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Integrating Aquaculture–Agriculture to Combat Food Insecurity in Malawi (IAAM)

A Baseline Report

May 2026

Working Paper 69

Agriculture, fishing and forestry



3ie International Initiative for Impact Evaluation

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About this report

This paper presents the findings of a baseline survey conducted for the evaluation of the Integrating Aquaculture -Agriculture to Combat Food Insecurity in Malawi (IAAM) project implemented by CDF Canada. This publication has been produced with financial support from Norway. The findings and conclusions presented in this report are those of the authors and do not necessarily reflect the views of the Government of Norway, 3ie's donors or governing bodies. Please direct any comments or queries to the corresponding author, Sebastian Martinez, at smartinez@3ieimpact.org

Suggested citation: Martinez, Sebastian, Bidisha Barooah, Rohan Shah, Rishabh Bhattacharya, and Esau Gideon Banda. 2025. Integrating Aquaculture–Agriculture to Combat Food Insecurity in Malawi (IAAM). 3ie Working Paper 69. New Delhi: International Initiative for Impact Evaluation (3ie). Available at http://doi.org/10.23846/WP0069

Technical editor: Sebastian Martinez
Publications and web design: Akarsh Gupta
Production manager: Mallika Rao

Cover photo: CDF Canada

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Acknowledgement

We wish to thank the Co-operative Development Foundation of Canada (CDF Canada) team for their support at every stage of the evaluation. We are particularly grateful to Gerald Maulidi, Valentine Uwase, and Theodore Mulula for their support with data requests, assistance in the field, and most importantly, ongoing input that helped to strengthen our understanding of the program. We also thank all aquaculture farmers for taking the time to speak to us and provide much needed information that significantly contributed to the insights presented in the report. Imani Consultants Limited (ICL) collected the data used in this survey. We also thank Devika Lakhote, Sanchi Lokhande, and Fiona Kastel from 3ie for their instrumental role in the geospatial analysis included in this report.

Executive summary

Malawi faces persistent food insecurity driven by extreme poverty, climate shocks, and low agricultural productivity. Aquaculture, though still emerging, plays an important role in livelihoods and nutrition, contributing significantly to animal protein intake and offering opportunities for income diversification, particularly for women. However, smallholder fish farmers face structural constraints, including low-quality inputs, weak extension systems, limited access to markets and credit, and weak integration within value chains.

The Co-operative Development Foundation of Canada (CDF Canada) project "Integrating Aquaculture-Agriculture to Combat Food Insecurity in Malawi (IAAM)", launched in 2024 aims to improve incomes, nutrition, and women's empowerment. The project includes six types of intervention, which are:

1. Co-operative and value chain development interventions
2. Intervention to build and strengthen resilience to climate shocks in aquaculture and agriculture
3. Agriculture market diversification interventions
4. Women's Rights & Gender Equality interventions
5. Sexual & Reproductive Health & Rights (SRHR) interventions
6. Interventions to recover forestry & biodiversity

This report presents baseline findings of the impact evaluation of the IAAM project, conducted by 3ie, which assesses the impact of interventions (1-3), listed above. The evaluation uses a clustered randomized controlled trial approach to rigorously assess the project's impact. A total of 160 Extension Planning Area Sections (EPAS) across eight districts were randomly assigned to treatment and control arms. The baseline survey, conducted in early 2025, covered 2,498 households across 154 sections, with interviews administered to both male and female respondents to capture aquaculture, agriculture, nutrition, and women's empowerment outcomes. Primary outcomes include aquaculture productivity and income, food security and dietary diversity, and women's participation in decision-making.

The baseline findings confirm that the randomization achieved balance across treatment and control arms, providing a strong basis for causal impact estimation at endline. Households are predominantly male-headed (approximately 87 percent), with an average household size of 5–6 members. Average land ownership is approximately 5.8 acres, with around 3.3 acres cultivated. Farming remains largely subsistence-oriented, with modest levels of market participation. Aquaculture engagement is widespread, with around 72 percent of households cultivating fish in ponds. Average pond size is approximately 318 m², with only a portion actively cultivated at the time of the survey, indicating underutilization of available pond capacity. . Fish productivity averages 0.15 kg per m², and aquaculture income remains modest relative to overall household income. Nearly half of the households report practicing some form of integrated aquaculture–agriculture system, though adoption of specialized best practices such as liming, use of commercial feed, and improved seed identification remains limited.the households report practicing some form of integrated aquaculture–agriculture system, though adoption of specialized best practices such as liming, use of commercial feed, and improved seed identification remains limited.

Food insecurity remains severe at baseline. The average Food Insecurity Experience Scale (FIES) score[1] is 5.5, and dietary diversity[2] averages six food groups across both the treatment and control areas. District-level variations are substantial, with several districts showing high proportions of households in severe food insecurity categories. Food and non-food expenditures are low and similar across treatment and control groups, underscoring widespread vulnerability.

Baseline findings highlight that even though women are actively involved in aquaculture and agriculture, their control over income and productive decisions remains constrained. Membership in common interest informal community groups for savings and credit is relatively common, but participation in cooperatives and SMEs is lower and uneven across districts. The baseline establishes important room for improvement in women's leadership, agency in aquaculture-related decisions, and access to productive resources.

Results also shed light on the geographic heterogeneity within project areas. Northern districts tend to show stronger cooperative participation and higher aquaculture knowledge, while southern districts exhibit greater crop diversification. Aquaculture productivity, market engagement and knowledge of aquaculture practices also vary widely.

The community and SME surveys show that aquaculture operates within large, agriculture-dominated EPA sections where fish farming remains small-scale, low-intensity, and largely subsistence-oriented. Extension support is heavily reliant on government services, while market access, hatcheries, cold storage, and financial institutions remain limited, reflecting weak value chain infrastructure. SMEs are relatively mature and often cooperative-based, with strong female ownership but limited technology use and uneven labor participation of women. Sales performance is highly skewed, indicating substantial heterogeneity in firm capacity. These findings highlight key value chain constraints that the project aims to address through co-operative strengthening, SME engagement, and market linkage interventions.

[1] The Food Insecurity Experience Scale (FIES) is a standardized, experience-based measure of food insecurity used by the food and agriculture organization (FAO) that classifies households into three categories: 0–3 indicates food-secure or mildly food-insecure conditions, 4–6 indicates moderate food insecurity, and 7–8 indicates severe food insecurity. FAO: "About the Food Insecurity Experience Scale (FIES)"

[2] The Household dietary diversity is a measure of food consumption that reflects the household's access to a variety of foods and was measured as the sum of total food groups consumed (out of 12 major food groups) during the 24-hour recall period, following the FAO's Household Dietary Diversity Score (HDDS) methodology. More details on these scores are given in Appendix table A 2.2 and A 2.3.

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Abbreviations and acronyms

AEDO	Agriculture extension development officer
ATET	Average treatment effect on treated
CAPI	Computer-Assisted Personal Interviews
CDF	Co-operative Development Foundation of Canada
EPA	Extension planning area
EPAS	EPA Section
FIES	Food Insecurity Experience Scale
GDP	Gross domestic product
HDDE	Household Dietary Diversity Score
ICL	Imani Consultants Ltd.
ITT	Intention-to-treat
MSMEs	Micro, small, and medium enterprises
Norad	Norwegian Agency for Development Cooperation
NVDI	Normalized Difference Vegetation Index
ICM	Integrated Co-operative Model
IAAM	Integrating Aquaculture–Agriculture to Combat Food Insecurity in Malawi
IAAS	Integrated aquaculture–agriculture system
RCT	Randomized controlled trial
SME	Small and medium enterprises
ToC	Theory of change
WOLREC	Women's Legal Resources Center
3ie	International Initiative for Impact Evaluation

1. Introduction

1.1 Context and rationale for evaluation

Malawi is a country that battles chronic food insecurity, with over 5.4 million of its 19.1-million people population at risk of moderate to severe food insecurity (Malawi IPC Chronic Food Insecurity Report 2022).[3] This is due to a vicious cycle of extreme poverty, recurrent climate shocks, and low-productivity domestic agricultural sector.

