Monitoring the Smallholder Horticulture Empowerment Promotion (SHEP) Project in Malawi using SWIFT (the Survey of Well-Being via Instant and Frequent Tracking)

Japan International Cooperation Agency and World Bank[1]

March, 2025

[1] This report was prepared by Lina Marcela Cardona, Harue Kitajima, Tomoya Masaki, Aya Tamura, Michino Yamaguchi, Nobuo Yoshida, and Kazusa Yoshimura as part of a collaborative effort between the Japan International Cooperation Agency and the World Bank to evaluate the performance of the Malawi Smallholder Horticulture Empowerment and Promotion Project using an innovative high frequency monitoring system.

Contents

Executive Summary

Overview

This study evaluates the impact of the Smallholder Horticulture Empowerment and Promotion (SHEP) project in Malawi (MA-SHEP), with a focus on poverty reduction, household welfare, and resilience to shocks and seasonal fluctuations. Using a quasi-experimental sampling design, high-frequency data from a modified Rapid Feedback Monitoring System (RFMS), and poverty estimates derived from the Survey of Well-Being via Instant and Frequent Tracking (SWIFT), this paper provides robust evidence of MA-SHEP's effectiveness in improving household welfare and resilience.

Key Findings

To rigorously assess the impact of MA-SHEP, this study employs a quasi-experimental design, using propensity score matching and post-stratification to balance the household welfare status of MA-SHEP participating farmers (MA-SHEP farmers) and non-participating farmers (non-MA-SHEP farmers). This methodological approach enhances the causal interpretation of results, ensuring that observed differences in household welfare and resilience stem from MA-SHEP rather than external factors. The data collection in the field and data analysis were conducted four times from February 2022 (round 1) to February 2023 (round 4).

The analysis reveals that MA-SHEP fostered significant behavioral changes, promoting market-oriented practices among farmers. Participants were more likely to conduct market surveys, negotiate prices, establish long-term supplier relationships, and collaborate on logistics. Additionally, the project advanced gender-inclusive decision-making, especially during the lean season, by actively increasing spousal involvement in business and financial management. Specifically, the data analysis highlights that male-headed households participating in MA-SHEP, representing nearly 80 percent of all households, were significantly more likely to engage their spouses in business and financial management compared to the non-MASHEP farmers in the control group.

While previous studies have documented such behavioral changes, this study quantifies their broader socioeconomic benefits, particularly in poverty reduction and resilience building.

Starting from comparable household welfare levels before the project was launched, MA-SHEP farmers consistently exhibited lower poverty rates than their non-MA-SHEP famers across all four survey rounds, with statistically significant differences. In February 2022 (round 1), the poverty headcount rate for MA-SHEP farmers was 35.3%—10 percentage points lower than that of non-MA-SHEP farmers. By February 2023 (round 4), this gap had widened to 13.5 percentage points. Similarly, household expenditure per capita among MA-SHEP farmers was 14% higher than that of non-MA-SHEP farmers in round 1, increasing to 18% in round 4.

Despite severe climate shocks, including Tropical Storm Ana and Cyclone Freddy, MA-SHEP farmers demonstrated greater resilience. Between June 2022 (round 2) and February 2023 (round 4), their poverty rate rose by only 3.3 percentage points, compared to almost 6-percentage-point increase among non-MA-SHEP farmers.

Food security also shows significant differences when the survey was conducted. The proportion of MA-SHEP farmers experiencing "Very Stressed" food insecurity remained consistently lower than that of non-MA-SHEP farmers. In November 2022 (round 3), 17% of MA-SHEP farmers fell into this category, compared to 28% of non-MA-SHEP farmers. In the rural central region, the percentage of non-MA-SHEP farmers classified as "Very Stressed" surged by over 20 percentage points between June 2022 (round 2) and November 2022 (round 3), whereas the increase for MA-SHEP farmers was only 3 percentage points.

This study is the first to quantify the impact of a SHEP project on poverty, household expenditure, and food insecurity, as well as resilience—measured through the stability of poverty and food security over time. These findings underscore MA-SHEP's effectiveness in reducing poverty, increasing household expenditure, and enhancing resilience against climate shocks and seasonal fluctuations. They provide compelling evidence for scaling up SHEP projects as a transformative tool for poverty alleviation in vulnerable agricultural communities.

Limitations and Proposed Solutions

1. **Lack of Pre-Project Poverty Estimates**

A key limitation was the absence of pre-project poverty data for MA-SHEP farmers, as the project was already operational when the study began. To address this, asset ownership and housing conditions were used as proxies for pre-project poverty levels. While effective for estimating long-term poverty trends, these proxies are less suited for capturing short-term fluctuations. Future surveys should incorporate rapidly changing indicators such as food consumption and subjective well-being to better measure short-term poverty dynamics.

2. **Still High Evaluation Costs**

Although MA-SHEP survey's data integration using SWIFT and RFMS helped reduce costs compared with the traditional household survey, further cost reductions can be achieved through:

- Localized Enumerator Deployment: Hiring enumerators within sample villages to lower transportation expenses, improve data collection resilience, and enable more frequent monitoring.
- Streamlined Questionnaires: Eliminating questions with minimal variation across survey rounds (e.g., market survey practices) to simplify data collection and reduce training costs.

3. **Lack of Comparison with Broader Rural Households**

This study compared MA-SHEP farmers to non-MA-SHEP farmers but did not include average rural households as a benchmark. Future evaluations should incorporate a broader rural population sample to contextualize MA-SHEP's impact more comprehensively. JICA will consider a follow up survey of the surveyed farmers when conducting ex-post evaluation for MA-SHEP three years after project completion in near future.

4. **Need for Further Expansion through Government Integration**

To ensure the sustainability and scalability of MA-SHEP, long-term monitoring should transition to government agencies such as the National Statistical Office (NSO). Building government capacity for ongoing evaluation would support national scaling and contribute to Malawi's long-term poverty reduction and climate resilience strategies.

Lessons Learned

This study highlights MA-SHEP's transformative potential in addressing persistent poverty and resilience challenges in rural Malawi. Key takeaways include:

1. Holistic Approaches Are Effective: Combining market-oriented training with inclusive household decision-making enhances income stability and food security.
2. Frequent Monitoring Is Essential: High-frequency data collection is critical for identifying seasonal vulnerabilities and climate-induced shocks.
3. Cost Efficiency Enhances Sustainability: Streamlining evaluation methods can significantly reduce costs without compromising data quality.
4. Scaling Requires Strong Partnerships: Integrating monitoring systems into government structures ensures long-term project sustainability and scalability.

These findings reinforce the value of expanding SHEP projects to accelerate poverty reduction, strengthen resilience, and promote sustainable development in vulnerable agricultural communities.

I. Introduction

In 2017, the Ministry of Agriculture, Irrigation and Water Development in Malawi (MoAIWD) and the Japan International Cooperation Agency (JICA) launched a technical cooperation project to promote and scale up the Smallholder Horticulture Empowerment and Promotion (SHEP) approach in Malawi. The Malawi SHEP (MA-SHEP) project aims to foster market-oriented agriculture among smallholder farmers by training them to conduct market surveys, collect price data, and select crops based on market demands. The project also provides essential training in horticultural techniques, household financial planning, and fostering gender-inclusive decision-making within families. Initially launched in the central region, the project expanded to the northern and southern regions, reaching 4,530 farmers across 18 districts by 2022.

While reports have highlighted the global success of SHEP projects—such as a 70% increase in horticultural income in Kenya (Shimizutani et al., 2021) and a 33% horticultural income increase among MA-SHEP farmers (JICA, 2020)—prior evaluations have not assessed the project's impact on poverty reduction, total household expenditure, or resilience to shocks. Measuring poverty incidence requires detailed consumption data, often collected through time-intensive surveys, and earlier reviews did not explore how farmers managed shocks such as Cyclone Ana, inflation, or food shortages during the lean season.

To address this gap, the World Bank and JICA partnered to evaluate MA-SHEP's impact on income generation, poverty reduction, and resilience to climate and economic shocks. Funded through an Externally Financed Output (EFO) agreement, the study conducted four rounds of data collection between March 2022 and February 2023, covering approximately 2,000 households. The evaluation compared MA-SHEP farmers with members of other agricultural cooperatives, focusing on decision-making, market access, poverty, food security, and agricultural productivity.

To collect data frequently and cost-effectively, the study utilized a modified version of Rapid Feedback Monitoring System (RFMS), a methodology that employs locally hired enumerators to conduct in-person interviews at cooperative offices, reducing logistical costs. Furthermore, RFMS integrates the Survey of Wellbeing via Instant and Frequent Tracking (SWIFT), a streamlined system that monitors household expenditures and poverty using a concise set of 10–15 questions. SWIFT employs advanced machine learning and multiple imputation techniques, validated across multiple countries.[2] By achieving high response rates and minimizing sampling bias, RFMS provides a reliable and cost-efficient alternative to traditional household surveys. Data collection was led by the Malawi National Statistics Office (NSO), with minimal technical support from the World Bank and JICA teams.

The study revealed significant benefits of the MA-SHEP project. Farmers exhibited improved decision-making, market engagement, and resilience to climate shocks. For instance, MA-SHEP farmers were more likely to conduct price surveys, involve spouses in financial decisions, establish long-term contracts with suppliers, and collaborate with peers on logistics. Poverty rates among MA-SHEP farmers were nearly 10 percentage points lower than those of non-participants, with continued improvements over time. Additionally, MA-SHEP farmers experienced better living conditions, such as increased asset ownership and improved housing, and demonstrated faster recovery from Cyclone Ana compared to non-participants.

This study underscores the effectiveness of the SHEP approach in Malawi in reducing poverty and enhancing resilience amid persistent challenges like climate shocks. Encouraged by these results, the government of Malawi has initiated plans for the nationwide expansion of the SHEP approach. Also, the success of RFMS as a high-frequency monitoring tool highlights its potential for adoption in other countries

[2] More details are available in Annex 1.

with minimal technical support.

II. Background

The SHEP approach

The Smallholder Horticulture Empowerment and Promotion (SHEP) approach, a flagship initiative by the Japan International Cooperation Agency (JICA), is designed to empower smallholder farmers in developing countries by transforming their agricultural practices into market-oriented and business-driven enterprises. Launched in Kenya in 2006 as a collaborative effort with the Kenyan government, SHEP sought to transition small-scale farmers from subsistence farming to market-oriented agriculture, encapsulated in its guiding philosophy: "Grow to Sell." By 2009, the initiative had successfully doubled the incomes of approximately 2,500 participating farmers, marking a milestone in improving livelihoods through market-driven agriculture.

Building on its success in Kenya, the SHEP approach has been expanded to a growing number of countries. As of April 2024, SHEP was implemented in 60 countries, including 30 in Africa, 4 in the Middle East, 12 in Asia, and 14 in Latin America. By that time, JICA had trained 44,932 officials and extension staff, benefiting 329,342 farmers directly through SHEP's capacity-building initiatives.

Looking ahead, JICA aims to scale up the SHEP approach to reach one million farmers by 2030. Central to this goal is the creation of 10,000 SHEP masters, who will be equipped with the expertise to implement the approach effectively, ensuring sustainable impact across diverse regions.

At its core, the SHEP philosophy—"Grow to Sell"—encourages farmers to adopt a market-oriented mindset, moving away from production-centered practices. The SHEP approach equips farmers with technical and managerial skills to analyze market trends, identify profitable crops, and tailor their production to meet market demands. Training encompasses agronomic practices, marketing strategies, financial literacy, and post-harvest management, enhancing farmers' capacity to operate as entrepreneurs. Additionally, SHEP fosters partnerships among farmers, agricultural extension officers, and market actors, building sustainable value chains that benefit all stakeholders.

SHEP approach also emphasizes participatory planning and inclusivity, actively engaging both men and women farmers in decision-making processes. This holistic approach not only boosts household incomes but also enhances resilience to climate shocks by promoting diversified, sustainable, and market-driven farming systems. SHEP's success has been widely recognized, serving as a model for similar initiatives and influencing agricultural policies in partner countries.

In 2014, Japan International Cooperation Agency (JICA) invited Malawian government officers to “Training Program for Market-Oriented Agriculture for Smallholder Farmers”. This training aims to promote the SHEP approach to the countries which wish to promote market-oriented agriculture for increasing income of smallholder farmers. After the training in Japan, Malawian officers started to implement the pilot project in Ntchisi and Mchinji districts. In the course of the pilot project implementation, considerable positive changes were observed among the target farmer groups, such as embarking upon collective marketing and improving bargaining power. The Government of Malawi (GOM) and the Government of Japan (GOJ) started the technical cooperation project in 2017 to support GOM in promoting and scaling up market-oriented agriculture for smallholder horticulture farmers based on the experience in the pilot project.

SHEP in Malawi (MA-SHEP) officially started in April 2017 in central region (Dowa, Mchinji, Ntchisi, Nkhotakota, Salima, Kasungu) targeting 35 groups and 1,548 farmers. The next batch started in July 2019 in Northern region (Chitipa, Mzimba, Karonga, Rumphi, Nkhata Bay) targeting 30 groups and 1,237

farmers. The third batch started in February 2021 in Southern region (Neno, Mwanza, Chikwawa, Nsanje, Thyolo, Phalombe, Mulanje) targeting 35 groups and 1,415 farmers.

SWIFT

The Survey of Well-Being via Instant and Frequent Tracking (SWIFT) is a rapid poverty assessment tool developed by the World Bank in 2014 to streamline and expedite the monitoring of poverty and inequality. By leveraging machine learning techniques on existing household survey data, SWIFT produces high-frequency poverty estimates that align closely with official statistics (see Yoshida et al. 2022 and Annex 1).

SWIFT employs concise surveys with a limited number of questions, focusing on key indicators that serve as robust predictors of poverty. This approach enables the collection of essential data quickly and cost-effectively, allowing for more frequent monitoring of poverty trends. The tool has been applied in various countries to guide policy interventions aimed at reducing poverty and improving household resilience (for example, see Yoshida and Aaron. 2024).

By delivering timely and reliable data, SWIFT supports policymakers and development practitioners in designing and implementing effective poverty reduction strategies. Its integration into monitoring systems facilitates real-time tracking of welfare outcomes, making it a valuable resource for achieving sustainable development goals.

