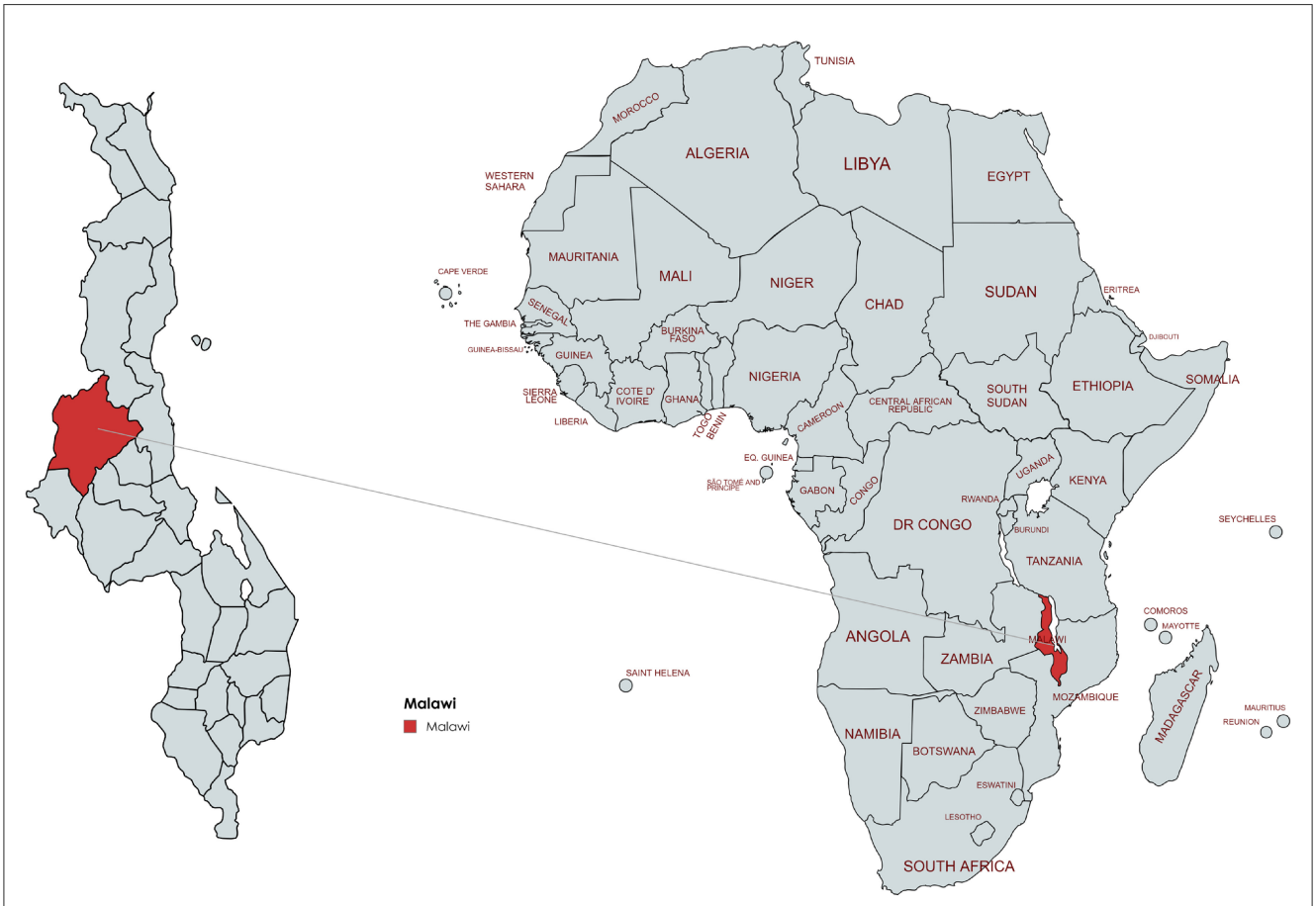

FIGURE 1
Map of study area. Source: created with MapChart.

the three cooperatives and the positions of the members. Two interview groups, one for committee members and the other for non-committee members, were formed in each cooperative to minimize potential bias from members' positions in the cooperative. A total of 71 farmers in six groups who participated in the collective action were interviewed. Interviews with other stakeholders such as the project team, social enterprises buying maize from cooperatives, and agricultural extension workers providing agricultural training to farmers were also conducted. These interviews aimed to collect data, opinions, and information on the actual changes and outcomes experienced by both direct and indirect stakeholders as a result of collective action. Interviews with 12 non-members of the cooperatives were conducted to understand the general status, issues, and risks confronting smallholder farmers in the targeted area. All group interviews lasted a maximum of one and a half hours, with two to three interviews conducted each day. The data collected from the interviews were coded and categorized, and content analysis was conducted to determine the actual advantages of participating in collective action as a member of agricultural cooperatives and the changes in their livelihoods.