Aquaculture is an emerging sector in Malawi, contributing to 4% of the country's gross domestic product (GDP) and having the capability to address the country's food insecurity (FAO 2025).[4] There are an estimated 17,012 smallholder fish farmers engaged in aquaculture (Malawi Annual Economic Report 2025), with women comprising about 38.5 % (CASA 2020).[5] Aquaculture has the potential to absorb some of the growing labor force of Malawi and build economic resilience, especially for women looking for means of livelihood to support their families.

Aquaculture is perceived as an alternative source of high-quality animal protein and livelihood, especially for lower income groups. Fish plays an important dietary and economic role in Malawi, providing 28% of animal protein intake. Per capita fish consumption increased from 10.7 kg in 2016 to about 12.6 kg in 2018 (WorldFish 2022).[6]

Smallholder fish farmers, who are primary participants in aquaculture in Malawi, face many challenges, including:

1. Lack of quality fingerlings
2. Low growth and low average yield per hectare
3. Lack of availability of quality fish feeds and fish feed alternatives
4. Weak advisory and extension services
5. Environmental impact of aquaculture and agriculture
6. Limited access to credit with high dependence on personal savings
7. Weak access to post-harvest services and facilities
8. Weak relationships with other aquaculture value chain actors, aggravated by a lack of an enabling business environment (Munthali et al. 2022).[7]

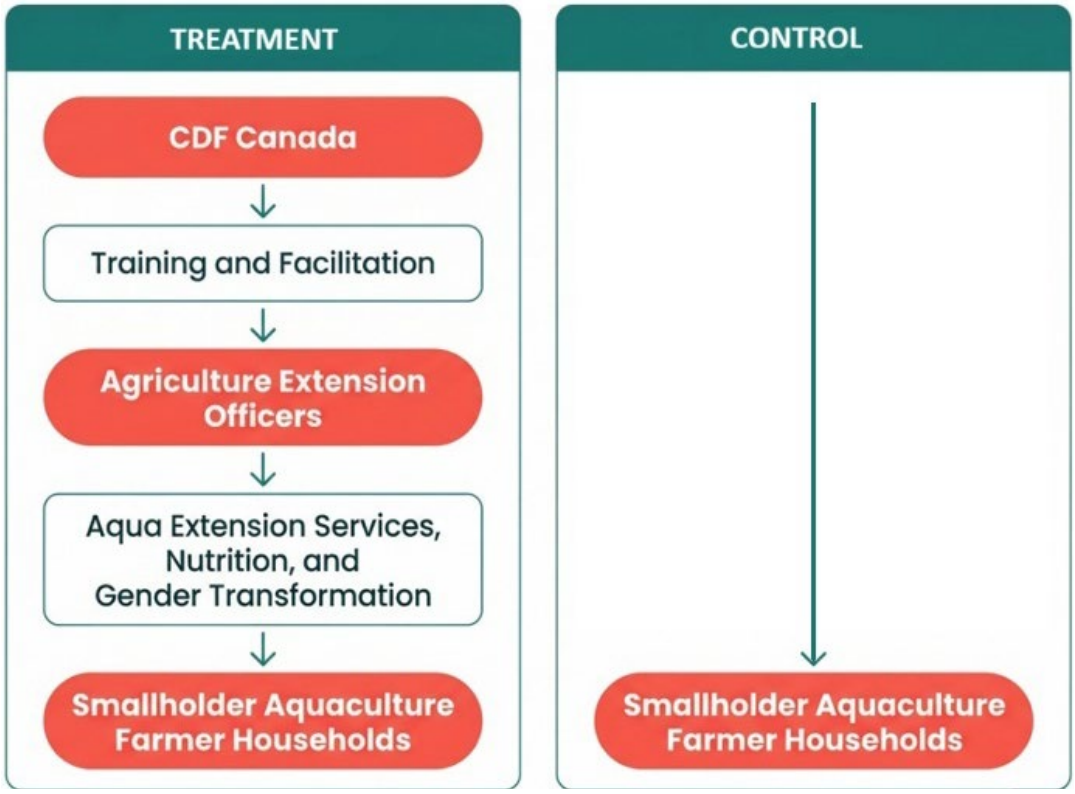
The "Integrating Aquaculture–Agriculture to Combat Food Insecurity in Malawi" (IAAM) project is a response to the urgent need to improve Malawi's food security. It is implemented by the Co-operative Development Foundation of Canada (CDF Canada) in

[3] IPC Global Support Unit. 2022. "Malawi IPC Chronic Food Insecurity Report – February 2022." Lilongwe: Government of Malawi, FAO, WFP, UNICEF, and FEWS NET.
[4] FAO. 2025. Malawi. *Text by Chimatiro, S.K. and B.B. Chirwa*. In: "Fisheries and Aquaculture." Accessed October 23, 2025. https://www.fao.org/fishery/en/countrysector/naso_malawi
[5] CASA. 2020. "Aquaculture Value Chain Analysis in Malawi. Commercial Agriculture for Smallholders and Agribusiness (CASA) Programme." Lilongwe, Malawi.
[6] Tran, N., J. Peart, U.E. Rodriguez, C.Y. Chan, Y. Hoong, V. Siamudaala, F. Njaya, and R. Kafakoma. 2022. "The Future of Fish Supply-Demand in Malawi and Its Implications for Nutrition Security and Poverty Reduction." Penang, Malaysia: *WorldFish*. Working Paper: 2022-21.
[7] Munthali, M. G., L. Chilora, Z. Nyirenda, D. Salonga, A. Wineman, and M. Muyanga. 2022. "Challenges and Opportunities for Small-Scale Aquaculture Development in Malawi."

partnership with a number of local organizations. The aim of the IAAM project is to increase the productivity, income, and access to markets for small-scale food producers, especially women, engaged in the integrated aquaculture-agriculture system (IAAS) that comprises fish, crops, livestock, and agroforestry sub-systems to combat food insecurity.

International Initiative for Impact Evaluation (3ie) is the program's evaluation partner tasked with designing and conducting, to the best of our knowledge, the first of its kind rigorous evaluation of a large-scale aquaculture intervention in Malawi, using counterfactual estimates to address attribution. The evaluation is a clustered, two-armed randomized controlled trial (RCT) that uses a theory-based impact evaluation approach. The evaluation has been designed to causally identify the extent to which the project achieves the intended impacts on aquaculture practices, productivity, smallholder income, nutrition, and women's empowerment. A cost measurement evaluation to assess value-for-money complements the two-arm trial, portrayed in Figure 1, as part of the final impact analysis at endline.

Figure 1: The two-arm trial



Through constructive dialogue and information sharing, CDF Canada and 3ie reached an agreement on random assignment of the treatment and control extension planning area sections (EPAS)[8] as a feasible evaluation design, with implementing partners securing buy-in and committing to the rollout plan and evaluation design.

[8] The government extension service in Malawi operates through a decentralized system organized around a tiered administrative structure: national, agricultural development divisions (ADDs), districts, and extension planning areas (EPAs). Each EPA is further divided into multiple EPA sections.

1.2 Objectives of the evaluation

The main evaluation objective is to examine the CDF Canada project's impacts of on the sub-set of stated project outcomes. Our work will also attempt to answer what factors and mechanisms led to impacts, or lack thereof, and how they influence outcomes.

The overall research question can be formulated as: What are the impacts of the aquaculture investments in the Norwegian Agency for Development Cooperation-(Norad-) funded CDF Canda IAAM project on the following primary outcomes:

1. Improved food security through increased production of fish, crops, and livestock
2. Strengthened production and income from aquaculture, better nutrition status of poor small-scale producers, especially women, and disadvantaged groups such as the youth, people living with disabilities, and improved women's decision making and empowerment.
3. If there are impacts for (1) and (2), what is their magnitude? If some but not all of the expected impacts materialize, which failed and what could explain this failure?

In this report, we discuss data collection for the baseline and present descriptive statistics and baseline values for the sample with respect to the broad aquaculture productivity, nutrition and women's participation in economic activities variables. We also report on balance tests to examine randomization performance and whether there are systematic differences across the control and treatment arms.

We conducted the baseline data collection during the first quarter of 2025.

The study required an ethical clearance of the field protocol by the Internal Review Board at the Malawi National Committee on Research in the Social Sciences and Humanities, which we received in January 2024. We now expect the subsequent round of data collection for endline to take place in 2028.