In the evaluation of MA-SHEP's impact on poverty, SWIFT models were trained using data from the Integrated Household Survey 2019-20 (IHS 2019-20) for the rural northern, central, and southern regions of Malawi. The IHS 2019-20, the most recent official household survey containing expenditure data at the time of writing, was used by the Malawi National Statistical Office (NSO) to estimate official poverty rates for 2019-20. Details of the SWIFT models used in this evaluation are provided in Annex 4.

RFMS

The Rapid Feedback Monitoring System (RFMS) is an evolution of the Monthly Interval Resilience Analysis (MIRA) protocol, developed to provide timely, high-frequency data on shocks, food security, and coping strategies among households. Initially piloted by Catholic Relief Services (CRS) in Malawi, MIRA combined baseline and end-line surveys with monthly household data collection, employing community-embedded enumerators equipped with digital tools. This approach facilitated rapid data collection and analysis, enabling communities and stakeholders to make evidence-based decisions to enhance resilience.

Building on MIRA's success, RFMS was co-designed by the World Bank, USAID, FCDO, CRS, and Cornell University, in collaboration with Malawi's National Statistics Office. RFMS integrates MIRA's high-frequency data collection on resilience with the World Bank's Survey of Well-Being via Instant and Frequent Tracking (SWIFT) methodology, which estimates household expenditure and poverty levels using concise surveys. This integration allows RFMS to monitor both resilience and poverty dynamics in near real-time, providing a comprehensive understanding of household well-being.

III. Literature Review

Resilience to climate shocks and poverty reduction are critical challenges for smallholder farmers, particularly in developing countries. Research consistently demonstrates that investing in technical and business skills is central to addressing these challenges. This section synthesizes relevant studies to highlight how similar interventions have enhanced farmers' resilience, adaptive capacities, and income-generation potential, providing context for evaluating Malawi’s SHEP project using RFMS with SWIFT technology.

Role of Technical and Business Skills in Enhancing Resilience

Studies show that equipping farmers with technical and business skills significantly strengthens their resilience against climate shocks. Justice A. Tambo and Tobias Wünscher (2017) developed a household resilience index, revealing that farmer innovators—who apply technical and entrepreneurial knowledge—

are approximately 6% more resilient to climate variability than their peers. Similarly, Hellen A. Awiti, Eric O. Gido, and Gideon A. Obare (2022) emphasize that climate-smart crop diversification, supported by technical knowledge and business planning, enhances farmers' capacity to manage climate variability effectively.

The importance of data-driven tools is also underscored. Carlo del Ninno et al. (2022) employ machine learning algorithms to predict household resilience, highlighting the role of analytical and ICT skills in mitigating the effects of environmental shocks. Priya Chetri, Upasna Sharma, and P. Vigneswara Ilavarasan (2021) further argue that access to ICTs and informed decision-making, closely tied to technical and business skills, directly boost farmers' adaptive capacity.

Entrepreneurship, Market Linkages, and Value Chains

Entrepreneurship and market-oriented approaches are pivotal in enabling farmers to transition from subsistence farming to more resilient and sustainable systems. Aslihan Arslan et al. (2020) investigate the role of farmer entrepreneurship and value chain collaborations, finding that these factors significantly enhance adaptive capacities and income generation. Katrin Arning and Sandra Venghaus (2024) complement these findings by demonstrating how sustainable practices, rooted in informed decision-making, empower households to better cope with crises. The integration of marketing skills into resilience-building programs is especially relevant. "Farmers' Resilience to Climate Change through the Circular Economy and Sustainable Agriculture" (2024) emphasizes that training in marketing and business strategies is critical for improving farmers' ability to adapt to climate shocks while boosting economic outcomes.

Innovations in Climate-Smart Agriculture

Technological and agricultural innovations play a transformative role in building resilience and reducing poverty. Teshome Emiru and Getachew Abate Kassa (2023) demonstrate that adopting climate-smart agricultural practices, facilitated by technical skill development, significantly enhances smallholder farmers' capacity to withstand climate shocks. These findings are supported by Hemali Oza et al. (2023), who emphasize the need for standardized tools and training to measure and enhance household and community resilience effectively.

Literature on the Evaluation of SHEP Projects

Previous evaluations of SHEP projects have demonstrated their transformative potential in transitioning farmers to market-driven, sustainable practices. Shimizutani et al. (2021) used a Randomized Controlled Trial (RCT) across 14 counties, showing substantial horticultural income growth (up to 70% increases), behavioral changes toward market-oriented practices, and improvements in gender collaboration. Nomura et al. (2024) examined the SHEP project's impact in Oromia, Ethiopia, using GIS and propensity score matching, finding higher horticultural incomes and food security among participants. The study also highlighted the project's success in promoting gender equity and climate-smart strategies.

Contribution of This Paper

Previous studies underscore the critical role of strengthening marketing, business, and agricultural production skills in improving income, gender equity, and food security among smallholder farmers. The documented successes of SHEP projects across various countries highlight the transformative potential of these skill-building initiatives. This paper contributes new and significant insights into the Malawi SHEP project's impact, particularly under the compounded challenges of extreme climate conditions and abject poverty in the aftermath of Cyclone Ana. Through the innovative application of the RFMS with SWIFT monitoring system, the study demonstrates how the project effectively reduced monetary poverty and bolstered resilience.

The analysis also reveals notable behavioral changes, including increased participation of women in business decision-making and enhanced access to market information, enabling more informed crop choices and cultivation schedules. Furthermore, the study highlights how the project facilitated the establishment of long-term business relationships with buyers, reinforcing resilience and sustainability. By evaluating the Malawi SHEP project's success under severe climate stress, this paper deepens our understanding of how

market-oriented agricultural interventions can be tailored to address chronic poverty and mitigate vulnerabilities to shocks faced by smallholder farming communities.

IV. Data Collection

Objectives

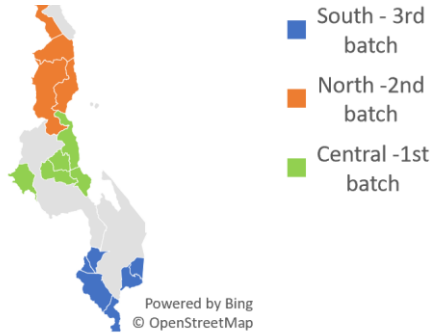
The primary objective of data collection for the MA-SHEP project was to evaluate its impact on poverty reduction, household welfare, and resilience to seasonal and climate-induced shocks. This section outlines the methodologies, tools, and strategies employed to gather data that directly informed the analysis presented in subsequent sections of this report.

Sampling design

National Statistics Office (NSO) Malawi was hired to implement the MA-SHEP survey. The sampled households in this survey consisted of the treatment and control groups. The treatment group includes farmers from the MA-SHEP project, while the control group includes farmers from other agricultural cooperatives. JICA provided the list of the agricultural cooperatives under the non-MA-SHEP project.

This study selected 18 regions[3] where the MA-SHEP project has been implemented. In each of the 18 regions except for Mzimba North and Nkhotakota, three agricultural cooperatives were selected under the control and treatment groups. In Mzimba North and Nkhotakota, three agricultural cooperatives were selected for the treatment group, but only two groups were selected for the control group because the team could find only two farmers' associations with more than 20 members.

Figure 1：MA-SHEP target area



For each selected agricultural cooperative, 20 farmers were selected randomly. We selected 2,120 farmers for the survey, of which 1,080 were selected for the treatment groups and 1,040 for the control groups.

Modules

Data collection utilized the Rapid Feedback Monitoring System (RFMS), integrating the Survey of Well-Being via Instant and Frequent Tracking (SWIFT) for rapid, cost-effective poverty assessment. The questionnaire was designed collaboratively by the World Bank and JICA teams and structured into the following modules:

1. **JICA-MA-SHEP Specific Module**: This module includes questions closely related to the MA-SHEP project-specific components, such as whether households have conducted a market survey in the past six months, whether they have any specific buyers, whether they hold regular meetings, why they decide to follow the recommendation of MA-SHEP, etc. This module tries to see if the MA-SHEP households have been implementing what they have been taught or whether there is any behavioral difference among MA-SHEP and non-MA-SHEP households regarding agricultural decision-making.

[3] 18 regions include Dowa East, Dowa West, Mchinji, Nkhotakota, Ntchisi, Salima, Chitipa, Mzimba North, Mzimba South, Nkhatabay, Rumphi, Chikwawa, Mulanje, Mwanza, Neno, Nsanje, Phalombe, Thyolo

2. **Food Security**: This module includes questions for calculating the coping strategy index (CSI)[4]. Based on the CSI index, households can be classified into three categories; 1) Minimal food insecurity, 2) Stressed, and 3) Crisis. The module also includes questions asking whether households have consumed some particular food items in the past seven days, which are used for the SWIFT poverty estimation.
3. **Market Access**: This module asks the type of market the households normally go to purchase food or sell their produces, and how long it will take to get there to capture the market access of the households.
4. **Livelihoods**: In this module, we ask households about the primary and secondary income sources. The module also includes questions about "ganyu," which means piecework in a local language and typically implies the informal short-term labor in rural areas, such as helping other farms to prepare land or harvest. It is known to be an important source of income, particularly for poor households.
5. **SWIFT Poverty Module**: This module includes the questions mainly used for the SWIFT poverty estimation. All the questions are derived from the Malawi fifth integrated households survey (IHS5), conducted in 2019-2020 using the SWIFT model building process. Three models were created for the central, north, and south regions; therefore, each region has a slightly different set of questions in this module. Questions are mainly about housing conditions, such as the material of the roof or number of rooms, and asset ownership, such as whether the households own bicycles.

Modules were updated each round to address emerging issues. For instance, questions on the impacts of Cyclone Ana and rising input costs due to global inflation were introduced in later rounds.

Data Collection Rounds and logistics

Data collection occurred over four rounds between February 2022 and February 2023:

- **Round 1**: February 2022
- **Round 2**: June 2022
- **Round 3**: November 2022
- **Round 4**: February 2023

Each round involved in-person interviews conducted by enumerators equipped with tablets, ensuring real-time data capture and quality checks. On average, interviews lasted 30 minutes per farmer. To save data collection cost, all enumerators were hired in each district, and both treatment (MA-SHEP farmers) and control (non-MA-SHEP farmers) were requested to come to their agricultural cooperative offices. Such arrangements reduce the cost of data collection significantly. [5]

Quasi-experimental sampling and sampling weight adjustments

The study's household selection process aimed to ensure comparability in welfare levels between the treatment group (MA-SHEP farmers) and the control group (non-MA-SHEP farmers). However, the absence of reliable pre-project data on poverty status, household income, or expenditures posed challenges in achieving perfect equivalence between the two groups. To address this limitation, the third round of the

[4] The CSI is measured based on five questions on household's coping strategies (WFP (2008) **The Coping Strategies Index - Field Methods Manual**). The questions are in the past 7 days, if there have been times when you did not have enough food or money to buy food, how often has your household had to: 1) Rely on less preferred and less expensive foods? 2) Borrow food, or rely on help from a friend or relative? 3) Limit portion size at mealtimes? 4) Restrict consumption by adults in order for small children to eat? 5) Reduce number of meals eaten in a day? The answers to these questions are then aggregated into one CSI indicator.

[5] Annex 6 includes additional details of data collection related information.

MA-SHEP survey included recall questions on asset ownership and housing conditions—key correlates of poverty and income— prior to the launch of MA-SHEP project to approximate pre-project welfare levels.

Table 1 presents these findings, illustrating that, prior to the launch of MA-SHEP, farmers in rural southern Malawi demonstrated similar levels of asset ownership and housing conditions. For example, 80% of MA-SHEP farmers and 78% of non-MA-SHEP farmers lived in homes with mud floors, a notable indicator of poor households. Similarly, 20% of MA-SHEP farmers and 21% of non-MA-SHEP farmers owned a bed. However, some indicators suggest slightly worse conditions among MA-SHEP farmers. For instance, only 30% of MA-SHEP farmers owned a radio, compared to 35% of non-MA-SHEP farmers, and non-MA-SHEP farmers had, on average, more rooms in their homes. Conversely, 94% of non-MA-SHEP farmers used collected firewood as cooking fuel, compared to 85% of MA-SHEP farmers, indicating marginally poorer conditions among non-MA-SHEP farmers. Overall, the data do not provide clear evidence that one group was consistently poorer than the other before the project's inception in February 2021.

Despite the generally comparable welfare conditions between the treatment (MA-SHEP farmers) and control (non-MA-SHEP farmers) groups, further adjustments were made to enhance comparability. Sampling weights were refined using propensity score matching and post-stratification techniques to balance key poverty indicators, such as asset ownership and housing conditions, between the groups. Table 2 also presents the adjusted means of these indicators following the application of sampling weights. Similar analyses of pre-project conditions and corresponding adjustments were conducted for data from the rural northern and central regions (see Annex 2).

Table 1. Comparison of pre-project housing conditions and asset ownership in rural southern Malawi

Variables	Pre-reweighting		Post-reweighting	
	NM	M	NM	M
Floor = mud	0.78	0.8	0.8	0.8
Roof = grass	0.48	0.47	0.47	0.47
lighting = battery	0.81	0.73	0.73	0.73
Cooking fuel=collected firewood	0.94	0.85	0.85	0.85
Pit latrine with slab	0.31	0.3	0.3	0.3
Mortar	0.56	0.49	0.49	0.49
Bed	0.2	0.21	0.21	0.21
Radio	0.35	0.3	0.3	0.3
Iron	0.15	0.14	0.14	0.14
Byicycle	0.49	0.41	0.41	0.41
Table	0.31	0.27	0.27	0.27
# of rooms	2.25	2.16	2.16	2.16

Source. Authors' estimation using the MA-SHEP survey.
Note. NM refers to Non-MA-SHEP farmers and M refers to MA-SHEP farmers.