The process of qualitative and quantitative data collection was implemented under ethical guidelines and with the approval of the Seoul National University Institutional Review Board (approval number: IRB No. 2309/003-002). Before conducting the interviews, the interviewees were informed about the background and purpose of the research, interview procedure, information security, and protection, and gave their signatures on the prepared written consent form if they consented.

3.3 Quantitative data collection and analysis

A baseline survey was conducted before the intervention in 2021. For the endline survey conducted in 2023, a household survey questionnaire was developed and supplemented based on the data collected through qualitative methods. Subsequently, a household survey was conducted from October 2–12, 2023. Data were collected from 475 households in the baseline and endline surveys, comprising 329 cooperative members and 146 non-members, using a multi-stage sampling approach. First, cooperatives in the area were purposively selected to examine the impacts of collective action within the member group. From these cooperatives, 746 member farmers were listed, and a simple random sample was drawn at a 95% confidence level with a 4% margin of error to represent the member population. Second, the non-members were randomly selected from the same geographic areas to compare the effects between the two groups in the targeted area.

The difference-in-differences (DID) method was adopted to assess the impact of collective action on farmers' household income and food security. Household income was calculated as the total income of the household, while food security was measured using the Food Consumption Score (FCS). FCS is a widely used indicator among researchers and international organizations for assessing household dietary diversity, as part of the multidimensional aspects of food security (Belay et al., 2024). It is derived from the frequency of consumption of diverse food groups using a weighted system over a 7-day recall period. Data were collected through the baseline and endline surveys, and the DID method was applied to estimate the causal effects of collective action on changes in household income and dietary diversity over time.

The DID model is specified as follows:

$$Y_i = \beta_1 + \beta_2 Member_i + \beta_3 POST_t + \delta\left(Member_i \times POST_t\right) + \mu_i + \varepsilon_{it}$$

In this expression, Y_i denotes the dependent variables, while $Member_i$ is a dummy variable denoting participation in collective action, and $POST_t$ is a dummy variable for the time period. μ_i captures unobserved time-invariant individual characteristics, including number of household members, age, gender, education level of household head, used land size, off-farm income, inorganic fertilizer use, labor time, distance from market, and number of cultivated crops, which serve as control variables, while δ is an interaction coefficient indicating the average causal effect.

Applying the DID method relies on the parallel trends assumption, which suggests that any differences between the treatment and control groups after the intervention should reflect those that existed before the intervention. However, since pre-intervention data were collected at a single time point, directly testing this assumption was not possible. As a result, differences in baseline characteristics between the two groups could introduce potential bias in the estimation.

To address this concern, the entropy balancing (EB) method was used to adjust for covariate distribution imbalances in the control group. EB applies a maximum entropy reweighting scheme to improve covariate balance (Hainmueller, 2012; Hainmueller and Xu, 2013). Compared to other methods commonly used in the social sciences, EB offers advantages in ensuring covariate balance by directly assigning weights based on known sample moments, thereby reducing the need for additional balance testing before estimating causal effects. In this study, EB was applied using a set of baseline covariates, including number of household members, age, gender, education level of household head, used land size, on- and off-farm incomes, distance from market, number of cultivated crops, and NGO support.

In addition, to ensure the robustness of the estimated treatment effects, this study employs the doubly robust difference-in-differences (DR-DID) method. The DR-DID estimator combines inverse probability weighting (IPW) and outcome regression adjustment, ensuring that the treatment effect estimates remain unbiased provided that at least one of the models (propensity score or outcome regression) is correctly specified (Funk et al., 2011). First, a logit model was used to estimate the propensity score, predicting cooperative membership based on the same set of baseline covariates. Second, inverse probability weights were computed and applied to reweight observations. Third, the DID model was estimated using both IPW and covariate-adjusted regression to generate doubly robust estimates of the treatment effect. This approach provides greater protection against selection bias compared to conventional DID and entropy balancing alone, although the parallel trends assumption cannot be fully tested due to the data constraints.

4 Results

4.1 Qualitative analysis

4.1.1 Advantages of participating in collective action in relation to agricultural activities

Prior to assessing the impact of participation in collective action, cooperative members were asked whether they had benefited from collective action and, if so, what specific advantages they had experienced. First, most members expressed satisfaction with access to agricultural extension services, which provided agricultural technologies such as fertilization methods, minimum tillage, intercropping, and mulching. Most respondents agreed that using fertilizers is an effective way to increase productivity, provided the farmer is aware of how to use fertilizers on the farm. This finding aligns with those of previous studies, revealing that participation in collective action improves access to agricultural extension services to increase productivity (Bizikova et al., 2020; Wassie et al., 2019). More specifically, this study found that agricultural extension services provided by extension workers invited by cooperatives were useful for farmers, imparting knowledge on the methods of fertilizer usage, including information on the timing and appropriate dosage of fertilizer application. The members enthusiastically embraced knowledge and information regarding agricultural technologies such as conservation agriculture (including minimum tillage, crop rotation, intercropping, and natural mulching). They expressed agreement that adopting conservation agricultural practices positively contributes to increasing crop yields on their farms.