1.3 Scope of the evaluation

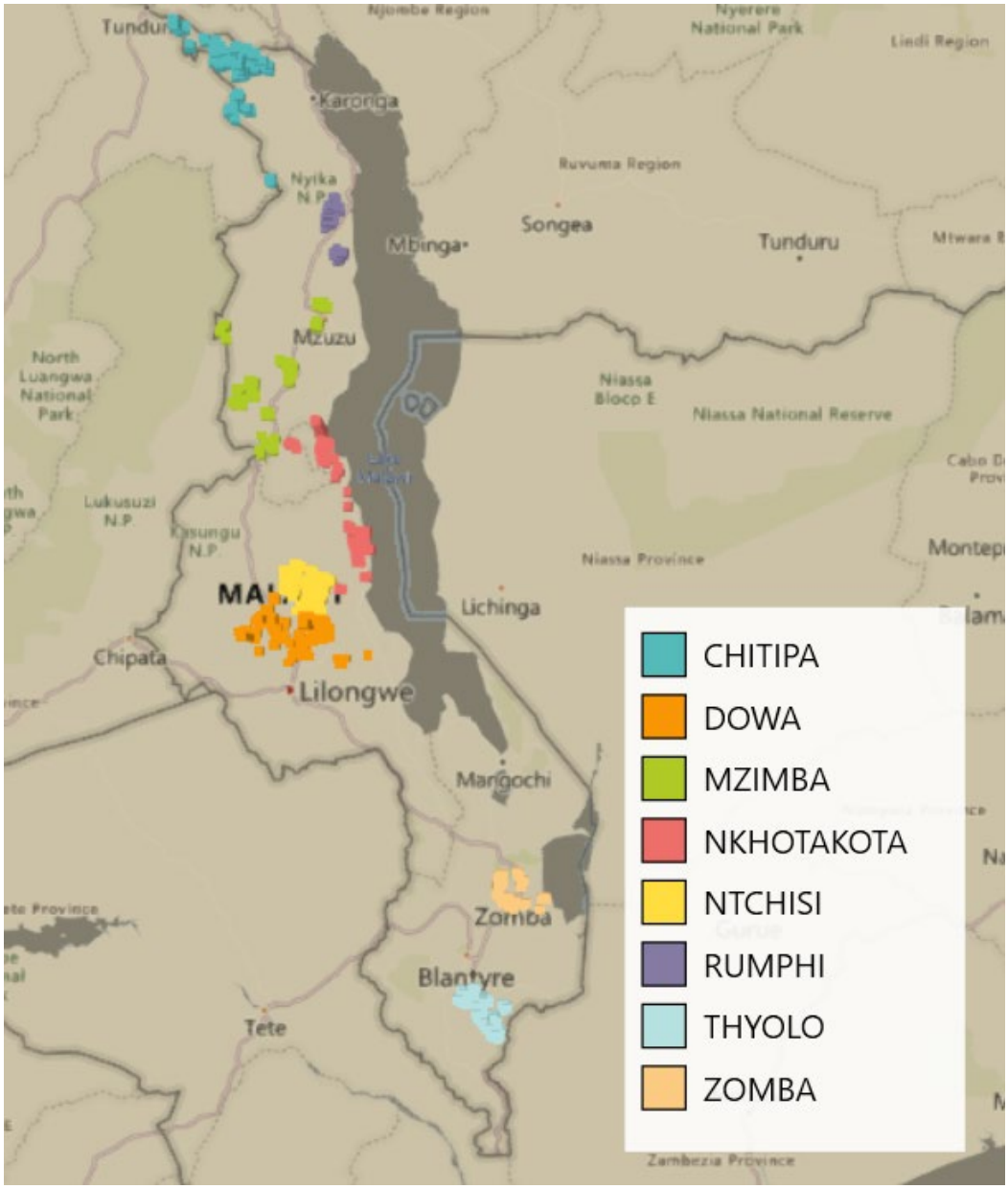
1.3.1 Geographical area

The IAAM project is implemented in eight (8) districts of Malawi:

- Northern Region: Chitipa, Mzimba, and Rumphi districts
- Central Region: Dowa, Nkhotakota, and Ntchisi districts
- Southern Region: Thyolo and Zomba districts

We selected the districts based on their potential for resource development in IAAS, high poverty rates among agricultural populations, opportunities for ecological restoration, and commitment to aquaculture–agriculture production to combat food insecurity. The map of project study districts is shown in Figure 2

Figure 2: Project study districts



1.3.2 Target population

The primary participants and intended beneficiaries of the project are rural smallholder households engaged in agriculture and fish farming. In Malawi, small-scale aquaculture producers are characterized by an average of 1.4 fishponds per household, with a mean pond size of 299.5 square meters (Munthali et al. 2022).[9] Small-scale fish farms in the country can be broadly categorized into two groups: (1) individually owned farms and (2) community-managed farms. For the purposes of this project, the target beneficiaries are farmers who, at baseline, own individual ponds, representing approximately 87% of small-scale fish farm ownership in Malawi.

[9] Maggie G. Munthali et al. 2022. "Characteristics of the Small-Scale Aquaculture Sector in Malawi." Policy Brief No. 17, March 2022.

1.3.3 The IAAM project interventions

IAAM project interventions have six components; the evaluation focused on four of them. The six intervention areas of the IAAM projects are related to:

i. *Co-operative and value chain development interventions*
The project aims to increase small-scale producers' participation in off-farm value chain activities: strengthening and developing cooperatives/farmer organizations and micro, small, and medium enterprises (MSMEs), particularly women-led. The project also aims to increase equitable provision of inclusive agricultural extension and advisory services (aquaculture, crops, livestock, and forestry) through strengthened capacity of informal, public, and private stakeholders in climate-smart integrated farming systems and their value chains to scale up innovative practices.

ii. *Interventions to build resilience in climate shocks in aquaculture and agriculture production*
The project will promote integrated fish, livestock, and bio-fortified crops through (a) integrated pond-based polyculture of tilapia and other indigenous fish species with livestock (chickens and goats); (d) climate-smart post-harvest fish processing; and (c) growing of orange sweet potato nutrient-dense food.

It will increase equitable provision of inclusive agricultural extension and advisory services (aquaculture, crops, livestock, and forestry) by strengthening the capacity of informal, public, and private stakeholders in climate-smart integrated farming systems and their value chains to scale up innovative practices.

iii. *Agriculture market diversification interventions*
The project will increase smallholder farmers', especially women's, access to climate-smart farming inputs (resilient fish seeds, strengthened fish hatchery operations, fish feeds, etc.) and markets (fresh and processed).

iv. *Women's rights and gender equality interventions*
The project will promote women's participation in decision making both at household and community levels.

v. *Sexual and reproductive health and rights interventions:*
The project will improve sexual and reproductive health for women, men, boys, and girls through social behavior change communication.

vi. *Forestry and biodiversity re-saturation interventions*
The project will promote reforestation and planting of native bamboo species in riparian zones and wetlands through enhanced ecosystem services benefits from the relationship between planting trees, water table protection, fish farming, soil fertility, and so on.

The impact evaluation discussed in this report was designed to measure the joint effects of components 1, 2 and 3.

1.3.4 Theory of change (ToC)

Fish is acknowledged as a major nutrient-dense animal-source food for a significant proportion of the nutritionally vulnerable people in Malawi, overshadowing that of most of terrestrial animal foods. Its consumption is high in Malawi and likely to be higher in the future with economic development and changing preferences. Therefore, there is a need to promote economically viable, climate resilient, and environmentally sustainable aquaculture technologies and practices.

In aquaculture, the key challenges of small-scale producers, including women, are the use of low-quality fingerlings, lack of quality fish feeds, weak fish farm management practices, and poor connectivity to input and output markets. They also face challenges in accessing information and extension services that have hindered the sustainable growth of their yields and production. IAAS aims to increase farm-productivity through a diversification of production by combining fish, crops, livestock, and agroforestry sub-systems. In partnership with small and medium enterprises (SMEs), IAAM will establish demonstration ponds in eight districts to showcase the desired skills and good practices to adopt and replicate the IAAS approaches, such as: (1) a pond on rice-fish integration; (2) polyculture of **local/indigenous fish species** integrated with goats; and (3) ponds integrating **local/indigenous fish species** with poultry. All three types of ponds will be integrated with orange flesh sweet potato vines cultivated around them. In addition, IAAM will provide regular on-farm training and mentoring of the smallholder farmers, especially women, with the support of **MSMEs, cooperatives, NGOs, extension workers**, and other local players, especially through peer collaboration among women and youth. Through strengthened extension and capacity building, farmers are expected to adopt improved IAAS practices, leading to increased productivity, higher incomes, and ultimately improved household food security.