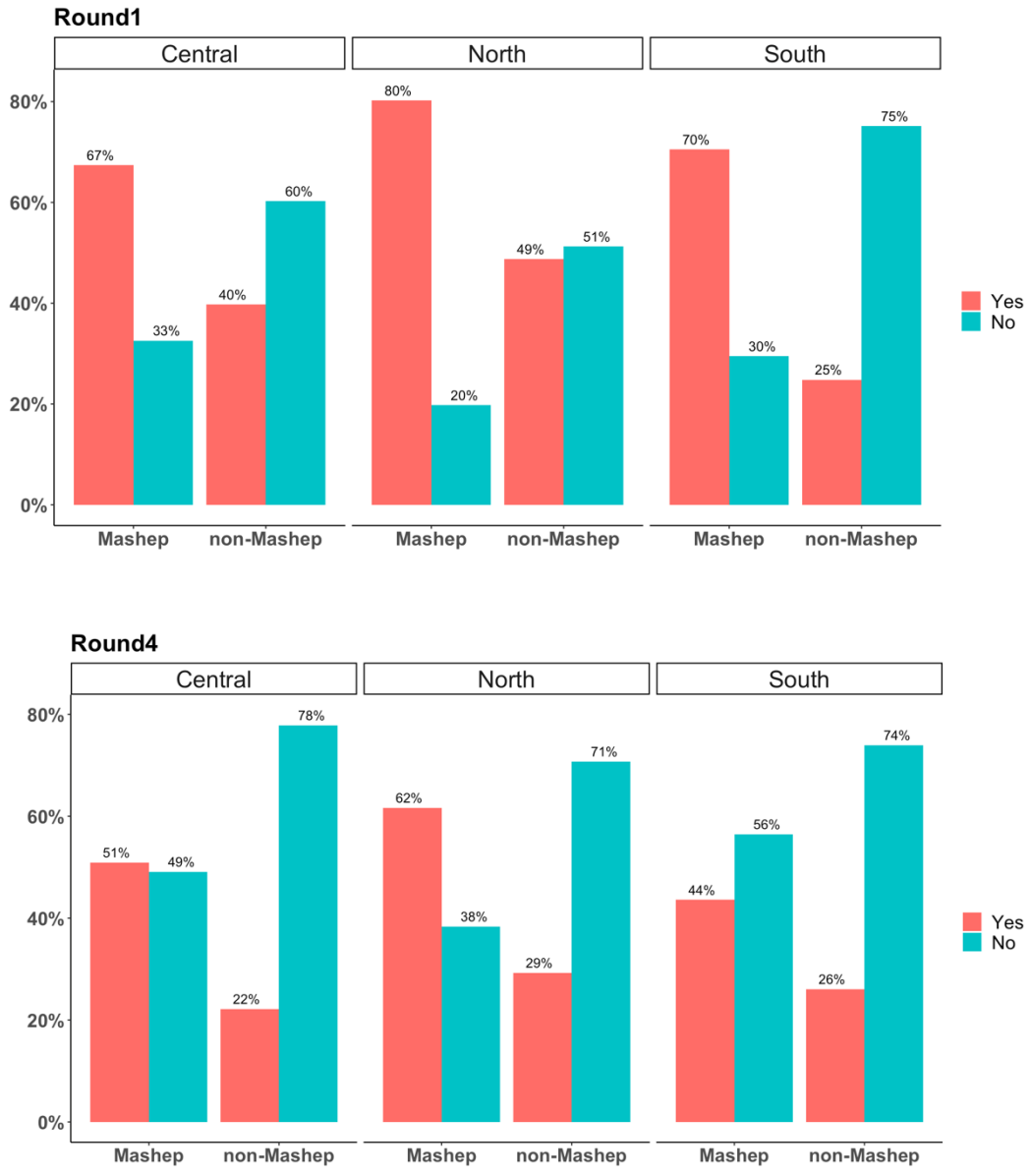
V. Key Findings

Behavioral change

The primary objective of MA-SHEP is to enhance marketing, business, and agricultural production skills, ultimately improving income, gender equity, and food security among smallholder farmers. This section examines key behavioral differences between MA-SHEP and non-MA-SHEP farmers. Figure 2 illustrates the extent to which farmers independently conducted market surveys during their free time over the past six months for their group or personal benefit. Conducting market surveys is a fundamental component of the MA-SHEP project, and the findings indicate that MA-SHEP farmers participate in this activity more frequently than their non-MA-SHEP counterparts. Notably, farmers in central and northern regions who

completed MA-SHEP training in 2019 and 2021, respectively, have continued conducting market surveys even years after the project concluded. This sustained practice highlights the enduring impact of MA-SHEP training.

Figure 2 : Whether they conducted market surveys in the past six months

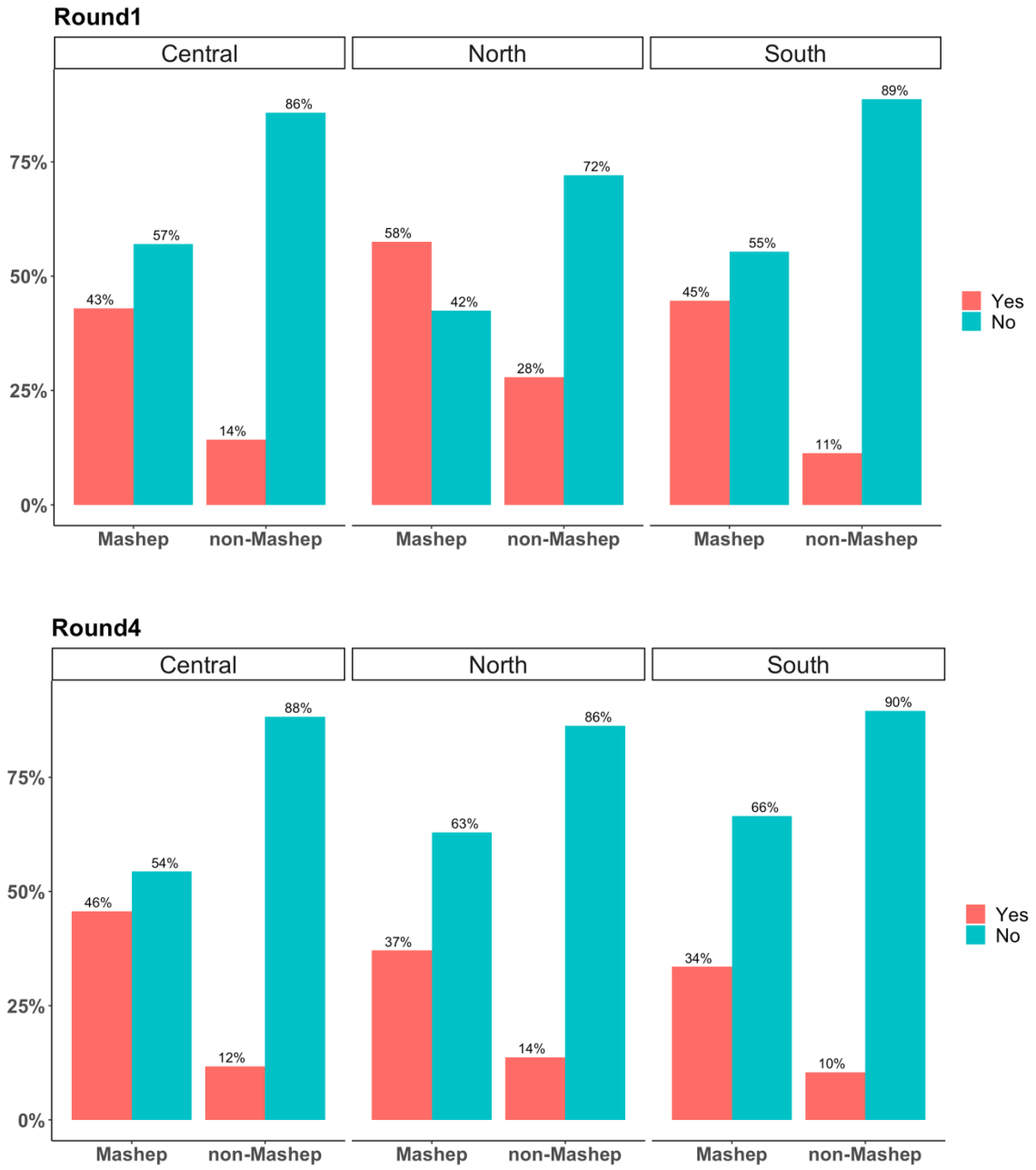


Source. Authors' estimation using the MA-SHEP survey.

Note. Non-Mashep refers to farmers who belong to cooperatives but are not under the MA-SHEP project, or Non-MASHEP farmers, and Mashep refers to farmers who belong to cooperatives under the MA-SHEP project, or MA-SHEP farmers.

Having specific buyers is a crucial factor in determining the degree of market orientation in farming. Without specific buyers, farmers must search for buyers after harvesting their products, often leaving them with no choice but to accept lower prices offered by random buyers on the spot. In contrast, having specific buyers provides financial stability, although it necessitates proactive market research, such as comparing prices among potential buyers. Figure 3 clearly shows that MA-SHEP farmers are significantly more likely to have established specific buyers than their non-MA-SHEP counterparts.

Figure 3 : Whether they have any specific buyer for the products

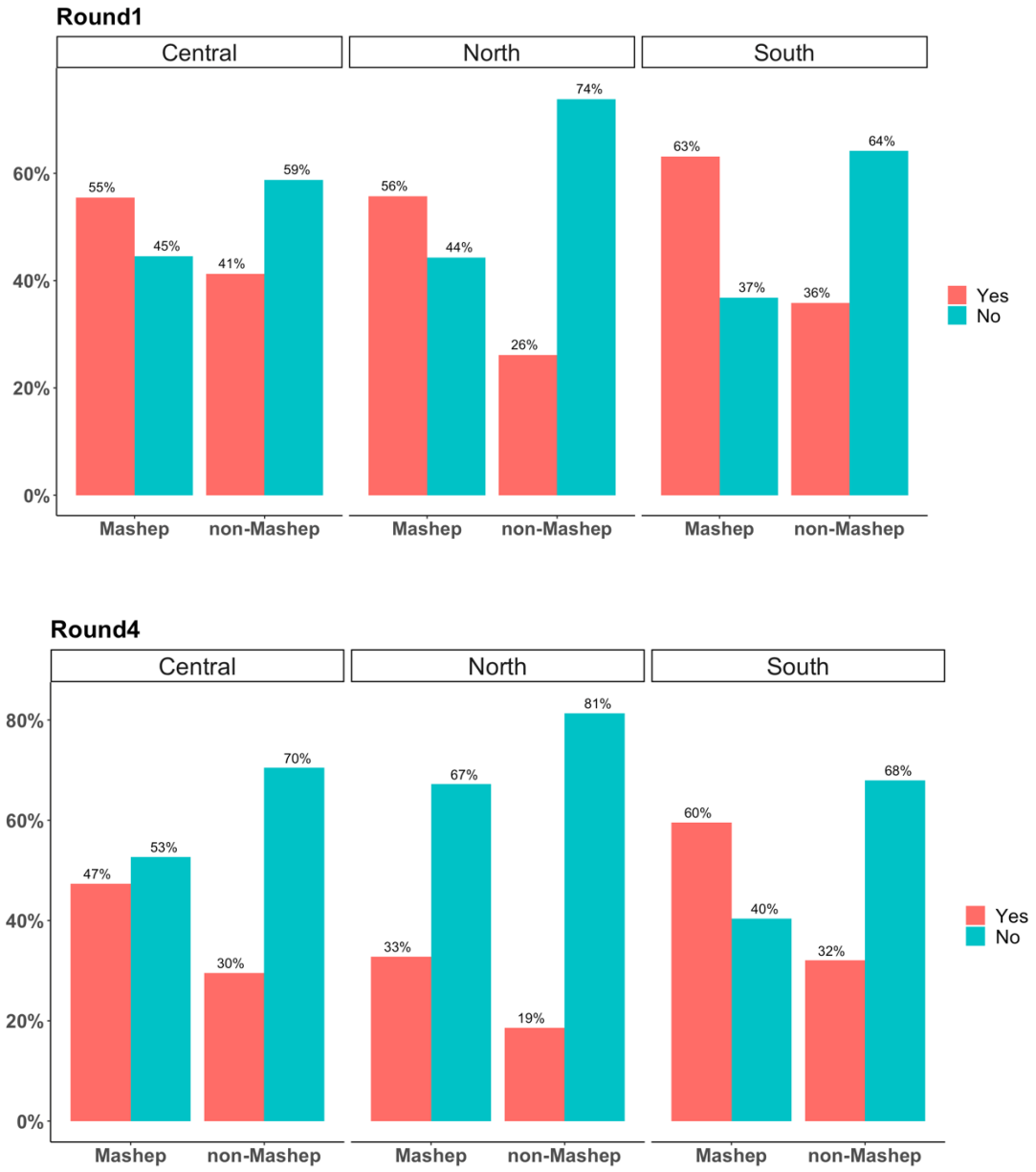


Source. Authors' estimation using the MA-SHEP survey.
Note. Non-Mashep refers to farmers who belong to cooperatives but are not under the MA-SHEP project, or Non-MASHEP farmers, and Mashep refers to farmers who belong to cooperatives under the MA-SHEP project, or MA-SHEP farmers.

An essential step toward market-oriented agriculture, particularly for agricultural cooperatives, is the practice of aggregating crops in bulk for sale. This approach not only enables farmers to secure better prices but also allows them to sell to larger buyers who typically would not purchase small quantities from individual farmers. Figure 4 illustrates the percentage of MA-SHEP and non-MA-SHEP farmers who aggregated crops with others during sales. In round 1, the majority of MA-SHEP farmers were already

selling crops in bulk. Although the percentage decreased in round 4 for farmers in the central and northern regions, they still remain significantly more likely to engage in bulk selling compared to non-MA-SHEP farmers.