Second, increasing access to market information was identified as another advantage of collective action as revealed in the previous studies (Naziri et al., 2014; Shiferaw et al., 2011). The interview respondents unanimously agreed that the committee's efforts to gather and share market information were transparent and democratic. The committees were responsible for searching for potential buyers and appropriate prices. This information was then shared with the members during officially announced meetings where they could actively participate in the decision-making process for selling products. The members expressed satisfaction with this process, noting that they were able to sell their products with greater bargaining power and at higher prices than before joining the cooperatives.

These results indicate that enhanced access to agricultural services and assets, including extension services, input loans, and market information sharing, played a critical role in improving crop yield and market participation. The findings suggest that interventions leveraging the multifaceted roles of the agricultural cooperative are particularly effective in improving smallholder farmers' livelihoods.

4.2 Quantitative analysis

4.2.1 Descriptive statistics

Table 1 provides a detailed summary of the descriptive statistics of the variables used in the analysis. The differences in characteristics between member and non-member groups, such as the age and education level of the household head, household size, land size, proportion of female-headed households, market distance, crop diversity, labor time, FCS, and income from both agricultural and non-agricultural sources in 2021, were not statistically significant.

On average, household heads in the member group were 47 years old, while those in the non-member group were 45 years old. Both groups had an average of five household members, and the education level of the household head was ~7 years for both. The proportion of female-headed households was 20% among members and 25% among non-members. Similarly, the number of crops

TABLE 1 Descriptive statistics and balance test.

	Members	Non-members	Mean difference	*p*-value
Age of Head of HH	47.21	45.33	1.88	0.18
Number of HH	5.49	5.33	0.16	0.37
Education level of HH	6.93	7.30	−0.36	0.26
Female Head of HH ratio	0.20	0.25	−0.05	0.20
Land size in 2021	3.44	3.03	0.41	0.16
Agri income in 2021	145.08	120.96	24.11	0.67
Non-agri income in 2021	86.83	52.02	34.80	0.24
FCS in 2021	39.37	39.59	−0.22	0.89
Labor time in 2021	1163.79	916.71	247.08	0.05
Fertilizer use in 2021	179.00	132.02	46.99	0.03
Market distance in 2021	33.88	30.40	3.48	0.30
Crop diversity in 2021	2.28	2.33	−0.05	0.55
Support from NGO in phase 1	0.27	0.19	0.08	0.08
Support from NGO in phase 2	0.63	0.36	0.28	0.00
Number of obs	329	146		

cultivated in 2021 was nearly the same, averaging 2.3 per household in both groups.

In terms of land use, members had slightly larger agricultural landholdings, with a difference of 0.4 acres compared to non-members. The average annual agricultural income was 145 USD for members and 120 USD for non-members, while the average annual non-agricultural income was 87 USD for members and 52 USD for non-members. However, none of these differences were statistically significant.

The difference between the groups was found in fertilizer use. In 2021, members used 47 kg more inorganic fertilizer than non-members, and this difference was statistically significant, suggesting that members had greater access to agricultural inputs. Furthermore, the proportion of farmers who received support from NGO in phase 2 in the member group was 28% higher than the non-member group, which was statistically significant.

4.2.2 Effects of participation in collective action on household income and food security

Descriptive statistics reveal imbalances in certain variables, such as fertilizer use and support from NGOs, which may introduce selection bias in the subsequent analysis. To address this issue, we employed three types of DID methods, which are conventional DID, DID with EB, and DR-DID.

Before conducting these DID analyses, a logistic regression was performed to estimate the propensity scores for DR-DID. As shown in Table 2, NGO support was a key determinant of cooperative membership, suggesting that farmers who received support from NGO were more likely to join cooperatives than those who did not. In this context, there is a possibility that NGO support was not randomly assigned, which could lead to selection bias. As shown in Table 2.1 in Appendix, the results of the multinomial logistic regression indicate that certain variables, such as age of the household head, and number of household members, significantly influenced the likelihood of receiving NGO support. This suggests that NGO support may act as a mediating variable between household demographic characteristics and participation in collective action. To further examine this potential mediation pathway, a mediation analysis was conducted as shown in Table 2.2 in Appendix. The results indicate that cooperative membership exerted a significant direct effect on both outcome variables, household income and FCS, while an indirect effect mediated through NGO support was identified only for FCS. This finding suggests that unobservable factors, such as access to external networks or institutional trust facilitated by NGO support, may indirectly influence food security outcomes. In contrast, NGO support did not show an indirect effect on household income, likely because key services provided by NGOs, such as extension services and input loans, which are more directly linked to income improvements, were already included as control variables in the analysis.