The IAAS system aims to recycle all unconsumed organic leftovers and natural organic manure to boost crop, animal, and fish output. Farmers use livestock manure to fertilize the fishponds to propagate planktons, the natural fish food, reducing the need for pond fertilizer and commercial fish feeds. Pond mud and sediments are excellent and inexpensive organic fertilizers for vegetable crops such as sweet potatoes, legumes, cereals, and fruit orchards. The treated, nutrient-rich pond water can be used to irrigate vegetable crops and fruit trees. Crop residues are used as supplemental feeds for livestock and some fish species, such as the redbreast tilapia. Rice fields provide a favorable environment and habitat for fish to flourish. Fish contribute to nutrient cycling by feeding on invertebrates and other organic particles created in the rice fields. Rice-fish farming preserves biodiversity due to its reduced need for pesticides and allows the adoption of native fish species, such as tilapia.

In addition, IAAM will help address the key challenges in small-scale producers', especially women's, access to input and output markets. It will: (1) ensure sustainable access to quality and resilient fish seeds/fingerlings and quality fish feeds by linking them to trained seed producers and reliable fish feed suppliers within their communities; and (2) promote market optimization by linking small-scale producers, especially women, to storage solutions and off-takers to enhance market access for both fresh and processed fish products. Inclusion of smallholder farmers in commercial value chains and engaging with agro-dealers/SMEs, cooperatives, and other relevant value-chain actors will bring about a circular business relationship in the sale of inputs, food production, off-taking of

fish harvests, collection and distribution, and processing and retail of fish products. These interventions are expected to improve market access and efficiency, enabling farmers and SMEs to capture greater value from production and increase household income.

Currently, the Government of Malawi is the primary provider of extension services for aquaculture, crops, livestock, and forestry. However, it has severe resource and capacity constraints that have had a negative impact on agricultural production and economic participation of small-scale producers. While the private sector (cooperatives and SMEs) may be capable of helping small-scale producers move toward market-oriented agriculture, they lack the understanding of how to engage with small-scale producers regarding their needs.[10]

The project will develop training modules on better management practices in IAAS—aquaculture, crops, livestock, and forestry subsystems—for strengthening the capacity of informal, public, and private stakeholders. They will deliver these training modules and associated skills to extension workers, small-scale producers, cooperatives, SMEs/agro-dealers, and other relevant actors. To reach women and marginalized groups in the communities, IAAM will use media like cooperatives and farmer groups for information dissemination.

In Malawi, the growth of the cooperative movement has been challenging. Many cooperatives are informal, small, and moribund. Membership is location specific. This is why their scale of operation, market presence, and efficiency level remain weak. They have little capitalization and limited access to and control over assets and resources. To organize small-scale producers into cooperatives, IAAM will adopt CDF Canada's Integrated Co-operative Model (ICM). The model is rooted in the integration of a network of three distinct and interconnected types of co-operatives, with each functioning separately in the areas of agricultural production, marketing, and financial services. If small-scale producers are organized into cooperatives, this will enhance backward and forward linkages. Because cooperatives have a shared vision of sustainability and mutual self-help, they can demonstrate the power of collaboration that enables smallholder farmers to have a more informed collective approach in market positioning, negotiations, and sales. SMEs may more readily reach out to them to sell inputs and promote their appropriate application for improved farm management and yields. The integration of cooperatives (cooperation among cooperatives) can translate into increased value added to smallholders as buyers/consumers through lower product pricing and/or product quality differentiation based on fair trade practices.

All the above activities are expected to improve smallholder farmers' knowledge, skills, and access to IAAS technologies. Along with better linkages to quality input and output markets, this will lead to an increase in smallholder farmers', including women's, adoption of IAAS technologies. The integration of fish, crops, and livestock systems is expected to improve resource efficiency and nutrient recycling, leading to increased productivity and more resilient farming systems that contribute to improved household income and food security.

[10] Mentioned in the CDF Project Implementation Plan on Page 3.

The projects recognizes gender-based cultural constraints and gendered power relations that influence the vulnerability of women small-scale producers, such as (1) their weak response to climate shocks and inability to adapt; (2) low quality of and weak access to land and agricultural inputs for climate resilience; (3) inadequate supply and quality of gender-sensitive extension services that cater mostly to men; (4) declining efficiency and productivity of their smallholder farming practices; and (5) weak competitiveness and market access exacerbated by limited knowledge of the value chain and opportunities of value addition processes.

Alongside prioritizing women's participation in IAAS-related activities, the project will integrate **gender-transformative approaches** to address structural and normative barriers that limit women's access to resources, decision making, and economic opportunities. These interventions will operate across **individual, household, community, and societal levels**, and be embedded within value chain development, integrated aquaculture–agriculture, and biodiversity restoration activities.

IAAM will adopt the **SASA! community mobilization methodology**, implemented in partnership with Women's Legal Resources Center (WOLREC), to challenge unequal power relations and harmful social norms that perpetuate gender inequality. Through a phased approach combining **local activism, media and advocacy, communication materials, and training**, SASA! will promote equitable gender norms, strengthen women's voice and leadership, and increase their participation in household and community decision making. The project will engage traditional leaders, community activists, and institutional actors to support sustained shifts in attitudes and practices.

These gender-transformative initiatives aim to address underlying power imbalances between women and men that constrain women's economic participation and increase their vulnerability to violence and exclusion. By applying social norms–based interventions, the project will contribute to reduced acceptance of gender inequality and violence against women, improved community responses to gender-based violence, and enhanced agency and resilience of women within IAAS and related value chains. Strengthened participation and decision-making power of women and youth is expected to improve resource allocation at household and enterprise levels, contributing to enhanced productivity, income, and food security outcomes.

In alignment with the Malawi's Ministry of Health's Reproductive Health Directorate, the project's sexual and reproductive health and rights component will prioritize **youth-friendly health services** to improve access to and uptake of quality sexual and reproductive health and rights services among adolescents and young people. IAAM will apply **social and behavior change communication** approaches to address both supply- and demand-side barriers by strengthening adherence to youth-friendly health services' standards among service providers and stimulating demand for services among youth. Guided by stakeholder mapping and needs assessments, these evidence-based interventions will focus on reducing stigma, improving service quality and accessibility, and promoting supportive social and gender norms, thereby contributing to improved sexual and reproductive health outcomes.