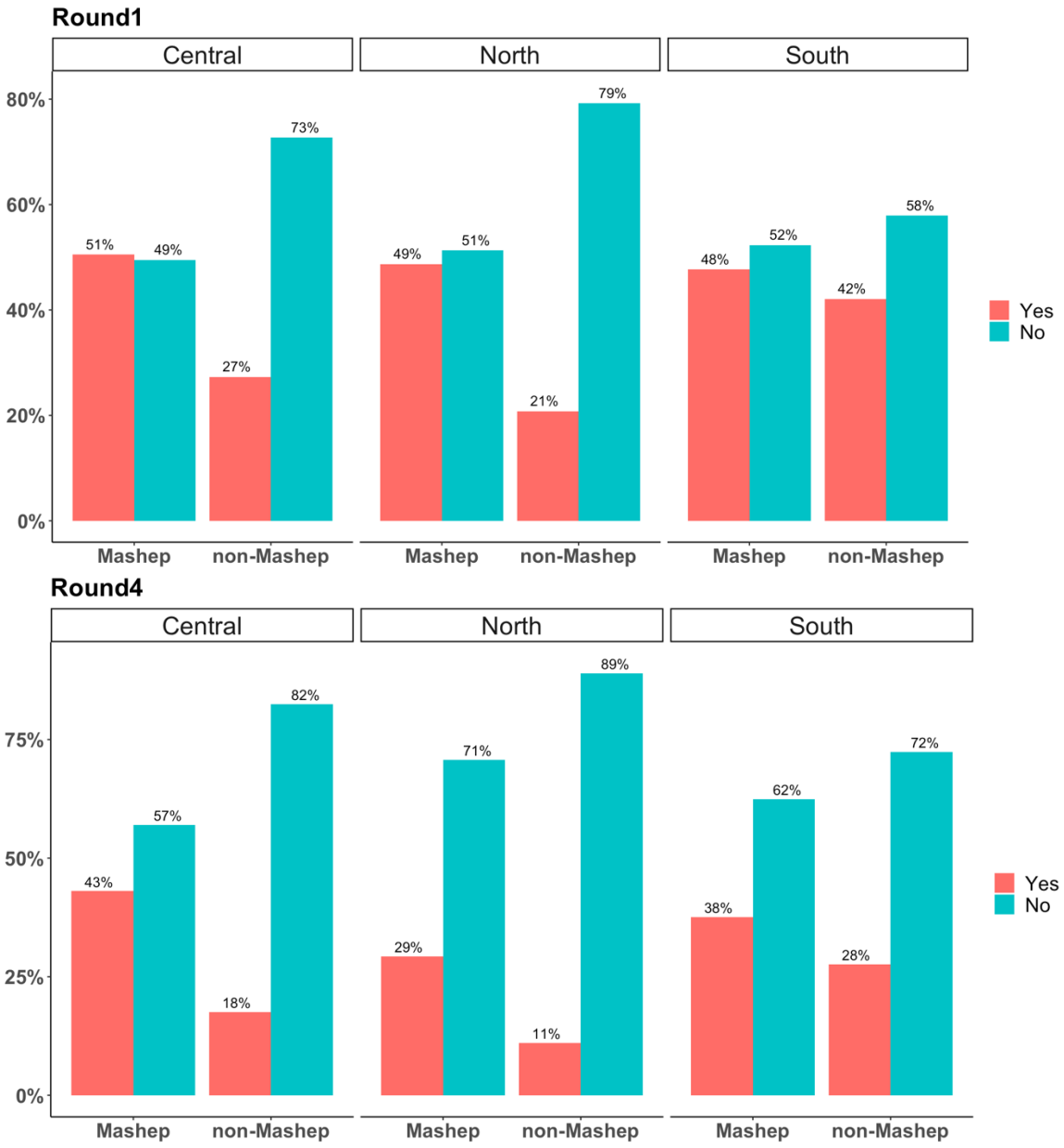
Figure 4 : Whether they aggregate crops in bulk when they sell



Source. Authors' estimation using the MA-SHEP survey.
Note. Non-Mashep refers to farmers who belong to cooperatives but are not under the MA-SHEP project, or Non-MASHEP farmers, and Mashep refers to farmers who belong to cooperatives under the MA-SHEP project, or MA-SHEP farmers.

Similar to selling the crops with other farmers, they can also buy inputs together such as seeds and fertilizer. This will normally lower the price as the quantity gets large compared to the scenario when they buy inputs individually. As shown in Figure 5, it is clear that MA-SHEP farmers are more likely to take this strategy.

Figure 5 : Whether they buy inputs together

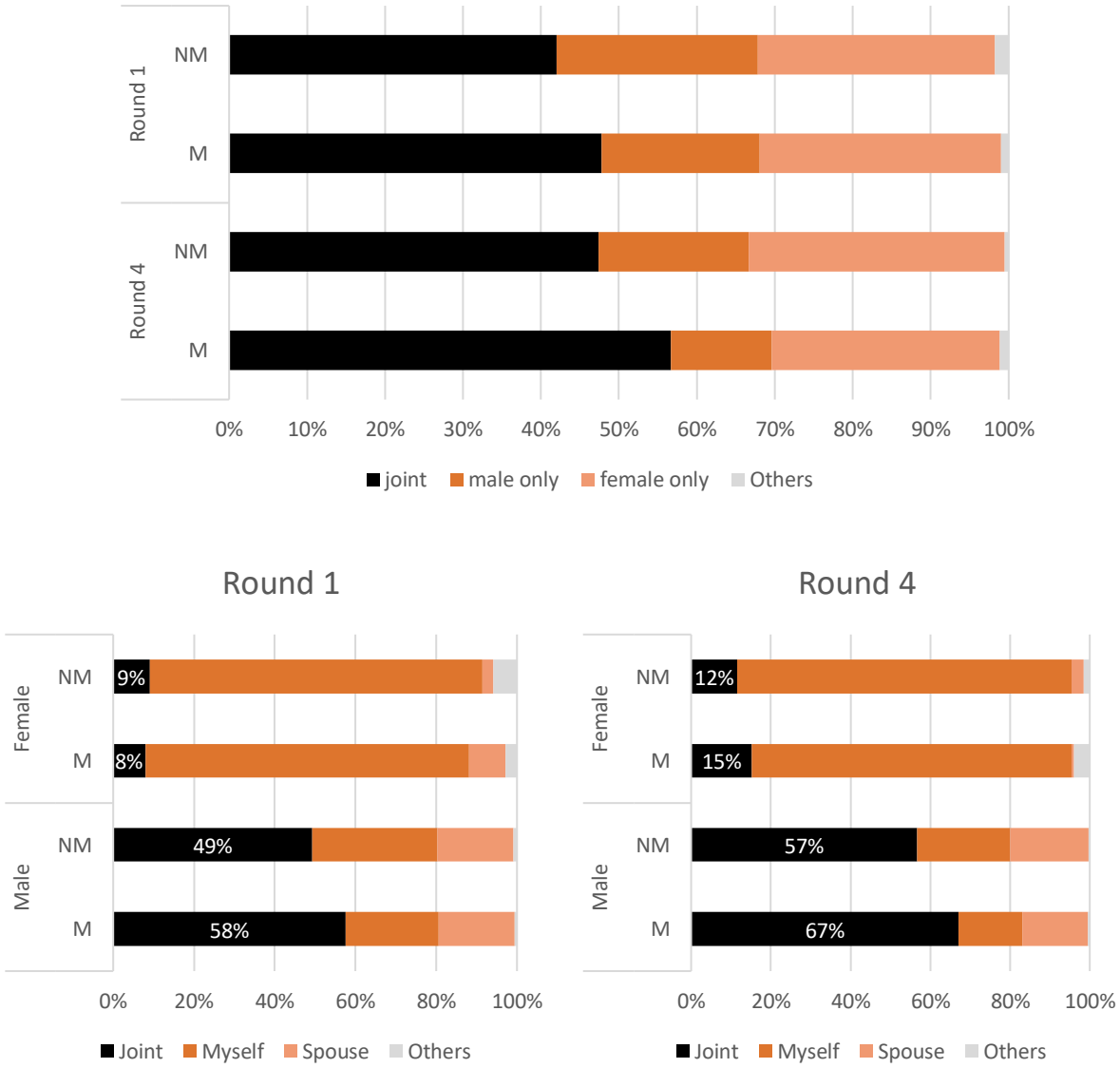


Source. Authors' estimation using the MA-SHEP survey.
Note. Non-Mashep refers to farmers who belong to cooperatives but are not under the MA-SHEP project and Mashep refers to farmers who belong to cooperatives under the MA-SHEP project.

Figure 6 shows who is the decision maker in farm management for MA-SHEP/non-MA-SHEP farmers. One of the key components of MA-SHEP is to emphasize the importance of division of labor, cooperation and communication among family members, especially between the household head and his spouse. This can be seen clearly in Figure 6. For example, MA-SHEP farmers are more likely to make decisions together with a head and spouse, rather than just by the household head alone. Among households with male heads, the tendency to joint decision making is more prominent among MA-SHEP farmers than non-MA-SHEP farmers. Among the female household heads, the joint decision making is rare and there is no difference

between MA-SHEP and non-MA-SHEP farmers. In both groups the share of households under joint decision making increased between round 1 (February 2022) and round 4 (February 2023). Considering that the male-to-female ratio of household heads in this study was approximately 8 to 2, it is suggested that behavioral changes among these males may have significantly contributed to the overall impact of the project.

Figure 6: Who makes decisions on farm management in your family including both male and female household heads



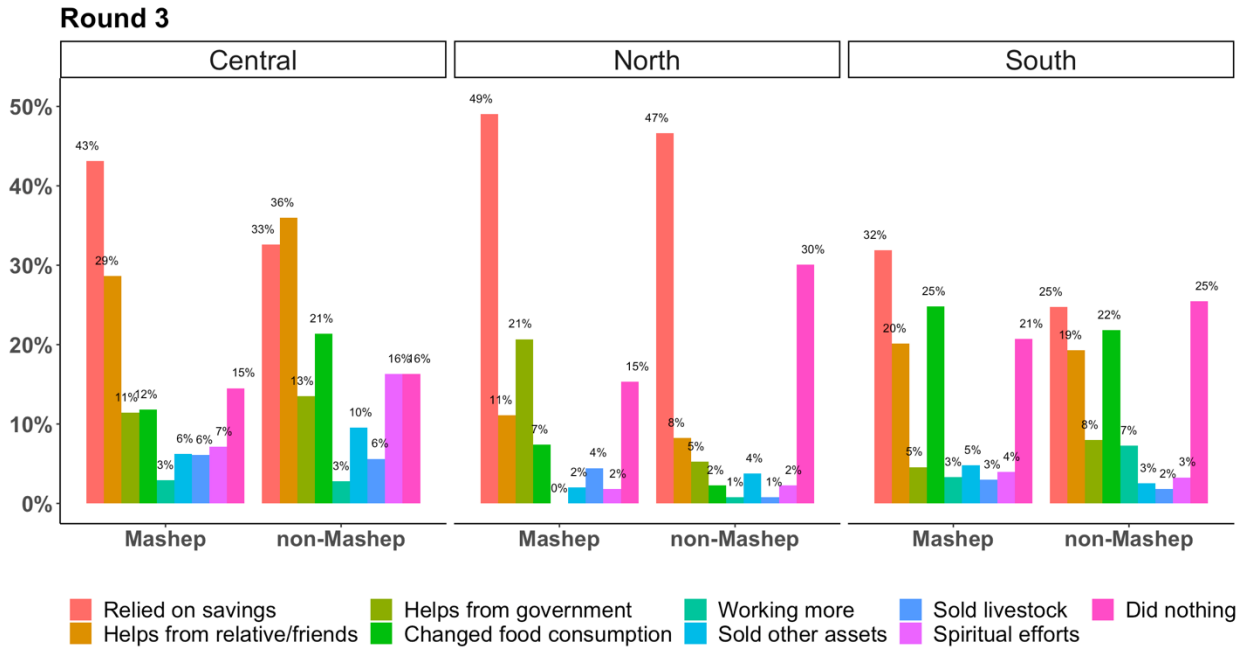
Source. Authors' estimation using the MA-SHEP survey.
Note 1. NM refers to farmers who belong to cooperatives but are not under the MA-SHEP project and M refers to farmers who belong to cooperatives under the MA-SHEP project.
Note 2. All numbers are estimated without sampling weights.

Malawi is vulnerable to various natural disasters such as cyclone or drought almost every year. During this project, in addition to COVID19 which was still widely spreading, southern Malawi was hit by the tropical

storm Ana in January 2022, and again by the Cyclone Freddy in February 2023. As the majority of the population is still heavily dependent on agriculture, it is critically important for the farmers to be resilient against climate shocks.

Figure 7 shows the different coping mechanism taken by MA-SHEP/non-MA-SHEP farmers against external shocks[6]. In general, MA-SHEP farmers are more likely to rely on savings than non-MA-SHEP farmers, which might suggest that they have more cash as a result of increased income, or they save more as part of the behavioral change induced by the project.

Figure 7 : Coping mechanism against shocks



Source. Authors' estimation using the MA-SHEP survey.
Note. Non-Mashep refers to farmers who belong to cooperatives but are not under the MA-SHEP project, or Non-MASHEP farmers, and Mashep refers to farmers who belong to cooperatives under the MA-SHEP project, or MA-SHEP farmers.

Impact on household welfare

Impact of MA-SHEP on Asset Ownership and Housing Conditions in Rural Malawi

Figure 8 compares housing conditions and asset ownership between MA-SHEP and non-MA-SHEP farmers in rural southern Malawi two years after the project's launch. It includes the pre-program conditions and the situation in round 3 (November 2022). It is important to note that due to the reweighting exercise, pre-project conditions were identical for both groups. For rural northern and central regions, the same figures are available in the annex.