TABLE 2 Logit estimates for determinants of participation in collective action of farmers.

	Coefficient	Std. err.
Age of Head of HH	0.01	0.01
Number of HH	−0.03	0.07
Education level of HH	−0.03	0.04
Female Head of HH ratio	−0.46*	0.27
Land size	0.09	0.06
Agri income in 2021	0.00	0.00
Non-agri income in 2021	0.00	0.00
Market distance	0.00	0.00
Number of cultivated crops	−0.26*	0.16
Support from NGO in phase1	1.86***	0.32
Support from NGO in phase2	2.09***	0.27
Constant	−0.52	0.73
Number of obs	475	

Significance levels: *p < 0.10, **p < 0.05, ***p < 0.01.

To assess the quality of the covariate balance after applying EB, the balance statistics are reported in Table 2.3 in Appendix. The table shows that the baseline covariates were well-balanced between the treatment and control groups after weighting. The results of the DID analyses, presented in Table 3, indicate that the estimated average treatment effect on the treated (ATT) of cooperative membership is statistically significant across all three models. In terms of household income, cooperative members experienced an income increase of 216–264 USD relative to non-members. Regarding the FCS, cooperative members scored 5–7 points higher than non-members, suggesting that they relatively consumed more diverse foods. Given that FCS declined in both groups between 2021 and 2023, this finding suggests that cooperative members were more likely to maintain a relatively diverse diet despite worsening food security conditions in Malawi during this period.

The results indicate that collective action across various stages of agricultural activities contributed to enhancing the economic wellbeing and maintaining the dietary diversity of smallholder farming households, even in the face of multiple risks, including the COVID-19 pandemic, market instability, and climate-related uncertainties.

4.2.3 Heterogenous effects of participation in collective action on household income and food security

As shown in Table 4, all ATT estimates for male-headed households are positive and statistically significant. The increase in household income among male-headed households ranges from 192 to 249 USD, while FCS increases by 5–7 points, suggesting that they consumed more diverse and frequent foods than non-members among male-headed households. These results suggest that participation in collective action through cooperatives had a positive impact on both economic outcomes and dietary diversity for male-headed households.

For female-headed households, the results follow the same trend as those for male-headed households. Their household income increased by 277–400 USD, with a greater increase in income compared to male-headed households. However, the FCS results for female-headed households were not statistically

TABLE 3 ATT estimation on household income and food consumption score.

Variable	Household income			FCS		
	DID	DID with EB	DR-DID	DID	DID with EB	DR-DID
Coop membership	263.53*** (83.03)	253.19** (112.00)	216.04** (107.16)	5.33*** (1.95)	6.26*** (2.29)	7.45*** (2.16)

Significance levels: *p < 0.10, **p < 0.05, ***p < 0.01.
Standard errors in parenthesis.

TABLE 4 ATT estimation by gender on household income and food consumption score.

Subsamples	Household income			FCS		
	DID	DID with EB	DR-DID	DID	DID with EB	DR-DID
Male-headed HH	248.83***	203.59**	191.60*	5.87***	5.78**	7.88***
	(94.87)	(103.52)	(107.79)	(2.19)	(2.43)	(2.43)
Female-headed HH	277.11**	400.23***	317.21***	3.11	7.46	5.91
	(141.39)	(130.24)	(107.72)	(4.28)	(5.02)	(4.39)

Significance levels: *p < 0.10, **p < 0.05, ***p < 0.01.
Standard errors in parenthesis.

significant, suggesting that participation in collective action did not have a crucial impact on their dietary diversity status. This finding aligns with previous studies indicating that heterogeneous effects exist in smallholder farmers' participation in collective action (Grashuis and Su, 2019). Specifically, some studies suggest that female-headed households are likely to have not only fewer opportunities to participate but also fewer benefits from collective action (Mudege et al., 2015; Olumeh and Mithöfer, 2024). The heterogeneous result may stem from differences in economic status between male- and female-headed households, as suggested by Ochieng et al. (2017), given that the mean income of female-headed households remains lower than that of male-headed households despite the observed increase in household income. In addition to this economic disparity, various social and cultural factors, such as intra-household decision-making dynamics, time constraints, and limited market access, may also contribute to the lower levels of dietary diversity observed among female-headed households (Opata et al., 2020; Wekwete, 2014).