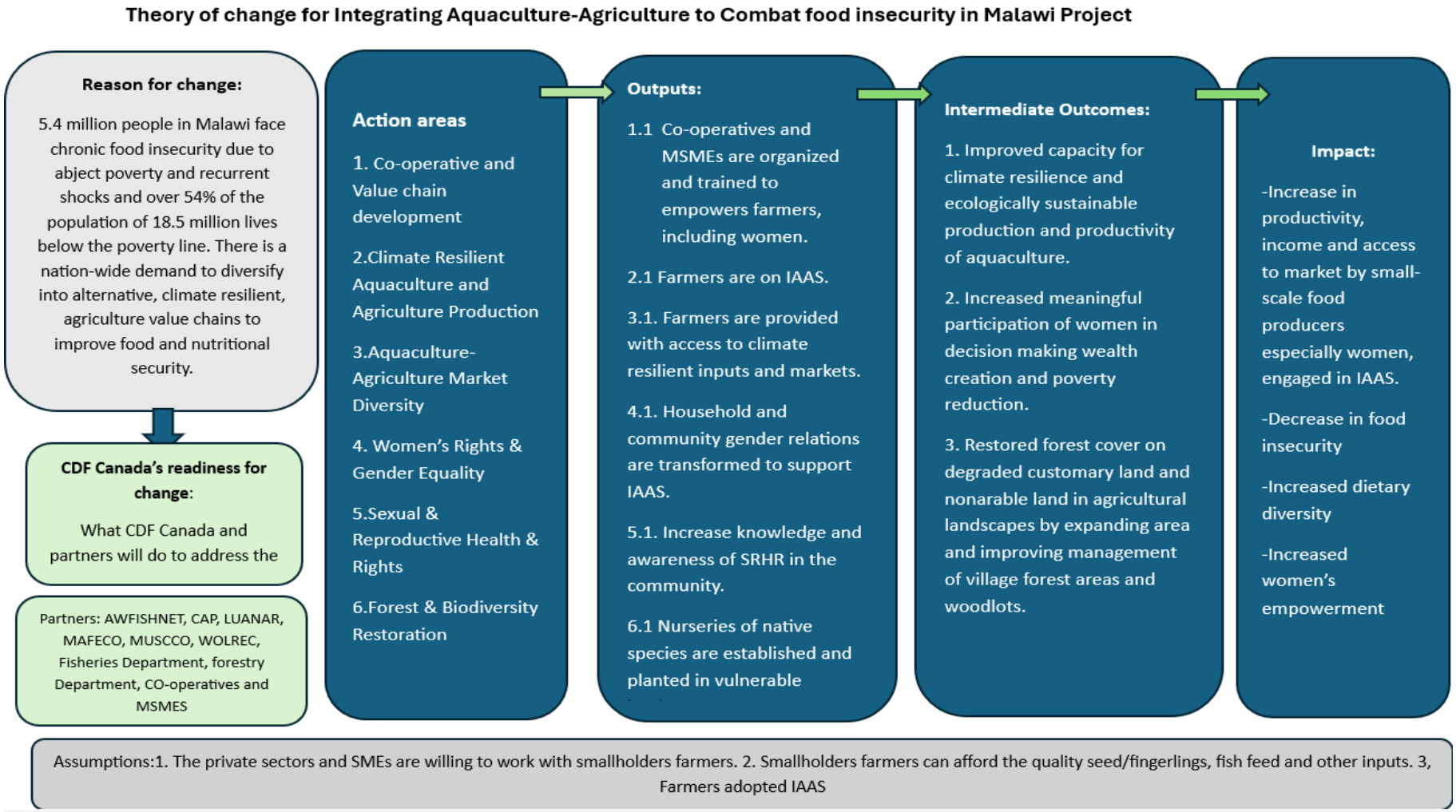
Finally, the project recognizes the relationship between forests and aquaculture and fisheries. Tree destruction increases siltation in rivers, destroying fish habitats and

reducing the amount of water for aquaculture. Capture fisheries are the source of broodstock for aquaculture. When fish habitats are degraded, aquaculture is threatened. Due to this, the project will promote forest cover and trees on farmlands to address habitat loss and erosion- and sedimentation-related habitat disturbance.

To summarize, through the project activities, the resource-poor fish farmers will benefit from improved forest cover and access to forest products and the recycling of all unconsumed organic leftovers and natural organic manure will result in improved agricultural and fish farm waste resource utilization efficiency, enhanced soil fertility, and increased crop and fish yields and incomes. IAAM will closely collaborate with LUANAR to ensure that biosecurity measures are in place and that no environmental issues are caused by leftovers and organic manure. Apart from the increase in income per unit of land area, the environmentally friendly and nutrition-sensitive rice-fish farming systems will contribute to dietary diversity and nutritional security. Food security can be achieved through IAAS, value chain participation, and reduction of food loss along the production chain—farm to table. Integrating approaches and actions to advance gender equality and female empowerment through each stage of the value chain and explicit gender equality advocacy will improve empowerment of women.

The achievement of the impacts mentioned above rests on key assumptions such as (1) the private sector and SMEs are willing to work with smallholder farmers; (2) smallholder farmers can afford the quality seed/fingerlings and other inputs; and (3) farmers buy into the idea of IAAS. The schematic diagram of the ToC is shown in Figure 3. These assumptions will be partially tested through baseline and endline measurement of key variables including input access, adoption of improved practices, market participation, and household decision-making dynamics.

Figure 3: Theory of change



2. Identified outcomes and key indicators

The impact evaluation will measure the project's effects on intended outcomes associated with the first four project components, as outlined in the ToC. The key outcomes of interest relate to food insecurity, household nutrition, income, and productivity, presented in Table 1. We will measure the outcomes using established indicators and measurement protocols. The IAAM ToC intermediate/final outcomes and measured indicators mapped to the questionnaires have been shown in AppendixA1.

Table 1: Primary outcomes

IAAS and adoption	**Production** • Percentage change in the volume of fish and crops produced at the household level (kilograms) • Percentage of farmer households practicing IAAS **Income** • Percentage changes in income generated from fish, crop, and livestock farming activities • Types of income-generating skills members of marginalized groups develop **Adoption and access** • Types of IAAS and other climate-smart agricultural technologies that participating households adopt • Percentage of farmer households accessing IAAS-related inputs or outputs from private-sector enterprises, agro-dealers, SMEs, or cooperatives • Number of farmers with knowledge of IAAS and access to climate-smart agriculture technologies
Nutrition outcomes	**Food security** • *Food Insecurity Experience Scale (FIES):* Percentage change in household food access based on responses to the eight-item FIES module • *Months of inadequate food:* Number of months in a year during which households report inadequate food (fewer than three full meals per day) **Dietary diversity** • *Household Dietary Diversity Score (HDDS):* Percentage change in dietary diversity, measured by frequency of consumption across food groups in the past 24 hours
Empowerment and capacity strengthening	• Increased women's participation in IAAS-related production, income generation, and decision making within households • Enhanced knowledge and skills among women that can be applied to income-generating activities • Increased participation of women in cooperatives, SMEs, and producer groups

3. Research design

3.1 Evaluation design

The Malawi Ministry of Agriculture is divided into 28 District Agriculture Development Offices, which are subdivided into 154 EPAs. EPAs are further divided into EPA sections (EPAS) - the lowest level in the ministry's structure and the main point of service delivery to farmers. Each EPAS is managed by an agriculture extension development officer (AEDO).

To meet the requirements of the impact evaluation, the project needed a total of 160 EPAS, each containing a large enough group of fish farmers to make group training and program interventions feasible. To be considered viable for the evaluation, an EPAS needed to have eight or more fish farmers, served by an AEDO who is responsible for only one EPAS.

The evaluation design is a RCT with the EPAS as the unit of randomization. We chose to randomize at the section level because it is the main point of service delivery to farmers, not only by the government of Malawi but also by its development partners. A typical EPA section in Malawi comprises 5 to 15 villages that vary in size (Kundhlande et al. 2014). Randomization at the section level reduces but does not eliminate the risk of control group contamination because there are many circumstances where a subset of or all commercial operations in the aquaculture value chain may transcend section boundaries. To minimize or control for such spillovers into control EPAs, 3ie will closely monitor program implementation with CDF Canada.

For the randomization, our sampling frame is the list of sections for the eight districts from a census CDF Canada conducted in 2024.

3.1.1 Exclusion criteria

We applied the following exclusion criteria to remove certain farmers and/or EPAS from the program sample. We used these criteria to ensure the integrity and relevance of the sample for program implementation and evaluation purposes.

A. Information completeness

Eight farmers without complete information on their EPAS were dropped from the analysis, leaving a total of 3,444 data points spread across 302 EPA sections in the 8 districts.

B. Administrative consideration

To facilitate efficient administration and logistics, the project aimed to focus on sections with a minimum of eight farmers. We created an indicator variable in the data to flag EPAS among the 302 identified that met this threshold. Upon analysis, 180 EPA sections were found to have at least 8 farmers, while the remaining 112 sections were dropped from sample consideration.

C. Compatibility with the randomization strategy

3ie employed a pairwise randomization approach to ensure balance between treatment and control groups. This method required an even number of EPAS across all districts for effective pairing. To achieve this, we strategically dropped four sections from the analysis, leaving a total of 176 EPAS. These remaining sections were then paired based on the number of farmers to minimize potential imbalances and improve the robustness of the randomization process.