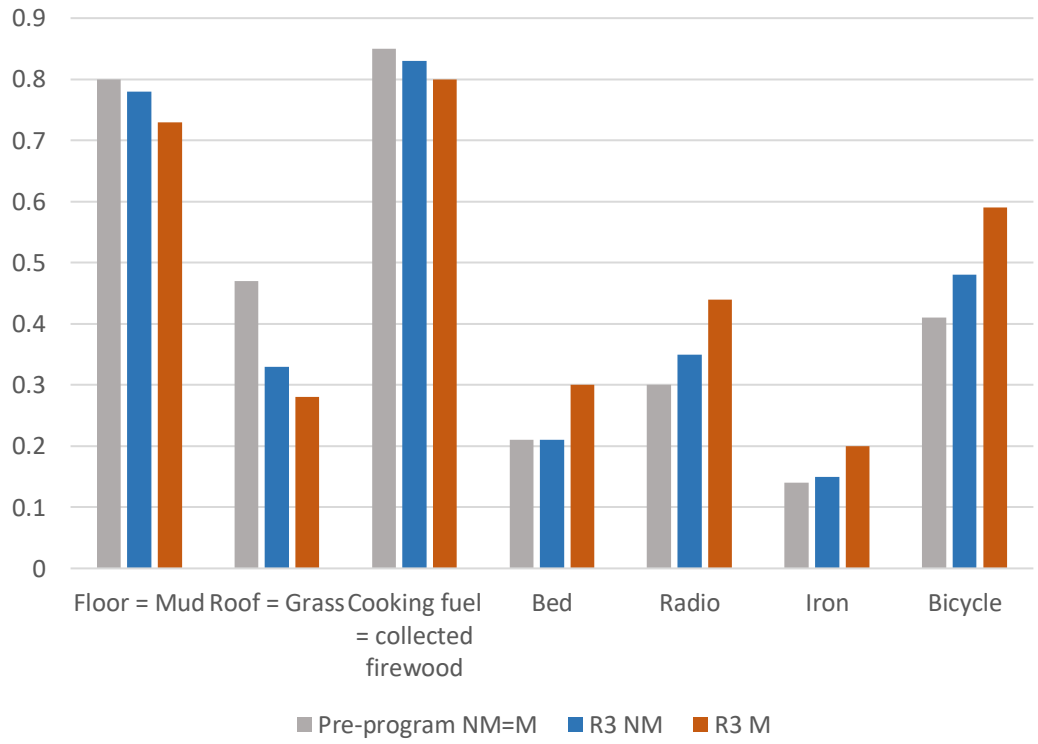
Between before the launch of the MA-SHP project and round 3 of the survey (November 2022), radio ownership among MA-SHEP farmers increased significantly, from 30% to 44%, while it rose only marginally for non-MA-SHEP farmers, from 30% to 35%. Similarly, ownership of iron among MA-SHEP

[6] This question was only asked in round 3 and 4. External shocks include1) Drought, 2) Flood/Water logging. 3) Crop pest or disease, 4) Livestock disease, 5) Household business failure, 6) Loss of job/non-payment of salary, 7) Loss of assistance/aid, 8) Loss of remittances, 9) Fall in sale price of crops, 10) A rise in prices of food, 11) Death in the household, 12) Break-up of the household, 13) Illness or injury of someone in the household, 14) Outbreak of illness in broader community (epidemic)

farmers grew from 14% to 20%, whereas it remained nearly unchanged for non-MA-SHEP farmers. Bed ownership also showed greater growth among MA-SHEP farmers compared to their counterparts. Bicycle ownership among MA-SHEP farmers experienced a substantial rise, from 41% to 59%, compared to a smaller increase of 7 percentage points among non-MA-SHEP farmers.

Improvements in housing conditions were also more pronounced among MA-SHEP farmers. For instance, the share of MA-SHEP farmers living under grass roofs—the poorest roofing material—declined faster than for non-MA-SHEP farmers. Similar trends were observed for mud floors and the use of collected firewood as cooking fuel, both of which are strong indicators of poverty. These findings suggest that MA-SHEP farmers experienced more rapid improvements in household welfare compared to non-MA-SHEP farmers.

Figure 8. Housing conditions and asset ownership in rural southern Malawi in round 3



Source. Authors' estimation using the MA-SHEP survey.
Note. NM and M refer to non-MA-SHEP and MA-SHEP farmers. R3 refers to round 3 of the MA-SHEP survey.

Impact of MA-SHEP on Poverty Reduction and Resilience in Rural Malawi

Poverty rates were estimated using three SWIFT models trained separately for the rural northern, central, and southern regions of Malawi. The estimates align closely with official poverty rates. Figure 9 illustrates the poverty rates of MA-SHEP (M) and non-MA-SHEP (NM) farmers across all four survey rounds, aggregated from the three regions. The figure clearly shows that poverty rates among MA-SHEP farmers were consistently lower than those of non-MA-SHEP farmers, with all differences statistically significant at the 5% level. Moreover, the gap between the two groups widened over time. In round 1, the poverty headcount rate for MA-SHEP farmers was 35.3%, around 10 percentage points lower than that of non-MA-SHEP farmers. By round 4, this difference had grown to 13 percentage points. Notably, both groups had

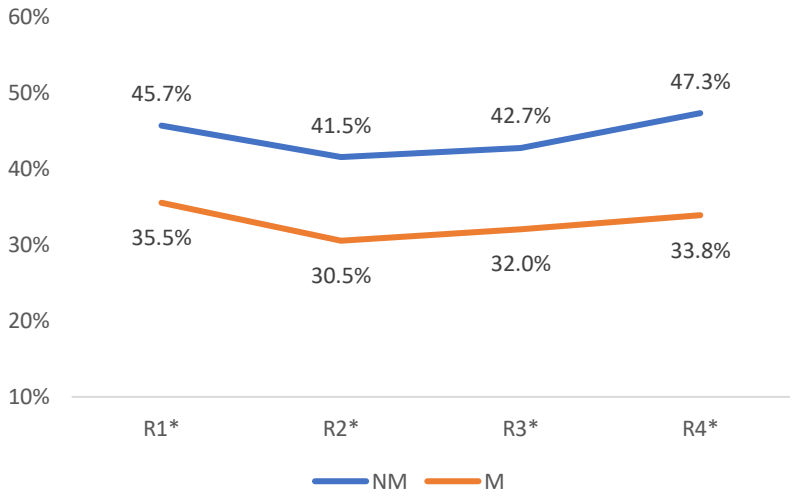
similar household welfare levels prior to the launch of the MA-SHEP project, suggesting that the observed differences in poverty incidence can be attributed to the project's impact.

Several additional insights emerge from the data. In rural Malawi, most households rely on maize as a staple crop, with the primary harvest occurring from April to August. Household consumption is largely dependent on this harvest, leading to a lean season from November until the next harvest begins in March. Reflecting this seasonal cycle, poverty rates for both groups declined in round 2 (June 2022) before gradually increasing through round 4 (February 2023).

Additionally, Malawi experienced significant climate shocks during the survey period, including Tropical Storm Ana in January 2021 (just before round 1) and Cyclone Freddy in February 2022 (around round 4). These events exacerbated the vulnerability of many households to extreme poverty, as limited resources constrained their ability to smooth consumption and prepare for such shocks.

Despite these challenges, MA-SHEP farmers demonstrated greater resilience. Between round 2 and round 4, the poverty rate among MA-SHEP farmers increased by only 3.3 percentage points, compared to almost 6 percentage points for non-MA-SHEP farmers. Moreover, MA-SHEP farmers managed to reduce the poverty headcount rate over time, while non-MA-SHEP farmers experienced a slight increase in poverty. These findings suggest that MA-SHEP farmers were better equipped to manage their vulnerability and maintain welfare during difficult conditions.

Figure 9. Poverty Headcount Rates for MA-SHEP and non-MA-SHEP farmers over Four Rounds



Source: Author's own calculations using the MA-SHEP survey data
Note. R1 – R4 refer to the round of the MA-SHEP survey. * indicates statistical significance at 5 percent. NM and M refer to non-MA-SHEP and MA-SHEP farmers, respectively.

Figure 10 presents poverty rates estimated separately for each region. Across all three regions, non-MA-SHEP farmers consistently show higher poverty rates than MA-SHEP farmers. The disparity in poverty rates is particularly pronounced in the rural northern and central regions, where the MA-SHEP project has been implemented for a longer period, compared to the rural southern region.

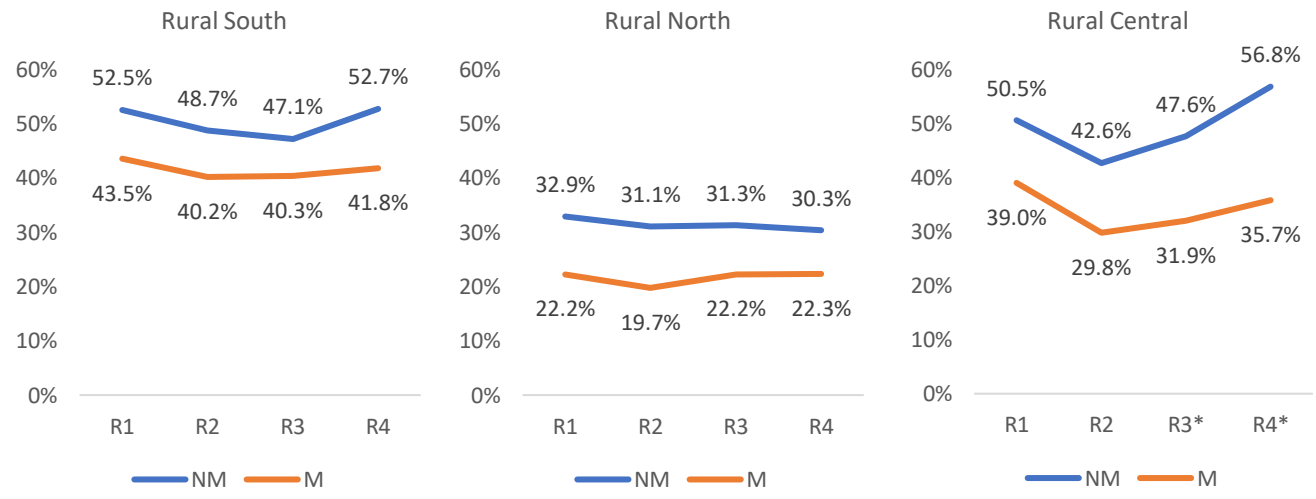
For example, in the rural central region during round 4 (February 2023), the poverty rate for non-MA-SHEP farmers was 56.8%, compared to 35.7% for MA-SHEP farmers—a gap of 21 percentage points. Notably, in the last two rounds, the differences in poverty rates between MA-SHEP and non-MA-SHEP farmers are

statistically significant, despite the limited sample size. [7] These findings suggest that the longer duration of the MA-SHEP project in the central regions may have contributed to the greater poverty reduction observed in these areas.

For the rural central and southern regions, the seasonality of poverty observed in the aggregated data (Figure 9) is evident. However, the increase in poverty after the harvest season (Round 2 – June 2022) was smaller for MA-SHEP farmers compared to non-MA-SHEP farmers. For instance, the poverty headcount rate rose by 1.6 percentage points in the rural southern region and 6 percentage points in the rural central region for MA-SHEP farmers, while it increased by 4.0 and 14.2 percentage points, respectively, for non-MA-SHEP farmers.

Additionally, despite the survey period coinciding with major climate events such as Tropical Storm Ana (January 2022) and Cyclone Freddy (February 2023), both regions showed a slight reduction in poverty for MA-SHEP farmers, in contrast to an increase in poverty for non-MA-SHEP farmers. These findings suggest that MA-SHEP farmers were better able to manage the adverse effects of seasonal and environmental challenges.

Figure 10. Comparison of Poverty Headcount Rates Across Three Regions



Source: Author's own calculations using MA-SHEP data
Note 1. The sample weight adjustments are made to control for differences in the pre-project conditions by taking the non-MA-SHEP farmers' conditions as a reference.
Note 2. NM refers to "non-MA-SHEP farmers," and M refers to "MA-SHEP" farmers.

Seasonality, Resilience, and the Broader Impact of MA-SHEP on Household Expenditure

The poverty rate analysis focuses on the lower end of the household welfare distribution. This section examines the impact of MA-SHEP on average household expenditures. Figure 11 shows that across all rounds, MA-SHEP farmers consistently reported higher mean household expenditure per capita. In round 1, for example, their expenditure was approximately 14% higher than that of non-MA-SHEP farmers, and

[7] Indeed, the differences in poverty rates between MA-SHEP and non-MA-SHEP farmers are statistically insignificant across all other rounds and regions. This is likely attributable to the limited sample sizes, with only approximately 300 observations available.

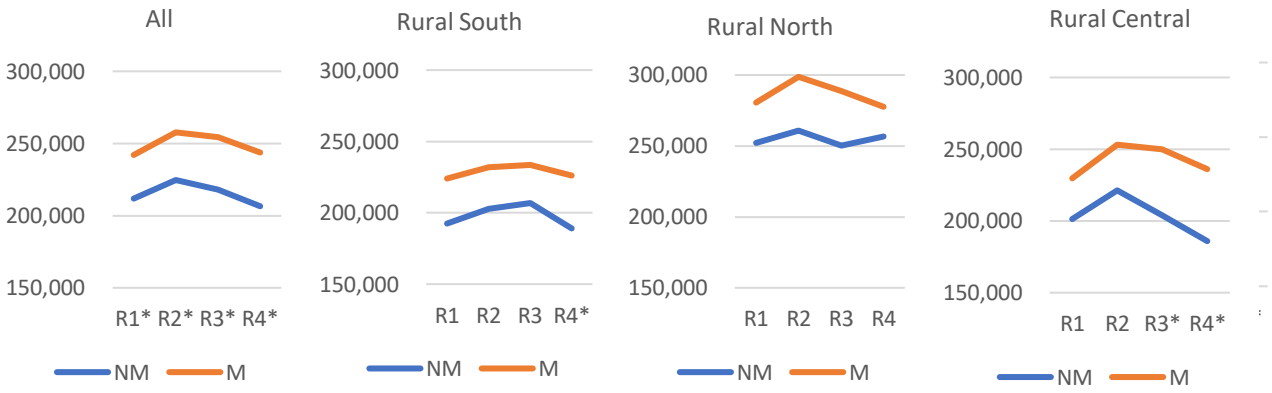
by round 4, this gap had widened to 18%. Similar to poverty trends, these differences were statistically significant in every round when data from all three regions were combined.

Regionally, the largest differences in expenditure appeared in the rural central and southern regions, both of which were heavily impacted by Tropical Storm Ana and Cyclone Freddy (see Figure 11). By round 4, mean expenditures among MA-SHEP farmers in these regions were 27% and 20% higher, respectively, compared to non-MA-SHEP farmers. In contrast, the rural northern region exhibited a smaller gap of 8%.

Notably, in the rural central region, mean household expenditure per capita among non-MA-SHEP farmers declined by more than 16 percentage points between the harvest season (round 2) and the lean season (round 4). In comparison, MA-SHEP farmers reduced their expenditures by only 7%, further demonstrating their resilience to seasonal fluctuations and climate shocks.

Previous evaluations of SHEP projects have largely focused on horticultural income growth. However, even if horticultural income increases significantly, its impact on total household income and expenditure—which directly influence poverty rates—can be limited if horticultural income represents only a small portion of household income. The analysis presented here goes beyond horticultural income to emphasize the impact on the real total household expenditure per capita, offering a more comprehensive assessment of household welfare. These findings confirm the significant impact of the SHEP project on overall household expenditure, demonstrating its broader contribution to poverty reduction beyond horticultural income growth.