5 Discussion

The results indicate that participation in collective action benefited smallholder farmers, even amid diverse risks such as COVID-19 and market instability caused by global conflicts. Findings from this study, conducted between 2021 and 2023, suggest that participation in collective action during this period of increased uncertainty had significant advantages, particularly in increasing household income and improving dietary diversity, compared to non-participating farmers. This indicates that building more strategic policies and practical support for diverse forms of collective action, such as cooperatives and farmers' associations, is necessary, particularly in response to increasing uncertainty risks arising from climate change, conflicts, and market instability.

Importantly, the findings also highlight the gendered differences in the impacts of participation in collective action. While male-headed households among cooperative members experienced positive outcomes in both household income and food security, female-headed households did not experience comparable improvements in food security despite benefiting from increased household income. This study provides new evidence that gender disparities in the benefits of collective action also extend to maize producers in central Malawi, consistent with previous findings on other crops such as baobab and potato (Mudege et al., 2015; Olumeh and Mithöfer, 2024).

Several factors may be associated with this result, including differences in economic status, spending priorities, market accessibility, and intra-household decision-making dynamics between men and women (Ochieng et al., 2017; Opata et al., 2020; Wekwete, 2014). These findings suggest that interventions aimed at enhancing food security for female-headed households should not solely focus on income generation but also address broader factors such as market access and empowerment, considering the multidimensional nature of food security (Clapp et al., 2022).

Furthermore, the findings highlight the crucial role of external interventions from NGOs in promoting smallholder farmers' participation in collective action, as documented in previous studies (Markelova et al., 2009; Thorp et al., 2005). In this study, NGO support emerged as a key determinant of cooperative membership, while certain household characteristics influenced access to NGO support. This suggests that NGO support may act as an intermediary factor influencing smallholder farmers' participation in collective action. These findings underscore the importance of collaboration with NGOs, as their interventions play a crucial role in facilitating farmers' participation in collective action.

This study has several limitations. First, the ATT estimates for female-headed households show relatively wide confidence intervals, likely due to the smaller sample size in this subgroup. Future research with larger and more balanced samples is recommended to improve the precision of subgroup estimates and to allow for a more detailed examination. Given the gender-differentiated effects observed in this study, future studies should explore how collective action can be made more gender-responsive. Such insights could support the development of more targeted

and effective strategies to maximize the benefits of collective action. Second, while FCS is a widely used proxy for dietary diversity, it does not fully capture the comprehensive nature of food security, which encompasses four key pillars: availability, access, utilization, and stability (Clapp et al., 2022). Further research incorporating additional food security indicators, such as per capita calorie consumption, household dietary diversity scores, or food expenditure shares, is needed to examine the impacts of collective action across all dimensions of food security and across diverse geographic and socioeconomic contexts. Lastly, while the findings from this study provide valuable insights into collective action among smallholder farmers in Kasungu District, their generalizability remains limited due to the unique socio-economic and environmental factors specific to the region. Differences in market structures, policy environments, and cultural norms across other districts and countries may influence the effectiveness of similar interventions. To ensure broader applicability, future research should explore diverse geographic and socio-political settings, comparing collective action mechanisms in regions with varying levels of farmer organization, governmental support, and external funding. Additionally, longitudinal studies could assess the sustainability and scalability of collective action efforts in dynamic agricultural landscapes, contributing to more tailored policy recommendations for smallholder farmers worldwide.

6 Conclusion

Collective action has been widely promoted as a strategy to strengthen the livelihoods and market competitiveness of smallholder farmers. By pooling resources, sharing knowledge, and engaging in joint decision-making, smallholders are better positioned to overcome barriers that would be difficult to tackle individually. As previous studies suggest, collective action can enhance productivity, improve access to markets, increase bargaining power, and promote agricultural sustainability (Abdul-Rahaman and Abdulai, 2020; Markelova et al., 2009; Naziri et al., 2014; Reardon et al., 2009). However, there remains a continued need to generate empirical evidence on its effectiveness, particularly in the context of growing uncertainty and risk that increasingly threaten smallholder livelihoods.

This study aims to assess the actual effects of collective action under increasing uncertainty, such as climate risks and food insecurity, using both qualitative and quantitative methods. The findings demonstrate that participation in collective action through cooperatives significantly improved household income and contributed to better dietary diversity, even during a period when food security conditions worsened in the study area. This indicates that participation in collective action can ultimately lead to significant economic advantages and contribute to food security resilience of smallholder farmers.

However, the results also reveal the gender-differentiated outcomes. While male-headed households benefited from improved dietary diversity, this effect was not observed among female-headed households, despite the increase in income. This finding indicates that increased income may not directly translate to improved dietary diversity for female-headed households. Other barriers, such as limited control over resources, decision-making dynamics, and low accessibility to markets, may be associated with their food security outcomes.