3.1.2 Randomization

Randomization at the section level was implemented in a centralized computer. Random numbers were generated, and one section from each pair was assigned to the treatment group and the other to the control group. To mitigate the risk of sections becoming infeasible for inclusion in the study due to factors beyond the control of the evaluation or implementation teams, we employed an oversampling strategy. Specifically, we initially assigned 88 sections to the control group and to each treatment arm, thereby providing replacement sections as needed, as shown in Table 2 below.

Table 2: Number of sections selected for treatment and control arms

	Randomized	**Total sections selected**
C- No CDF Canada project	88	80
T- CDF Canada project	88	80
Total	**176**	**160**

To minimize the likelihood of control group contamination and other spillovers, we also dropped multiple sections that were managed by a single AEDO.

3.2 Sampling

3.2.1 Selection of households for interview

In line with CDF Canada's criterion for defining fish-farming smallholders, we selected households that owned fishponds at the time of the baseline interview, regardless of whether they were actively producing fish or not.

3.2.2 Selection of household members for interview

Household members for the baseline were selected for interviews as follows:

- The main household questionnaire was administered to household heads or their spouses, who were the most actively engaged in aquaculture and/or knowledgeable about household affairs. This included both male and female respondents.
- The nutrition module questions consisted of household food security, individual food intake, and nutrition knowledge. These were administered to the person in the household with the most knowledge about what was being consumed.
- Gender-specific modules were administered to the female spouses if the target respondent was male. They were skipped for unmarried male fish farmer households.

3.3 Power calculations

To achieve a Minimum Detectable Effect (MDE) of 0.2 standard deviations on standardized outcome variables and assume an Intra-Cluster Correlation (ICC) of 0.1[11], we proposed a sample of 2,900 fish farming households across 160 sections in T and C. Power calculations yield a MDE of 0.17 standard deviations on the impact of IAA.

[11] ICCs of 0.1 or lower are typical for household level outcome measurements such as consumption, income, and measures of agricultural productivity.

As discussed earlier, we were able to conduct baseline data collection from 2,498 households in 154 sections out of the targeted 2,900 household in 160 sections. We present power calculations using assumptions similar to those in our proposal. The minimum detectable effect sizes are presented in Table 3

Table 3: Minimum detectable effect size

	Sample N=2900 farmers
ICC=0.05	0.14
ICC=0.10	0.17

3.4 Implementation of the baseline survey

Following a public tender and interviews by a shortlist of three bidders, Imani Consultants Ltd (ICL) Malawi was contracted to implement the baseline survey. ICL Malawi is headquartered in Blantyre and has significant and relevant expertise in undertaking surveys for RCTs and covering a variety of development-related themes. Members of the evaluation team and ICL tested the first set of draft questionnaires for the baseline survey after incorporating feedback from the program implementation organization and the donors. After finalizing the paper-based baseline questionnaires, the survey firm programmed the questionnaires in Computer-Assisted Personal Interviews (CAPI) using SurveyCTO. The CAPI tools were bench-tested multiple times to ensure coherent flow of questions, and accurate skip patterns and translations. Detailed survey manuals were designed prior to ICL's training of enumerators and field supervisors.

The team sought and obtained ethics approval from the National Committee on Research in the Social Sciences and Humanities Internal Review Board.

The fieldwork exercise engaged a total of 42 field staff, organized into 7 teams operating across Malawi's 3 regions: Southern, Central, and Northern. Each team consisted of four enumerators, one supervisor, and one back-checker. The teams were deployed in eight districts: Thyolo and Zomba (Southern); Dowa, Nkhotakota, and Ntchisi (Central); and Chitipa, Mzimba, and Rumphi (Northern). We carefully aligned the assignment of field staff to the geography and workload in each district.

All field staff underwent a rigorous 13-day training program in Blantyre, Malawi. This included 11 days of intensive in-class training covering survey objectives, tool familiarization, ethical protocols, interviewing techniques, and use of SurveyCTO on Android tablets. This was followed by two days of field piloting within Blantyre to test the questionnaire, simulate field conditions, and identify any necessary refinements in survey administration. Feedback from this piloting informed final adjustments to both the data collection tools and standard operating procedures.

Because the baseline represents the first of a two-round panel, facilitating tracking of the households interviewed at baseline for follow-up interviews in endline is crucial. To minimize attrition, we collected information about neighbors and networks likely to have information and knowledge about household members' whereabouts if a household relocates between baseline and endline.

We used the SurveyCTO[12] mobile data collection platform, which contains a number of features and design options to facilitate collection of high-quality data with less effort. This section outlines the steps taken for data quality assurance and the particular SurveyCTO features we used to monitor and secure high-quality data collection.

3.5 Data collection

The household questionnaire is divided into five main sections: (1) household characteristics, (2) agriculture information, (3) aquaculture information, (4) women's empowerment, and (4) nutrition module. It includes information on household demographic characteristics, housing, income, savings, debt, economic shocks, and participation in group and community initiatives. Because increasing aquaculture productivity is a key outcome for the project, we have included several sections on the extent of household's involvement in aquaculture, expenditure on and income from aquaculture, and aquaculture sales. In the women's empowerment sections, we collected information on men's and women's (1) roles in household decision making about aquaculture production, production, and income; (2) awareness about good aquaculture practices, access to productive capital, livestock assets, financial resources, and consumption assets; and (3) mobility, attitudes toward women's involvement in aquaculture, and group membership.

The nutrition section includes information on food insecurity and dietary diversity. The survey was conducted with two respondents per household: one male and one female. The sections administered to either or both respondents are highlighted below in Table 4:

Table 4: Questionnaire sections administered to male and female respondents

	Respondent	
	Both male and female	**Female only**
Module 01: Household roster	☒	☐
Module 02: PPI	☒	☐
Module 03: Shocks	☒	☐
Module 04: Agriculture	☒	☐
Module 05: Aquaculture	☒	☐
Module 06: Knowledge about aquaculture practices	☒	☐
Module 07: FEIS	☒	☐
Module 08: Dietary diversity score	☐	☐
Module 09: Food consumption	☒	☐
Module 10: Non-food consumption	☒	☐
Module 11: Access to financial services	☒	☐
Module 12: Role in household decision making around production and income	☐	☒
Module 14: Gender empowerment	☐	☒
Module 15: Group participation	☒	☐

[12] More information available at: https://docs.surveycto.com/.

As mentioned earlier, we used three types of questionnaires to collect the baseline data: community, household, and SME. We shared multiple versions of the community, household, and SME's questionnaires with CDF Canada and carefully piloted them to test clarity, comprehension, and the time required for completion. The drafts underwent several rounds of revisions to incorporate stakeholder feedback. Evaluation team members conducted a series of checks of the entry into CAPI and translation into Chichewa. The original questionnaire incorporated components of standard nutrition indicators of dietary diversity (FAO and FHI 360 2016) and food insecurity (Cafiero et al. 2018, Bilinsky and Swindale 2010).

The baseline survey commenced in February 2025 and initially targeted 3,051 households across 8 districts and 160 EPAS. A total of 520 households (17%) could not be interviewed for reasons such as ineligibility, duplication, hard refusal, or absence of an eligible respondent at the time of the visit. Therefore, 2531 household surveys were successfully conducted at baseline, representing an overall response rate of 83%. EPAS not meeting this the inclusion criteria listed in section 3.2, were excluded from both the survey and subsequent project implementation; for example, six EPAS in Nkhotakota District were excluded on this basis. Following the exclusion, 2,498 households across 154 sections were retained for analysis. ▯mance is shown in ▯5▯▯6▯▯At endline, households will be tracked and resurveyed with additional protocols in place to minimize attrition. If evidence of differential attrition emerges at endline, the evaluation will employ inverse-probability weighting and bounding methods to assess sensitivity to attrition. rotocols in place to minimize attrition.

Table 5: District-level breakdown of household survey targets versus actual performance

District	Target	Interviews conducted	Response rate (%)	Not interviewed	% Not interviewed
Chitipa	516	389	75%	127	25%
Dowa	434	363	84%	71	16%
Mzimba	331	271	82%	60	18%
Nkhotakota	217	116	53%	101	47%
Ntchisi	441	378	86%	63	14%
Rumphi	251	205	82%	46	18%
Thyolo	546	518	95%	28	5%
Zomba	315	291	92%	24	8%
Total	*3,051*	*2,531*	*83%*	*520*	*17%*

Table 6: Households surveyed across treatment and control sections

Treatment	Sections covered	Households surveyed
Control	77	1,264
Treatment	77	1,234
Total	154	2,498

3.6 Data validation

An important requirement is that accurate survey data are recorded during the interview and that mistakes can be corrected efficiently during the interview. The response fields on the survey form were designed to prevent enumerators from entering data that are obviously incorrect, invalid, or inconsistent. The form disallowed answers that were clearly impossible or contradicted earlier responses, while still allowing unusual (but sometimes correct) values.