Figure 11. Comparison of the distribution of the mean household expenditure per capita (Malawi Kwacha in 2019/20 prices)

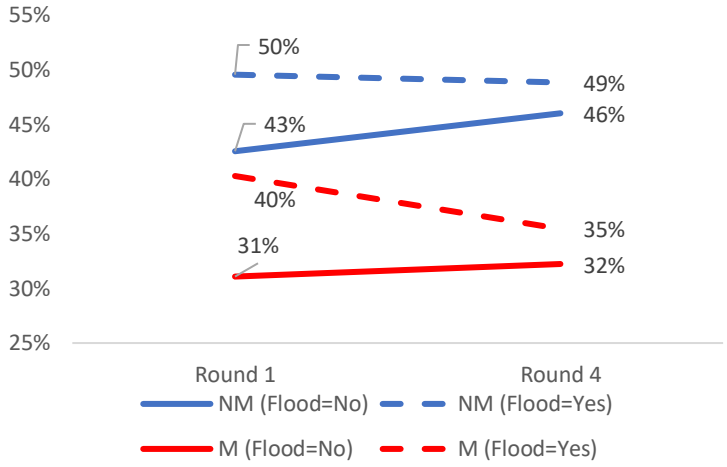


Source: Author's own calculations using MA-SHEP data
Note1. NM refers to "non-MA-SHEP farmers," and M refers to "MA-SHEP" farmers.
Note 2. All numbers are shown in Malawi Kwacha in 2019-2020 prices

Impact of Tropical Storm Ana on Poverty

Tropical Storm Ana in January 2022 caused significant flooding that affected both MA-SHEP and non-MA-SHEP farmers. In round 1, farmers impacted by the flood—regardless of group—exhibited higher poverty rates on average than those who were not affected. However, this disparity cannot be solely attributed to the flood, as poorer farmers often reside in areas that are particularly vulnerable to flood damage.

Figure 12. Impact of the January 2022 Flood on Poverty in Rounds 1 and 4



Source. Author's own calculations using the MA-SHEP survey data.
Note. M refers to MA-SHEP farmers and NM refers to non-MA-SHEP farmers.

Figure 12, however, reveals an intriguing trend. BY round 4, among MA-SHEP farmers, those impacted by the flood showed a gradual reduction in poverty over time, whereas the poverty rate for those not affected by the flood remained relatively unchanged. Among non-MA-SHEP farmers, the poverty rate for those impacted by the flood stagnated, whereas the poverty rate for those not affected by the flood increased slightly.

While further investigation is needed, this divergent performance suggests that the MA-SHEP project may play a role in enhancing the recovery of farmers from flood-related damages, contributing to improved resilience in the face of natural disasters.

Food Insecurity Trends and the Impact of MA-SHEP

The survey included questions on food insecurity, allowing for the calculation of the coping strategy index (rCSI). Households are classified as experiencing "Very Stressed" food insecurity if the rCSI score is 19 or higher, "Stressed" if the score falls between 4 and 19, and "Minimal" if the score is less than 4. Figure 13 presents the percentage of households classified as "Very Stressed" across four survey rounds, three regions, and the aggregated data for all regions.

Most rural Malawian households follow an agricultural calendar, harvesting crops in spring and summer and relying on this harvest for consumption until the next season. As a result, food insecurity typically improves after March-April (post-harvest) and gradually worsens toward winter, peaking in February. Figure 13 reflects this seasonal pattern for both MA-SHEP and non-MA-SHEP farmers in the rural central and southern regions, as well as in the aggregated data. However, MA-SHEP farmers in the rural northern region exhibit little to no seasonality in food insecurity, while non-MA-SHEP farmers in the same region clearly show seasonal fluctuations.

Figure 13 also highlights that MA-SHEP farmers are generally more food secure than non-MA-SHEP farmers, with a consistently smaller percentage of households classified as "Very Stressed." In the aggregated data, the percentage of MA-SHEP farmers in this category is significantly lower than that of non-MA-SHEP farmers in all rounds except round 2. Additionally, consistent with regional poverty trends,

the southern region experiences the most severe food insecurity, while the northern region appears to be better off compared to other areas.

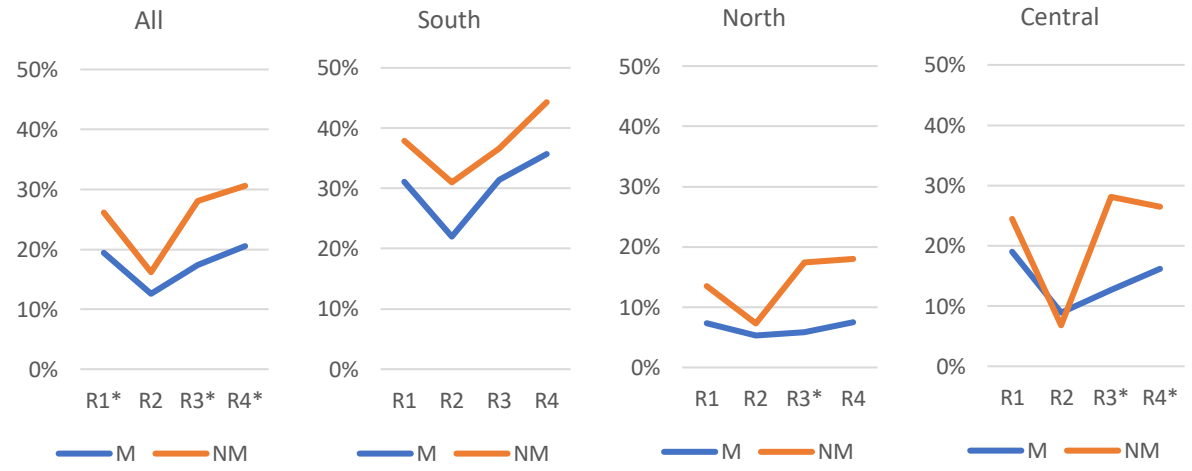
Similar to poverty trends, food security for MA-SHEP farmers gradually worsened from July 2022 (round 2) to February 2023 (round 4), whereas non-MA-SHEP farmers experienced a much steeper increase during the same period. By December 2022 (round 3), the percentage of non-MA-SHEP farmers classified as "Very Stressed" exceeded 28% in the aggregated data, compared to only about 17% for MA-SHEP farmers.

This trend is particularly pronounced in the rural central region. In June 2022 (round 2), 7% of non-MA-SHEP farmers were classified as "Very Stressed," slightly lower than the 9% observed among MA-SHEP farmers. However, by December 2022 (round 3), the percentage of non-MA-SHEP farmers in the "Very Stressed" category rose sharply by over 20 percentage points to 28%, while the percentage of MA-SHEP farmers increased by only 3 percentage points to 12.7%. A similar pattern was observed in the rural northern region, where food insecurity among non-MA-SHEP farmers rose significantly between June and December 2022, while MA-SHEP farmers experienced almost no change.

In contrast, in the rural southern region, both MA-SHEP and non-MA-SHEP farmers experienced a comparable increase in the percentage of households classified as "Very Stressed" after June 2022 (round 2).

These findings suggest that in areas where the SHEP project was introduced earlier—such as the rural central and northern regions—there are indications that the project contributed to strengthening farmers' ability to mitigate the risks of food insecurity and reduce seasonal fluctuations over time.

Figure 13. Food security among different types of farmers in round 1



Source. Author's own calculations using the MA-SHEP survey data.
Note. M refers to MA-SHEP farmers and NM refers to non-MA-SHEP farmers.

VI. Key Challenges, Measures Taken, and Lessons Learned

This project provides strong evidence that the MA-SHEP project significantly increases farmers' income, reduces poverty incidence, and strengthens resilience against seasonal and climate shocks. According to the World Bank's poverty assessment, Malawi faces three critical challenges: (i) being one of the poorest

countries globally, (ii) stagnating poverty rates over the past decade, and (iii) persistent vulnerability due to slow agricultural growth and frequent climate shocks. The findings of this project suggest that the MA-SHEP project offers a promising solution to these issues by addressing both poverty and resilience deficits in rural Malawi.

Contributors to MA-SHEP's Success

The MA-SHEP survey provides insights into factors contributing to the project's effectiveness. Key differences in agricultural practices and management between MA-SHEP and non-MA-SHEP farmers include:

1. Market Orientation: MA-SHEP farmers were more likely to conduct market surveys and establish relationships with buyers.
2. Inclusive Decision-Making: MA-SHEP farmers engaged spouses in financial decisions and farm management, particularly during the lean season.

While these factors point to possible drivers of the project's success, further systematic econometric and statistical analysis is required to draw firm conclusions.

Limitations and Solutions

1. Lack of Pre-Project Poverty Estimates

The study lacked direct pre-project poverty data for MA-SHEP farmers, as the project was already operational across all regions when the study began. To address this, we used pre-project indicators such as asset ownership and housing conditions, which are reliable proxies for poverty. While these proxies allow for reasonable estimates of pre-project poverty levels, they are less effective in capturing short-term fluctuations caused by shocks. Future surveys should include rapidly changing indicators like food consumption and subjective well-being for more precise estimates of short-term poverty changes.

2. High Evaluation Costs

While the integration of RFMS data reduced additional costs, future evaluations should focus on reducing expenses further:

- Localized Enumerator Deployment: Hiring enumerators within sample villages, as in RFMS, would lower transportation costs, increase resilience to climate shocks, and enable frequent data collection.
- Streamlined Questionnaires: Dropping questions with little variation across rounds, such as market survey practices, could simplify data collection and reduce training costs.

3. Comparison with Regular Farmers

While the survey compared MA-SHEP farmers with non-MA-SHEP farmers, it did not include average rural households. Future evaluations should include regular farmers in the survey design to better assess the project's impact relative to the broader rural population.

4. Need for Government Integration

To ensure the sustainability and scalability of the MA-SHEP project, monitoring and evaluation must transition to the government, such as the National Statistical Office (NSO). Building capacity within the government would enable continuous project evaluation and refinement, supporting nationwide scaling and contributing to Malawi's poverty reduction and climate resilience goals.

Lessons Learned

This project highlights the transformative potential of the MA-SHEP project in addressing persistent poverty and resilience challenges in rural Malawi. Key lessons include:

1. Holistic Approaches Work: Combining market-oriented training with household-level decision-making improves income stability and food security.
2. Frequent Monitoring Matters: High-frequency data collection is critical for capturing seasonal and shock-related vulnerabilities.
3. Cost Efficiency Is Key: Streamlining data collection methods can significantly reduce evaluation costs while maintaining effectiveness.
4. Scaling Requires Partnerships: Integrating monitoring systems into government structures ensures the project's long-term sustainability.

These findings underscore the importance of expanding SHEP projects to accelerate poverty reduction, strengthen resilience, and support sustainable development in vulnerable agricultural communities.

VII. Concluding remarks

This study presents the first comprehensive evaluation of the Smallholder Horticulture Empowerment and Promotion (SHEP) project in Malawi, focusing on its impact on poverty reduction, household welfare, and resilience to shocks and seasonal fluctuations. Leveraging innovative high-frequency monitoring systems like the Rapid Feedback Monitoring System (RFMS) and poverty estimation using the Survey of Well-Being via Instant and Frequent Tracking (SWIFT), this research offers robust evidence of the project's effectiveness.

The findings demonstrate that the MA-SHEP project significantly contributed to poverty reduction, with MA-SHEP farmers consistently exhibiting lower poverty rates compared to non-MA-SHEP farmers. For instance, the poverty headcount rate for MA-SHEP farmers was 35.3% in round 1, 10 percentage points lower than their non-MA-SHEP counterparts. By round 4, this gap had widened to 14 percentage points. Additionally, the project improved household welfare, as reflected in higher mean household expenditure per capita, which was 14% higher for MA-SHEP farmers in round 1, increasing to 18% in round 4. These results underscore MA-SHEP's ability to deliver not just income growth but also measurable improvements in overall household well-being.

Beyond poverty reduction, the study highlights the resilience of MA-SHEP farmers to external shocks and seasonal fluctuations. Despite experiencing significant climate events, such as Tropical Storm Ana and Cyclone Freddy, MA-SHEP farmers demonstrated superior adaptive capacity. For instance, between round 2 and round 4, the poverty rate among MA-SHEP farmers increased by only 3.5 percentage points, compared to a 7-percentage-point rise for non-MA-SHEP farmers. Similarly, MA-SHEP farmers faced less severe food insecurity, with only 17% classified as "Very Stressed" in December 2022 (round 3), compared to 28% of non-MA-SHEP farmers.

This evaluation underscores the transformative potential of the SHEP approach in building resilience and fostering sustainable development. The use of a quasi-experimental design, including propensity score matching and post-stratification, strengthens the validity of these findings, enabling credible causal inferences.

Underlying these quantitative improvements in welfare and resilience are brought through several critical behavioral changes that MA-SHEP fostered among participating households. These behavioral mechanisms explain how the project achieved its impacts: (1) the promotion of market-oriented practices, including market surveys, price negotiation, establishing long-term supplier relationships, and collaboration on logistics; (2) the encouragement of gender-inclusive decision-making, particularly during the lean season, by increasing spouses' involvement in business and financial management.

Recommendations

To maximize the impact of the SHEP project, the following measures are suggested:

1. **Scale-Up and Integration**: Expand the SHEP project to other regions in Malawi and similar contexts globally, with an emphasis on integrating climate resilience measures into the project design.
2. **Continued Monitoring and Evaluation**: Employ frequent, high-resolution poverty and resilience monitoring tools, such as RFMS, to refine project implementation and assess long-term impacts.
3. **Focus on Capacity Building**: Strengthen farmers' skills in market-oriented agriculture, decision-making, and financial management to enhance sustainability and adaptability to shocks.
4. **Broader Comparative Analysis**: Include comparisons with non-agricultural households to further contextualize the project's effectiveness.

The findings of this study provide compelling evidence that the SHEP project represents a viable pathway for addressing persistent challenges of poverty and vulnerability in agricultural communities, offering lessons for policymakers and development practitioners worldwide.