These findings imply the importance of designing collective action interventions that address gender-specific constraints. Enhancing women's agency, improving their access to markets, and promoting inclusive participation within cooperatives may be essential to ensuring that the benefits of collective action are equitably distributed. Moreover, the case presented in this study demonstrates that external factors such as NGOs can play a significant role in promoting farmers' collective action through cooperatives. To stabilize and scale up the impacts and to address current limitations, such as gender-based disparities, coordinated efforts are needed from both within and outside farmers' organizations. Importantly, government can play a key role by developing supportive policy frameworks, allocating resources, and scaling up successful NGO-supported initiatives to reach more smallholder farmers across diverse contexts. Although the impacts of collective action were significant in this case, smallholder farmers and their organizations are likely to remain vulnerable to a variety of risks unless institutions and policies function in a sustainable and effective manner. Given the increase in unpredictable risks, future studies should explore ways to provide consistent and effective support for collective action among smallholder farmers through appropriate interventions, strategic partnerships, and policy frameworks.

Data availability statement

The data used in this study are subject to certain restrictions. Although the datasets supporting the study's findings are held by Good Neighbors International, they are not publicly accessible due to institutional data protection guidelines. Access to these data may be provided upon reasonable request, subject to Good Neighbors International's review and approval. All data access inquiries should be directed to innoprogram@gni.kr.

Ethics statement

The studies involving humans were approved by Seoul National University Institutional Review Board (approval number: IRB No. 2309/003-002). The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

JS: Data curation, Investigation, Methodology, Conceptualization, Software, Writing – review & editing, Resources, Formal analysis, Visualization, Validation, Writing – original draft, Funding acquisition, Project administration. SJ: Supervision, Writing – review & editing. TN-C: Data curation, Validation, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. This work was funded by Good Neighbors International and the Korea International Cooperation Agency (KOICA) under a research consultancy agreement. The study was commissioned by Good Neighbors International as part of the endline survey for a KOICA-funded project. No specific grant number is applicable.

Acknowledgments

We sincerely appreciate the research opportunities provided by Good Neighbors International, Good Neighbors Malawi, and the Korea International Cooperation Agency (KOICA).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2025.1607329/full#supplementary-material

References

Abdul-Rahaman, A., and Abdulai, A. (2020). Farmer groups, collective marketing and smallholder farm performance in rural Ghana. *J. Agribusiness Dev. Emerg. Econ.* 10, 511–527. doi: 10.1108/JADEE-07-2019-0095

Adeyeye, S. A. O., Ashaolu, T. J., Bolaji, O. T., Abegunde, T. A., and Omoyajowo, A. O. (2023). Africa and the Nexus of poverty, malnutrition and diseases. *Crit. Rev. Food Sci. Nutr.* 63, 641–656. doi: 10.1080/10408398.2021.1952160

Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Econ. Geogr.* 79, 387–404. doi: 10.1111/j.1944-8287.2003.tb00220.x

Aguilar, F. X., Hendrawan, D., Cai, Z., Roshetko, J. M., and Stallmann, J. (2022). Smallholder farmer resilience to water scarcity. *Environ. Dev. Sustain.* 24, 2543–2576. doi: 10.1007/s10668-021-01545-3

Beegle, K., Christiaensen, L., Dabalen, A., and Gaddis, I. (2016). *Poverty in a Rising Africa (Online-Ausg.)*. Chicago: The World Bank. doi: 10.1596/978-1-4648-0723-7

Belay, A., Mirzabaev, A., Recha, J. W., Oludhe, C., Osano, P. M., Berhane, Z., et al. (2024). Does climate-smart agriculture improve household income and food security? Evidence from Southern Ethiopia. *Environ. Dev. Sustain.* 26, 16711–16738. doi: 10.1007/s10668-023-03307-9

Benson, T. (2021). *Disentangling Food Security From Subsistence Agriculture in Malawi*. Washington, DC: International Food Policy Research Institute. doi: 10.2499/9780896294059

Bizikova, L., Nkonya, E., Minah, M., Hanisch, M., Turaga, R. M. R., Speranza, C. I., et al. (2020). A scoping review of the contributions of farmers' organizations to smallholder agriculture. *Nat. Food* 1, 620–630. doi: 10.1038/s43016-020-00164-x

Borda-Rodriguez, A., and Vicari, S. (2014). Rural co-operative resilience: the case of Malawi. *J. Co-Oper. Org. Manage.* 2, 43–52. doi: 10.1016/j.jcom.2014.03.002