3.6.1 Monitoring and auditing of surveys

To assure quality in data collection, survey supervisors accompanied enumerators with revisits to a random sample of surveyed individuals to perform back-checks. To complement this manual quality assurance, SurveyCTO offers a text auditing option that allowed us to monitor the quality of survey administration. ICL consistently checked SurveyCTO meta-data about the survey administration, including how much time each enumerator spent on each question in the survey form and the sequence with which they progressed through the survey. Further and elaborated below, this also provides the opportunity, especially in the early days of implementation, to detect and take action to correct entered response patterns suggesting systematic misunderstandings on the part of a numerator or a group of enumerators.

3.6.2 Monitoring incoming data

In addition to checks on data collection in the field, ILC configured automated quality checks to monitor the overall quality of incoming data. For example:

1. Individual field values that are too low or too high
2. Individual field values that are outliers; SurveyCTO uses statistics to warn when field values are unusually high or low
3. Individual field values that are either too frequent or infrequent, allowing monitoring of the frequency of certain response values
4. Field means that are too low or too high, giving a warning when overall mean or average of a field is above or below a certain threshold
5. Mean values that differ from one sub-group to another, for example, checking that average values for a particular field do not differ significantly depending on the interviewer
6. Response distributions that differ from one sub-group to another, checking to see if the distribution of responses differs across sub-groups, which might indicate enumerator effects in the reported response

SurveyCTO gives warnings whenever submission values, frequencies, means, or distributions in data cause configured quality checks to fail. This allowed for a rapid response to any issues that arose.

In addition to the data quality checks ILC administered, the evaluation team conducted statistical checks by computing means, standard deviations, and histograms of important variables on a regular basis to make sure there were no data discrepancies. Large outliers in the data, where identified, were communicated to the survey firm, which conducted field checks to ensure accuracy. The first round of data post commencement of data collection was expected at the latest within 10 days of start of the survey. However, due to some initial challenges in field, these data arrived later than expected

and delayed our discovery of systematic weaknesses for time-use data. Once discovered, we took corrective action.

4. Data Analysis

The sample of households selected at baseline will be revisited at project completion (tentatively in January 2029). Therefore, two rounds of data will be available for the panel households (0=baseline and 1=end of treatment). We plan to provide two estimates of program impacts: the intention-to-treat estimator (ITT) and the average treatment effect on treated (ATET). The ITT estimate will be given by:

$$Y_{iut} = \alpha + \beta_1 Tu + \tau_t + V_t + D_u + Y_{iu0} + \varepsilon_{iut}, \quad t \in \{1\}$$

Where Y_{iut} is the outcome variable for household i in section u in time t = (1). T is a dummy variable that takes the value 1 if a section u is assigned to treatment. The omitted variable represents control sections. We include year (τ_t) and section-fixed effects (D_u), as well as controls for baseline values of Y_i. V_t is a vector of village characteristics that include, for example, (i) distance to markets, (ii) the presence of other NGOs and government interventions. ε_{iut} is the residual that we cluster at the EPA section level. The coefficient β_1 on T captures the impact of the treatment arm relative to the control.

In addition to this ITT estimator, if there is significant variation in uptake rates in treatment (or control) areas, we will also implement a two-stage instrumental variables procedure to estimate the ATET.

We randomized EPAS before the rollout of the baseline household survey. To assess whether randomization has been successful, complementing the balance tests in Annex 1, we will compare a set of household characteristics, including: (1) household size and composition, (2) household land holding, (3) education levels of adult men and women, and (4) the baseline means of our primary outcome indicators. We will explore heterogeneous impacts of the program on different sub-samples of the population as described in Table 7.

Table 7: Outcome-wise heterogeneous effects

Outcome	Indicator	Heterogeneous effects
Productivity	1. Number of ponds operated 2. Quantity of fish harvested by household 3. Quantity of fish sold by household 4. Total household income from aquaculture (sale of fish, fingerlings and associated businesses) 5. Total household expenditure on aquaculture 6. Share of income from aquaculture in total household income	1. Household head above and below 35 years of age 2. Female household head 3. Household head with disability
Nutrition	1. Dietary diversity score 2. Total food consumption expenditure	1. Household head above and below 35 years of age

Outcome	Indicator	Heterogeneous effects
	3. Household food insecurity 4. Household fish consumption (e.g., days consumed, types consumed)	2. Female household head 3. Household with disability
Women's empowerment	1. Role in household decision making around production and income 3. Number of women who are active members of farmer groups 4. Attitudes toward women's involvement in aquaculture	1. Household head above and below 35 years of age 2. Female household head 3. Household head with disability

5. Registration of the pre-analysis plan

The study was registered at the AEA RCT registry (AEARCTR-0014852) on November 28, 2024. The pre-analysis plan was registered with RIDIE (RIDIE-STUDY-ID-68afe73969b59) on August 28, 2024. It can be accessed here.

6. Internal validity of the evaluation (Balance and Orthogonality tests)

We present selected results from the full list of balance tests (Appendices A4 and A5) run across the treatment and the control arm to test for statistically significant differences with respect to the outcome variables discussed in Table 8. We have presented results from balance tests on household-level characteristics, agriculture, agroforestry, livestock rearing, aquaculture, IAAS knowledge, and women's empowerment outcomes. For nutrition outcomes, we used nutrition indices like household dietary diversity and FIES. These indices are described in Appendix A2.

Household characteristics across treatment and control groups were balanced at baseline, with no statistically significant differences across most indicators. The average age of household heads was 50 years in both groups, and about 87% of household heads were male. Average household size was around 5.6 members, with no meaningful difference between treatment and control households. Years of education among male and female household heads were also balanced across the two groups (7.7 versus 7.4 years for males and about 6 years for females).

Landholding and cultivation patterns were similar: households owned about 5.8 acres of land on average, of which 3.3 acres were cultivated. Crop harvest per acre was around 900 kilograms, and average annual income from crops was about MWK 246,000 (CAD 196[13]) per acre, with no significant differences across arms. Likewise, agricultural expenditures exceeded MWK 600,000 (CAD 477) annually, without notable variation between groups. Livestock expenditures and sales were similar across groups, and just under one-fifth of households integrated livestock with fish farming. We observed a marginal difference in income from forestry products with treatment households reporting higher sales (MWK 107,000 or CAD 85 versus MWK 83,000 or CAD 66); however, the effect was only weakly significant.

[13] 1 MWK = 0.0008 CAD as on April 30, 2025

Aquaculture-related outcomes were also balanced. Roughly 72% of households cultivated fish in ponds, with an average pond area of 318 square meters, of which about 240 square meters were under cultivation. Fish productivity averaged 0.15 kilogram/square meters and incomes from fish production were around MWK 280 or CAD 0.22 per square meter. Expenditure on aquaculture inputs was about MWK 34,500 (CAD 27.5) per household, with no statistical variation between groups. Integration of aquaculture with crops (27%), livestock (19%), or agroforestry (26%) was evenly distributed, and just under half of all households practiced IAAS. We also collected photographs and satellite images of ponds. Based on balance tests of whether the ponds in the images were active, filled with water, or had the potential to become active, there is no statistical difference between the treatment and control groups. There is also no statistical difference in the level of vegetation around the ponds between the treatment and control groups.

Food security and welfare indicators also showed no significant differences. Average household dietary diversity scores were around 6 food groups, and FIES scores averaged 5.5. Yearly, per capita food and non-food expenditures were MWK 365,000 (CAD 290) and MWK 288,000 (CAD 229), respectively, with no evidence of imbalance across treatment and control households.