Reference

Arning, Katja, and Stefan Venghaus. 2024. "Sustainable Practices and Household Resilience: An Empirical Analysis of Behavior Change in Times of Crises." *Energy Efficiency* 17: 101. https://doi.org/10.1007/s12053-024-10285-y

Awiti, Hezbon Akelo, Eric Obedy Gido, and Gideon Aiko Obare. 2022. "Smallholder Farmers Climate-Smart Crop Diversification Cost Structure: Empirical Evidence From Western Kenya." *Frontiers in Sustainable Food Systems* 6: 842987. https://doi.org/10.3389/fsufs.2022.842987.

Chetri, P., Sharma, U., & Ilavarasan, P. V.. 2021. "Role of Information and ICTs as Determinants of Farmer's Adaptive Capacity to Climate Risk: An Empirical Study From Haryana, India." *arXiv preprint arXiv:2108.09766.* https://doi.org/10.48550/arXiv.2108.09766 .

Garbero, Alessandro, and Matteo Letta. 2022. "Predicting Household Resilience with Machine Learning: Preliminary Cross-Country Tests." *Empirical Economics, 63(4), 2057–2070. https://doi.org/10.1007/s00181-022-02199-4*.

Hilmi, Y. S., J. Tóth, Z. Gabnai, G. Király, and Á. Temesi. 2024. "Farmers' Resilience to Climate Change Through the Circular Economy and Sustainable Agriculture: A Review from Developed and Developing Countries." *Renewable Agriculture and Food Systems, 39, e15. https://doi.org/10.1017/S1742170524000097*.

Kangogo, D., D. Dentoni, and J. Bijman. 2020. "Determinants of Farm Resilience to Climate Change: The Role of Farmer Entrepreneurship and Value Chain Collaborations." *Sustainability*, 12(3), 868. https://doi.org/10.3390/su12030868.

Kolenikov, S. 2014. "Calibrating Survey Data Using Iterative Proportional Fitting (Raking)." *Stata Journal* 14 (1): 22–59. https://doi.org/10.1177/1536867X1401400104

Nomura, H., Fikadu, A. A., Gebre, G. G., and Shah, P. 2024. "Analysis of the Smallholder Horticulture Empowerment and Promotion ('SHEP') Intervention on Income and Food Security in Ethiopia." *JICA Ogata Research Institute Discussion Paper* No. 27. Tokyo: JICA Ogata Research Institute for Peace and Development.

Oza, H., A. Nanavati, T. Clasen, A. P. Sallinger, M. Freeman, and S. Sinharoy. 2023. "A Critical Review on Measurement Tools of Urban Household and Community Resilience to Disasters and Environmental Shocks and Stressors among Low- and Middle-Income Countries: Theory, Application, and Guidance." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.5033666.

Shimizutani, S., Taguchi, S., Yamada, E., and Yamada, H. 2021. "The Impact of 'Grow to Sell' Agricultural Extension on Smallholder Horticulture Farmers: Evidence from a Market-Oriented Approach in Kenya." *Keio-IES Discussion Paper Series No. 2021-020*. Institute for Economic Studies, Keio University. https://ies.keio.ac.jp/upload/DP2021-020_EN.pdf.

Tambo, Justice A., and Tobias Wünscher. 2017. "Enhancing Resilience to Climate Shocks Through Farmer Innovation: Evidence from Northern Ghana." *Regional Environmental Change* 17: 1505–1514. https://doi.org/10.1007/s10113-017-1113-9.

Teklu, Abyiot, Belay Simane, and Mintewab Bezabih. 2023. "Effect of Climate Smart Agriculture Innovations on Climate Resilience Among Smallholder Farmers: Empirical Evidence from the Choke

Mountain Watershed of the Blue Nile Highlands of Ethiopia." *Sustainability* 15 (5): 4331: 1 – 26. https://doi.org/10.3390/su15054331.

Yoshida, Nobuo, Ricardo Munoz, Andrew Skinner, Kyung-eun Lee, Matia Brataj, and Divya Sharma. 2015. *SWIFT Data Collection Guidelines*. *Version 2*. Washington, DC: World Bank.

Yoshida, Nobuo, Shinya Takamatsu, Kazusa Yoshimura, Danielle Victoria Aron, Xiaomeng Chen, Silvia Malgioglio, Shivapragasam Shivakumaran, and Kexin Zhang. 2022. *The Concept and Empirical Evidence of SWIFT Methodology*. Equitable Growth, Finance and Institutions Insight. Washington, DC: World Bank.

Yoshida, Nobuo, and Danielle Victoria Aron. 2024. *Enabling High-Frequency and Real-Time Poverty Monitoring in the Developing World with SWIFT*. Washington, DC: World Bank.

Yoshimura, Kazusa, Danielle Aron, James Campbell, Xueqi Li, Joanna Upton, Nobuo Yoshida, and Kexin Zhang. 2022. "Rapid Feedback Monitoring System (RFMS) – Real-Time, Cost-Effective, Shock-Resilient Monitoring of Living Conditions and Food Security." Paper presented at the United Nations Economic Commission for Europe Conference of European Statisticians, Rome, Italy, October 26–28, 2022.

Zhang, Kexin, Shinya Takamatsu, and Nobuo Yoshida. 2023. "Correcting Sampling and Nonresponse Bias in Phone Survey Poverty Estimation Using Reweighting and Poverty Projection Models." *Policy Research Working Paper* no. 10656, World Bank.

Annex

Annex 1. SWIFT (Survey of Well-being via Instant and Frequent Tracking)

Instead of collecting consumption data directly, we estimate poverty rates using SWIFT (Survey of Well-being via Instant and Frequent Tracking). SWIFT imputes household expenditure per capita from 17 to 21 poverty correlates using models and estimates of poverty and inequality statistics from the imputed expenditure data. The imputation models for rural north, central, and south regions are available in Annex 3. This annex will explain the methodological background of the SWIFT approach.

A model is trained with household survey data, including household expenditure per capita and poverty correlates. This dataset is called a "training dataset" in this paper. A key assumption is that the relationship between household expenditure per capita and the poverty correlates is linear and stable over time, and a residual is included in the model since no projection is perfect.[8] Equation (1) shows how household expenditure is imputed in a SWIFT survey:

$$\ln y_{hs} = x_{hs}'\beta_s + u_{hs} \quad (1)$$

$$u_{hs} \sim N(0, \sigma_{t0})$$

$$\hat{\beta}_s \sim N(\hat{\beta}_{t0}, \hat{\sigma}_{\beta t0})$$

$\ln y_{hs}$ refers to the natural logarithm of household expenditure per capita of household *h* in a SWIFT survey (denoted as *s*) and is imputed from equation (1). x_{hs} is a $(k \times 1)$ vector of poverty correlates of household *h*. β_s is a $(k \times 1)$ vector of coefficients of poverty correlates drawn randomly from a multivariate normal distribution of $N(\hat{\beta}_{t0}, \hat{\sigma}_{\beta t0})$, where k is the number of variables. Both means of coefficients ($\hat{\beta}_{t0}$) and the variance-covariance matrix is estimated in the training dataset (denoted as *o*). u_{hs} is the residual, drawn from a normal distribution ($N(0, \hat{\sigma}_{t0})$) estimated in the training data.

The natural logarithm of household expenditure per capita of household h is usually imputed 20 times.[9] This implies each household *h* has 20 imputed natural logarithms of household income or expenditure, $\{\ln \widetilde{y_{hsr}}\}_{r=1}^{20}$, where r refers to an imputation round. As a result, the SWIFT dataset has 20 vectors of the imputed natural logarithm of household income or expenditure, $\{\ln \widetilde{y_{hs}}\}_{h=1,r=1}^{H,20}$ where H refers to the total number of households.

For each vector, we calculate a dummy that takes one if $\ln \widetilde{y_{hs}} < Z$ where Z refers to a poverty line; otherwise, 0 and estimate the population-weighted average. The mean of the 20 population-weighted average rates is deemed as the point estimate of the poverty headcount rate, while the standard error of the poverty headcount rate is estimated from the distribution of poverty rates.

The poverty correlates usually include variables like household size, gender ratio, educational attainment, employment status, ownership of consumer durables, housing conditions, location, etc. However, Yoshida et al. (2022) show that when a large shock occurs, the SWIFT-based poverty estimates based on these variables tend to underestimate an increase in the poverty rate. To address this underestimate of poverty, Yoshida et al. (2022) recommend the inclusion of fast-changing variables like consumption dummies, food insecurity, and subjective well-being.

---

[8] SWIFT can include higher orders of variables, like household size squared, in a model as long as these variables are included in the pool of candidate variables before the modeling starts. But, unlike some Machine Learning algorithms, SWIFT's modeling cannot automatically create higher orders of variables or interactions between multiple variables if they are not included in the variable set before the modeling starts.

[9] STATA manual recommends at minimum 20 times of imputation.

For the MA-SHEP survey, since the sample comes from three regions – rural north, rural central, and rural south, we trained additional models for rural north and rural central using the Integrated Household Survey 2019-20. For each region, we included 17 to 21 variables, which include fast-changing variables of around five food dummies and two food insecurity variables. The models are available in Annex 3.

Annex 2. Reweighting exercises

With one of the project objectives being to compare the households under the MA-SHEP project (MA-SHEP households) and those not under the MA-SHEP project (i.e., non-MA-SHEP households), it is important to make sure the results of the two groups are comparable. To achieve that, a reweighting exercise was introduced into the analysis.

In this exercise, the non-MA-SHEP households were considered as the benchmark. And the target of the reweighting is to match the indicators from the MA-SHEP households to the non-MA-SHEP households. The indicators are time-invariant variables that are considered to remain stable over time. These include household demographic variables, housing condition variables, and asset ownership variables. We especially matched the pre-project condition of the two groups so that the results could directly reflect the impact of the MA-SHEP project under comparison. With the weighted pre-project condition being controlled for the two groups, we could further estimate their household welfare using indicators sensitive to time changes (employment-related variables, food, nonfood consumption variables, subjective well-being variables, etc.). Therefore, matching these time-invariant indicators through reweighting would ensure comparability of poverty estimation results between the MA-SHEP households and the non-MA-SHEP households.

The reweighting process has three major steps: (i) Propensity Score Weighting, (ii) Maxentropy, and (iii) Post-stratification. It is worth noting that the first two steps, PSW and maxentropy, were conducted respectively for rural central, rural north, and rural southern regions. This is to maintain regional differences in nature and corresponds to different modeling in poverty estimation. The third step, post-stratification, would ensure comparability between the MA-SHEP and non-MA-SHEP groups.

Propensity Score Weighting

Propensity Score Weighting (PSW) is designed to adjust a survey's sampling weights by comparing a reference sample with a target sample. Usually, the reference sample is a nationally representative household survey, and the target sample is an independent phone survey. In this case, since the objective is to ensure comparability between the MA-SHEP households and the non-MA-SHEP households in the same survey, the non-MA-SHEP households (i.e., the control group) were treated as the reference, and the MA-SHEP households (i.e., the treatment group) were treated as the target.

PSW appends the target survey to the reference and estimates each household's probability of being included in the target survey using the logit regression. We include time-invariant variables available from the reference and target surveys to estimate this probability for both surveys. PSW then ranks all households in the target survey data based on the predicted probability and creates quintiles. The weights of households in the target survey are adjusted so that each quintile's share of households in the phone survey exactly resembles that of the reference survey. More specifically, the weights of households in the target survey are adjusted so that the sum of their weights in each quintile becomes identical to that of households in the reference survey.

Due to the difference in variable sets across three rural regions, variables included in the PSW could also differ. Details for variables included in the PSW are shown in Table A2.

Table A2. Variables included for PSW and maxentropy*

Regions	Variables included
Rural central	1) household size, 2) dependency ratio, 3) age of household head, 4) gender of household head, 5) marital status of household head being monogamous married, 6) wall material being earth, 7) wall material being bricks, 8) roof material being grass, 9) main source of lighting being battery torch, 10) cooking fuel being purchased firewood, 11) cooking fuel being charcoal, 12) toilet being pit latrine without slab, 13) rubbish disposal facility being rubbish pit, 14) household ownership of a bed, 15) household ownership of a mortal, 16) household ownership of an iron, 17) household ownership of a bicycle, 18) household ownership of a solar panel, 19) household ownership of a chair, 20) number of rooms in the house.
Rural north	1) household size, 2) dependency ratio, 3) age of household head, 4) gender of household head, 5) marital status of household head being monogamous married, 6) floor material being mud, 7) roof material being grass, 8) toilet being pit latrine with slab, 9) toilet being pit latrine without slab, 10) rubbish disposal facility being collected from rubbish bin, 11) rubbish disposal facility being rubbish pit, 12) cooking fuel being charcoal, 13) source of drinking water being communal standpipe, 14) source of drinking water being borehole, 15) household ownership of a bed, 16) household ownership of a mortal, 17) household ownership of an iron, 18) household ownership of a solar panel, 19) household ownership of a satellite dish, 20) household ownership of a clock.
Rural south	1) household size, 2) dependency ratio, 3) age of household head, 4) gender of household head, 5) marital status of household head being monogamous married, 6) floor material being mud, 7) roof material being grass, 8) main source of lighting being battery torch, 9) source of cooking fuel being collected firewood, 10) rubbish disposal facility being none, 11) toilet being pit latrine with slab, 12) household ownership of a mortal, 13) household ownership of a bed, 14) household ownership of a radio, 15) household ownership of an iron, 16) household ownership of a bicycle, 17) household ownership of a table, 18) number of rooms in the house.

*All housing condition and asset ownership-related variables are pre-project conditions.

Maxentropy

To refine the weights further, we execute maxentropy or raking. After PSW, summary statistics in the target data could differ largely from those in the reference survey. Such differences can be real, particularly when a long time has passed between the reference and RFMS data. Still, it is unlikely that summary statistics of time-invariant (slowly changing) indicators like household size, dependency ratios, household heads' educational attainments, or population shares of districts would change significantly within a relatively short period. Maxentropy or raking adjust weights to match the summary statistics of these time-invariant variables between the reference and target data in an exact (or very close) manner.

Since we matched the two groups from the same survey, we included more variables in maxentropy than usual. Variables included for maxentropy are the same as in Table A2.

Post-stratification

Due to the non-neglectable difference in household characteristics between rural central, rural north, and rural south regions, separate SWIFT models were developed for the three regions. Accordingly, the whole reweighting process was done separately for these regions. This means the above PSW and maxentropy were conducted for the three regions' samples. Post-stratification will adjust the weights further to match the population shares of the three regions for the MA-SHEP group with the -non-MA-SHEP group, thereby making the two groups comparable.