Clapp, J., Moseley, W. G., Burlingame, B., and Termine, P. (2022). Viewpoint: the case for a six-dimensional food security framework. *Food Policy* 106:102164. doi: 10.1016/j.foodpol.2021.102164

de Janvry, A., Fafchamps, M., and Sadoulet, E. (1991). Peasant household behaviour with missing markets: some paradoxes explained. *Econ. J.* 101, 1400–1417. doi: 10.2307/2234892

Fafchamps, M., and Hill, R. V. (2005). Selling at the farmgate or traveling to market. *Am. J. Agric. Econ.* 87, 717–734. doi: 10.1111/j.1467-8276.2005.00758.x

FAO (2023). *GIEWS Country Brief Malawi*. GIEWS - Global Information and Early Warning System. Available online at: https://www.fao.org/giews/countrybrief/country.jsp?code=MWI (Accessed August 15, 2024).

FAO, IFAD, and WFP (2014). *The State of Food Insecurity in the World 2014: Strengthening the Enabling Environment for Food Security and Nutrition*. World | ReliefWeb. FAO. Available online at: https://reliefweb.int/report/world/state-food-insecurity-world-2014-strengthening-enabling-environment-food-security-and (Accessed August 4, 2024).

Funk, M. J., Westreich, D., Wiesen, C., Stürmer, T., Brookhart, M. A., and Davidian, M. (2011). Doubly robust estimation of causal effects. *Am. J. Epidemiol.* 173, 761–767. doi: 10.1093/aje/kwq439

Gassner, A., Harris, D., Mausch, K., Terheggen, A., Lopes, C., Finlayson, R., et al. (2019). Poverty eradication and food security through agriculture in Africa: rethinking objectives and entry points. *Outlook Agric.* 48, 309–315. doi: 10.1177/0030727019888513

Grashuis, J., and Su, Y. (2019). A review of the empirical literature on farmer cooperatives: performance, ownership and governance, finance, and member attitude. *Ann. Public Cooper. Econ.* 90, 77–102. doi: 10.1111/apce.12205

Hainmueller, J. (2012). Entropy balancing for causal effects: a multivariate reweighting method to produce balanced samples in observational studies. *Polit. Anal.* 20, 25–46. doi: 10.1093/pan/mpr025

Hainmueller, J., and Xu, Y. (2013). ebalance: a stata package for entropy balancing. *J. Stat. Softw.* 54, 1–18. doi: 10.18637/jss.v054.i07

Hatab, A. A. (2022). Africa's food security under the shadow of the Russia-Ukraine conflict. *Strategic Rev. Southern Afr.* 44, 37–46. doi: 10.35293/srsa.v44i1.4083

Hunga, H. G., Chiwaula, L., Mulwafu, W., and Katundu, M. (2023). The seed sector development in low-income countries: lessons from the Malawi seed sector policy process. *Front. Sustain. Food Syst.* 7, 1–14. doi: 10.3389/fsufs.2023.891116

Kangogo, D., Dentoni, D., and Bijman, J. (2020). Determinants of farm resilience to climate change: the role of farmer entrepreneurship and value chain collaborations. *Sustainability*, 12:Article 3. doi: 10.3390/su12030868

Langyintuo, A. S., Mwangi, W., Diallo, A. O., MacRobert, J., Dixon, J., and Bänziger, M. (2010). Challenges of the maize seed industry in eastern and southern Africa: a compelling case for private–public intervention to promote growth. *Food Policy* 35, 323–331. doi: 10.1016/j.foodpol.2010.01.005

Lowder, S. K., Skoet, J., and Singh, S. (Eds.). (2014). "What do we really know about the number and distribution of farms and family farms in the world?," *Background paper for The State of Food and Agriculture 2014* (ESA Working Paper 14-02).

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

Matchaya, G. C., and Perotin, V. (2013). The impact of cooperative patronage: the case of National Smallholder Farmers' Association (NASFAM) of Malawi in Kasungu District. *Agrekon* 52, 75–103. doi: 10.1080/03031853.2013.798066

Mojo, D., Fischer, C., and Degefa, T. (2017). The determinants and economic impacts of membership in coffee farmer cooperatives: recent evidence from rural Ethiopia. *J. Rural Stud.* 50, 84–94. doi: 10.1016/j.jrurstud.2016.12.010

Mudege, N. N., Nyekanyeka, T., Kapalasa, E., Chevo, T., and Demo, P. (2015). Understanding collective action and women's empowerment in potato farmer groups in Ntcheu and Dedza in Malawi. *J. Rural Stud.* 42, 91–101. doi: 10.1016/j.jrurstud.2015.09.002

Mutonyi, S. (2019). The effect of collective action on smallholder income and asset holdings in Kenya. *World Dev. Perspect.* 14:100099. doi: 10.1016/j.wdp.2019.02.010

MVAC (2021). *IPC Malawi Acute Food Insecurity Analysis, Oct 2021 to Mar 2022*. Lilongwe: Government of Malawi.