More details on all of the abovementioned reweighting steps, particularly Propensity Score Weighting and maxentropy, can be found in Zhang et al. (2022). More information on raking can be found in Kolenikov (2014).

Annex 3. Comparison of Pre-project conditions and the results of reweighting in rural northern and central regions

Tables A3 and A4 show that like rural southern Malawi, rural northern and central Malawi regions also show that MA-SHEP and non-MA-SHEP farmers' pre-project welfare status was very similar. However, this paper conducts the above reweighting exercise to balance asset ownership and housing conditions between MA-SHEP and non-MA-SHEP farmers.

Table A3. Pre-project asset ownership and housing conditions – Rural Northern Malawi

Variables	Pre-reweighting		Post-reweighting	
	NM	M	NM	M
Floor = mud	0.58	0.49	0.49	0.49
Roof = grass	0.43	0.4	0.4	0.4
Pit Latrine with slab	0.35	0.38	0.38	0.38
Pit Latrine without slab	0.64	0.62	0.62	0.62
Collected from rubish bin	0.07	0.06	0.06	0.06
Rubbish Pit	0.91	0.89	0.89	0.89
Cooking fuel = charcoal	0	0.02	0.02	0.02
Communal stand pipe	0.12	0.14	0.14	0.14
Borehole (manual pump)	0.69	0.53	0.53	0.53
Bed	0.58	0.64	0.64	0.64
Mortar/pestle (mtondo)	0.77	0.72	0.72	0.72
Iron (for pressing clothes)	0.32	0.37	0.37	0.37
Solar Panel	0.34	0.36	0.36	0.36
Satellite dish	0.06	0.05	0.05	0.05
Clock	0.13	0.16	0.16	0.16

Table A4. Rural Central Malawi

Variables	pre-reweighting		post-reweighting	
	NM	M	NM	M
Wall=Compacted wall	0.20	0.23	0.23	0.23
Wall=bricks	0.53	0.50	0.50	0.50
Roof=Grass	0.67	0.65	0.65	0.65
Lighting = Battery	0.81	0.66	0.66	0.66
Cooking fuel = purchased firewood	0.06	0.06	0.06	0.06
Cooking fuel=charcoal	0.02	0.02	0.02	0.02
Pit Latrine without slab	0.33	0.30	0.30	0.30
Rubbish Pit	0.93	0.90	0.90	0.90
Bed	0.23	0.26	0.26	0.26
Mortar	0.41	0.47	0.47	0.47
Iron	0.16	0.24	0.24	0.24
Bicycle	0.41	0.45	0.45	0.45
Solar Panel	0.21	0.26	0.26	0.26
Chair	0.27	0.31	0.31	0.31
# of rooms	2.29	2.20	2.20	2.20

Source. Authors' estimation using the MA-SHEP survey.
Note. NM refers to Non-MA-SHEP farmers and M refers to MA-SHEP farmers.

Annex 4. SWIFT models

Tables A4.1, A4.2, and A4.3 show the models used for SWIFT poverty estimations. These tables include regression coefficients, standard errors, and p values with statistical significance.

Table A4.1 Rural North estimates

	Coefficient		St. Error	P-value
There is child in the household	-0.49	***	0.05	0.0%
Dependency ratio	-0.29	***	0.07	0.0%
Type of floor = smoothed mud	-0.15	***	0.03	0.0%
Type of toilet = pit latrine	-0.46	***	0.10	0.0%
No toilet facility	-0.46	***	0.11	0.0%
Type of toilet = open pit	-0.40	***	0.10	0.0%
Cooking fuel = charcoal	0.28	***	0.06	0.0%
Household owns a bed	0.09	***	0.03	0.8%
Household owns a bicycle	0.09	***	0.03	0.7%
Household owns a solar panel	0.08	**	0.03	1.3%
Household consumed meat	0.24	***	0.06	0.0%
Household consumed fruits	0.15	***	0.03	0.0%
Household consumed milk	0.22	***	0.04	0.0%
Household consumed oil	0.09	**	0.05	4.5%
Household consumed sugar	0.25	***	0.04	0.0%
Household limited size of meals	-0.11	***	0.03	0.0%
Constant	12.58	***	0.13	0.0%

*Note: * p-value<= 0.1, ** p-value<= 0.05, *** p-value <= 0.01*

Table A4.2 Rural Central estimates

	Coefficient		St. Error	P-value
There is child in the household	-0.45	***	0.03	0.0%
Dependency ratio	-0.28	***	0.05	0.0%
Highest education of household head: primary	-0.12	***	0.02	0.0%
Highest education of household head: none	-0.11	***	0.03	0.0%
Type of wall = compacted earth (yamdindo)	0.08	***	0.03	0.9%
Type of roof = grass	-0.09	***	0.02	0.0%
Source of cooking fuel is purchased firewood	0.15	***	0.03	0.0%
Source of energy for cooking is charcoal	0.21	***	0.04	0.0%
Type of Rubbish = rubbish pit	0.07	***	0.02	0.0%
Household owns a bed	0.09	***	0.03	0.1%
Household owns an iron (for pressing clothes)	0.10	***	0.03	0.2%
Household owns a solar panel	0.06	***	0.02	0.4%
Household owns a chair	0.05	***	0.02	0.9%
Household consumed meat in 7 days	0.11	***	0.03	0.0%
Household consumed fruits	0.15	***	0.02	0.0%
Household consumed milk	0.25	***	0.03	0.0%
Household consumed oil	0.14	***	0.02	0.0%
Household consumed sugar	0.19	***	0.02	0.0%
Household preferred less expensive food	-0.10	***	0.02	0.0%
Household limited the size of meals	-0.09	***	0.02	0.0%
Constant	12.13	***	0.05	0.0%

*Note: * p-value<= 0.1, ** p-value<= 0.05, *** p-value <= 0.01*

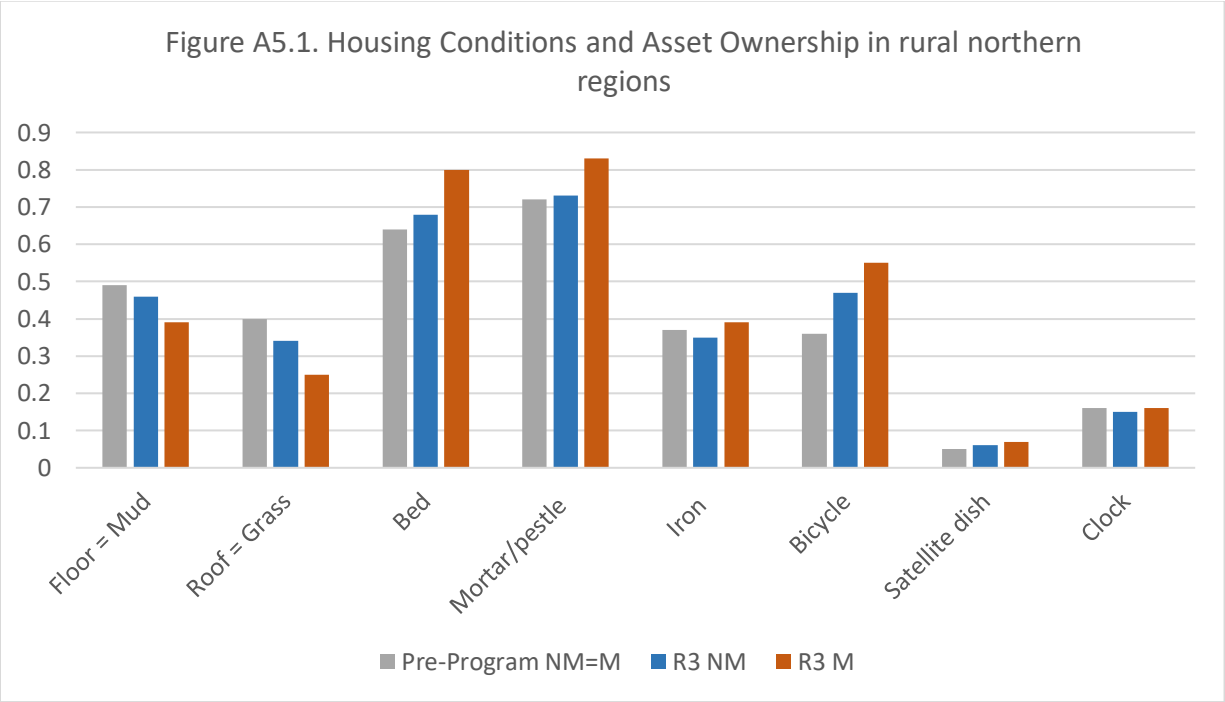
Table A4.3 Rural South estimates

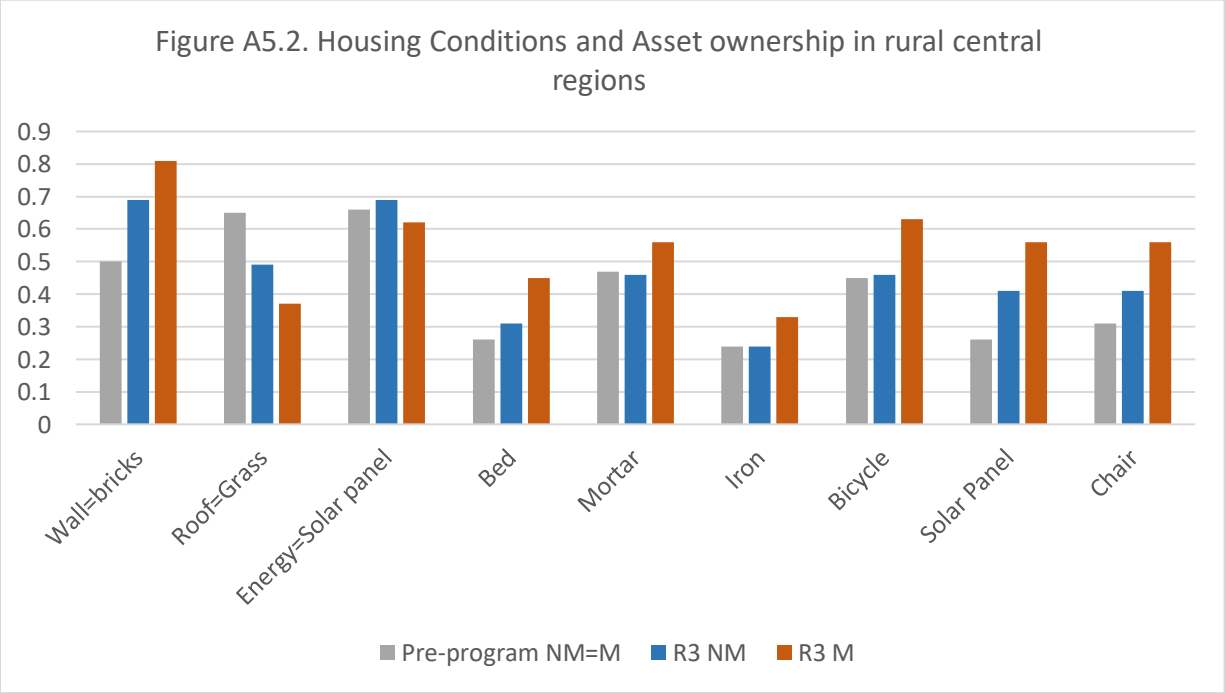
	Coefficient		St. Error	P-value
Dependency ratio	-0.54	***	0.04	0.0%
There is a hh member never attended the school	-0.12	***	0.02	0.0%
Household head is a widow	0.16	***	0.03	0.0%
Floor's material is mud	-0.09	***	0.02	0.0%
Roof's material = grass	-0.06	***	0.02	0.0%
Main source of lighting = battery torch	-0.11	***	0.03	0.0%
Cooking fuel is collected firewood	-0.10	***	0.03	0.0%
Household owns a bed	0.08	***	0.02	0.0%
Household owns a radio	0.05	***	0.02	0.5%
Household owns a iron (for pressing clothes)	0.13	***	0.03	0.0%
Household owns a table	0.08	***	0.02	0.0%
Household consumed meat in 7 days	0.20	***	0.03	0.0%
Household consumed fruits	0.12	***	0.02	0.0%
Household consumed milk	0.32	***	0.03	0.0%
Household consumed oil	0.13	***	0.03	0.0%
Household consumed sugar	0.18	***	0.02	0.0%
Household limited size of meals	-0.05	***	0.02	0.1%
Household borrowed food in 7 days	-0.06	***	0.02	0.1%
Constant	12.03	***	0.05	0.0%

*Note: * p-value<= 0.1, ** p-value<= 0.05, *** p-value <= 0.01*

Annex 5. Changes in asset ownership and housing conditions since the launch of MA-SHEP project for rural northern and central regions in Malawi

Figures A5.1 and A5.2 show the selected housing conditions and asset ownership in rural northern and rural central regions, respectively. Each figure includes pre-program conditions and the average conditions in round 3 (November 2022). The pre-program conditions are identical for MA-SHEP and non-MA-SHEP farmers because sampling weights are adjusted so that their pre-program conditions are identical.





Source. Authors' estimation using the MA-SHEP survey
Notes. NM refers to non-MA-SHEP farmers and M refers to MA-SHEP farmers. R3 refers to round 3 (November 2022).

Annex 6. Data collection (additional information)

The NSO provided a tablet and power bank to each enumerator and supervisor. The tablet issued to the supervisor was a backup tablet in case any of the tablets with the enumerators developed a fault. For each of the sampled groups, agricultural extension development officers (AEDOs) mobilized the sampled farmers to the identified venues where interviews were conducted. The survey team traveled to the interview venues using a vehicle from the District Agriculture Offices. Refreshments were provided to the farmers after interviews to compensate for the time spent waiting to be interviewed. Where some sampled farmers did not show up at the venue, the AEDOs followed up with the farmers, and replacements were made, where necessary, with other farmers within the group. On average, an interview lasted for 30 minutes.

In the first round, 2,116 farmers were interviewed, and after the data quality check, 2,093 observations were used for the analysis. In the second round, 2,107 farmers were interviewed, and after the data cleaning, 2,032 observations were used for the data analysis. In the third round, 1,993 farmers were interviewed, and 1,951 were used for the analysis. In the fourth round, 2,060 farmers were interviewed, among which 2,003 remained for the data analysis.