MVAC (2023). *IPC Malawi Acute Food Insecurity Analysis, Jun 2023 to Mar 2024 [IPC Malawi Acute Food Insecurity Analysis, Jun 2023 to Mar 2024]*. Lilongwe: Government of Malawi.

Naziri, D., Aubert, M., Codron, J.-M., Loc, N. T. T., and Moustier, P. (2014). Estimating the impact of small-scale farmer collective action on food safety: the case of vegetables in Vietnam. *J. Dev. Stud.* 50, 715–730. doi: 10.1080/00220388.2013.874555

Ochieng, J., Afari-Sefa, V., Lukumay, P. J., and Dubois, T. (2017). Determinants of dietary diversity and the potential role of men in improving household nutrition in Tanzania. *PLoS ONE* 12:e0189022. doi: 10.1371/journal.pone.0189022

Olumeh, D. E., and Mithöfer, D. (2024). Impact of collective action on household welfare: empirical evidence from baobab collectors in Malawi. *Ann. Public Cooper. Econ.* 95, 385–411. doi: 10.1111/apce.12448

Onyeaka, H., Tamasiga, P., Nkoutchou, H., and Guta, A. T. (2022). Food insecurity and outcomes during COVID-19 pandemic in sub-Saharan Africa (SSA). *Agric. Food Secur.* 11, 56–56. doi: 10.1186/s40066-022-00394-1

Opata, P. I., Ezeibe, A. B., and Ume, C. O. (Eds.). (2020). Impact of women's share of income on household expenditure in southeast Nigeria. *Afr. J. Agric. Resour. Econ.* 11, 51–64. doi: 10.53936/afjare.2020.15(1).04

Otekunrin, O. A., Momoh, S., and Ayinde, I. A. (2019). Smallholder farmers' market participation: concepts and methodological approach from sub-Saharan Africa. *Curr. Agric. Res. J.* 7, 139–157. doi: 10.12944/CARJ.7.2.02

Paloma, S. G. y., Riesgo, L., and Louhichi, K. (Eds.). (2020). *The Role of Smallholder Farms in Food and Nutrition Security*. Cham: Springer Nature. doi: 10.1007/978-3-030-42148-9

Reardon, T., Barrett, C. B., Berdegué, J. A., and Swinnen, J. F. M. (2009). Agrifood industry transformation and small farmers in developing countries. *World Dev.* 37, 1717–1727. doi: 10.1016/j.worlddev.2008.08.023

Shiferaw, B., Hellin, J., and Muricho, G. (2011). Improving market access and agricultural productivity growth in Africa: what role for producer organizations and collective action institutions? *Food Secur.* 3, 475–489. doi: 10.1007/s12571-011-0153-0

Thangata, P. H., Hildebrand, P. E., and Gladwin, C. H. (2002). Modeling agroforestry adoption and household decision making in Malawi. *Afr. Stud. Q.* 6, 271–294.

Thorp, R., Stewart, F., and Heyer, A. (2005). When and how far is group formation a route out of chronic poverty? *World Dev.* 33, 907–920. doi: 10.1016/j.worlddev.2004.09.016

USDA (2024). *Malawi Corn Area, Yield and Production* (No. U.S. Department of Agriculture). Available online at: https://ipad.fas.usda.gov/countrysummary/default.aspx?id=MIandcrop=Corn (Accessed August 20, 2024).

Wassie, S. B., Kusakari, H., and Masahiro, S. (2019). Inclusiveness and effectiveness of agricultural cooperatives: recent evidence from Ethiopia. *Int. J. Soc. Econ.* 46, 614–630. doi: 10.1108/IJSE-07-2018-0340

Wekwete, N. N. (2014). Gender and economic empowerment in Africa: evidence and policy. *J. Afr. Econ.* 23, i87–i127. doi: 10.1093/jae/ejt022

Wineman, A., Mwakiwa, E., Agyei-Holmes, A., Fall, M. G., Kirimi, L., Mpenda, Z., et al. (2024). *Price Shocks and Associated Policy Responses Stemming from the Russia-Ukraine War and Other Global Crises: Evidence from Ghana, Kenya, Nigeria, Senegal, Tanzania, and Zimbabwe*. Washington, DC: Innovation Lab for Food Security Policy, Research, Capacity, and Influence (PRCI).

World Bank (2018). *Climate-Smart Agriculture in Malawi (CSA Country Profiles for Africa Series)*. Washington, DC: International Center for Tropical Agriculture (CIAT).

World Bank (2024). *The World Bank Data*. Available online at: https://data.worldbank.org (Accessed August 15, 2024).