Orthogonality tests also indicate that treatment and control households were well balanced across key demographic, agricultural, aquaculture, and welfare indicators. Differences in household head's age, gender, education; household size; landholding; crop production; and agricultural expenditures were small in magnitude and statistically insignificant. Similarly, aquaculture participation, pond size, fish yields, aquaculture income, and integration with crops, livestock, or agroforestry showed no systematic variation across arms. Household welfare outcomes, including food and non-food expenditures, dietary diversity, and food insecurity scores, were also statistically comparable. Only a weak difference was observed in forestry income but overall, the results confirm that randomization achieved balance across treatment and control groups.

Table 8 reports results from both balance tests and orthogonality tests. The third column, *"difference,"* shows the difference of means using balance tests (regression estimates with standard errors clustered at the EPAS level), while the final column, *"treatment coefficient,"* shows the difference of means using orthogonality tests and takes district-level, fixed effects into consideration for tighter estimates. Log-transformed monetary variables appear at the end of the table and show that some monetary indicators might have outliers at baseline whose effects get controlled once the values are log transformed.

Table 8: Balance and orthogonality tests

Indicator	Control		Treatment		Difference(T-C)		Treatment coefficient	
Avg. household head age	50.43	(14.82)	50.30	(14.97)	-0.13	(0.81)	-0.163	(0.75)
%. of male household head	0.88	(0.33)	0.86	(0.35)	-0.02	(0.02)	-0.014	(0.02)
Avg. number of household members	5.70	(2.21)	5.54	(2.09)	-0.17	(0.14)	-0.154	(0.1)
Avg. years of education of male household head	7.65	(3.63)	7.36	(3.62)	-0.29	(0.28)	-0.282	(0.22)
Avg. years of education of female household head	5.87	(3.7)	5.97	(4.03)	0.09	(0.51)	0.08	(0.46)
Avg. land owned (acres)	5.99	(8.69)	5.55	(7.88)	-0.44	(0.67)	-0.445	(0.41)
Avg. land area cultivated (acres)	3.35	(4.35)	3.26	(4.54)	-0.10	(0.3)	-0.111	(0.21)
Avg. crop harvest (kg/acre)	916.59	(1759.34)	894.61	(1668.59)	-21.98	(86.89)	-24.187	(73.35)
Avg. total Income from crops (MWK/acre) (‘000s)	231.80	(421.81)	259.96	(618.33)	28.16	(30.43)	24.642	(24.45)
Avg. total expenditure on agriculture (MWK) (‘000s)	674.78	(1766.22)	624.05	(1350.56)	-50.73	(92.53)	-56.089	(74.49)
Avg. inc. from sale of forest products (MWK) (‘000s)	107.40	(426.61)	83.43	(265.57)	-23.96	(17.15)	-25.804*	(15.32)
Avg. livestock buying cost (MWK) (‘000s)	66.07	(361.18)	74.82	(491.87)	8.76	(20.73)	10.075	(19.23)
Avg. livestock sale income (MWK) (‘000s)	131.72	(408.06)	136.25	(524.54)	4.53	(22.64)	9.191	(18.98)
% households that cultivate fish in ponds	0.72	(0.45)	0.73	(0.44)	0.01	(0.04)	0.01	(0.04)
Avg. pond area owned (m^2)	327.18	(1247.12)	308.81	(769.72)	-18.37	(67.12)	-23.371	(56.01)
Avg. pond area under cultivation (m^2)	243.12	(1216.8)	237.32	(738.94)	-5.81	(59.66)	-9.999	(51.98)
Avg. fish produced per unit area (kg/m^2)	0.14	(0.33)	0.16	(0.54)	0.02	(0.02)	0.023	(0.02)
Avg. total Income from fish production (MWK/m^2)	263.35	(826.99)	300.49	(1562)	37.13	(54.61)	36.066	(54.79)
Avg. expenditure on aqua inputs/services (MWK) (‘000s)	35.33	(128.84)	33.78	(101.18)	-1.55	(7.16)	-2.182	(6.39)
% households integrating crop with fish farming	0.26	(0.44)	0.28	(0.45)	0.02	(0.02)	0.018	(0.02)
% households integrating livestock with fish farming	0.18	(0.38)	0.19	(0.4)	0.01	(0.02)	0.009	(0.02)
% households integrating agroforestry with fish farming	0.26	(0.44)	0.26	(0.44)	0.00	(0.03)	-0.003	(0.02)
% of households practicing IAAS	0.45	(0.5)	0.46	(0.5)	0.01	(0.03)	0.003	(0.03)
% of households having knowledge on IAAS	0.04	(0.2)	0.06	(0.23)	0.01	(0.01)	0.01	(0.01)
Avg. yearly food expense per capita (MWK) (‘000s)	374.16	(348.69)	354.69	(330.55)	-19.48	(20.09)	-20.895	(16.3)
Avg. yearly non-food exp. per capita (MWK) (‘000s)	298.40	(488.68)	278.09	(404.35)	-20.31	(26.16)	-21.572	(21.92)
Avg. household FIES score	5.46	(2.52)	5.52	(2.54)	0.06	(0.19)	0.048	(0.12)
% households that report inadequate food	1.32	(0.47)	1.31	(0.46)	-0.02	(0.03)	-0.02	(0.02)

Indicator	Control		Treatment		Difference(T-C)		Treatment coefficient	
Avg. months where HH couldn't provide 3 meals/day	2.38	(2.81)	2.66	(3.13)	0.28	(0.24)	0.26**	(0.12)
Avg. household dietary diversity score	6.07	(2.02)	5.98	(2.01)	-0.10	(0.17)	-0.092	(0.12)
Avg. salary/wages earned by household (000s)	391.28	(1189.37)	271.06	(696.7)	-120.21**	(50.36)	-125.521***	(47.69)
Avg. gross income from crops (mean) (000)	1716.11	(7768.73)	1858.95	(7369.48)	142.85	(387.57)	70.85	(268.14)
Avg. gross income from crops (median) (000)	1307.42	(4264.92)	1508.21	(5560.51)	200.79	(281.19)	154.94	(201.34)
Avg. gross income from fish (mean) (000)	107.04	(734.48)	71.46	(278.59)	-35.57	(31.22)	-37.52	(29.46)
Avg. gross income from fish (median) (000)	93.51	(719.28)	61.43	(255.79)	-32.08	(30.91)	-33.95	(29.31)
POND RELATED INDICATORS								
Prop. of households that have pond access	0.94	(0.23)	0.93	(0.25)	-0.01	(0.01)	-0.01	(0.01)
Avg. walking time to pond (minutes)	12.58	(15.33)	12.33	(15)	-0.26	(0.93)	-0.23	(0.87)
Prop. of GPT identified ponds	0.70	(0.46)	0.71	(0.46)	0.01	(0.03)	0.01	(0.03)
Prop. of GPT identified water	0.87	(0.34)	0.85	(0.36)	-0.02	(0.03)	-0.02	(0.03)
Prop. of ponds that could become a pond	0.84	(0.26)	0.84	(0.27)	0.00	(0.02)	0.00	(0.02)
Mean NDVI	0.28	(0.06)	0.28	(0.06)	0.00	(0.01)	0.00	(0.01)
LOG TRANSFORMED INDICATORS								
Log - Avg. total Income from crops (MWK/acre)	9.96	(4.35)	10.06	(4.33)	0.10	(0.3)	0.115	(0.2)
Log - Avg. livestock buying cost (MWK)	4.72	(5.42)	4.82	(5.45)	0.10	(0.3)	0.113	(0.24)
Log - Avg. livestock sale income (MWK)	5.93	(5.86)	6.06	(5.84)	0.14	(0.36)	0.197	(0.23)
Log - Avg. total Income from fish production (MWK/m^2)	2.19	(2.9)	2.24	(2.91)	0.05	(0.2)	0.002	(0.16)
Log - Avg. total expenditure on agriculture (MWK)	11.87	(3.15)	11.79	(3.15)	-0.08	(0.21)	-0.064	(0.14)
Log - Avg. income from sale of forestry products (MWK)	6.90	(5.4)	6.67	(5.38)	-0.23	(0.33)	-0.285	(0.29)
Log - Avg. exp. on aquaculture inputs/services (MWK)	5.52	(5.12)	5.33	(5.1)	-0.19	(0.4)	-0.266	(0.31)
Log - Avg. yearly food expense per capita	12.37	(1.19)	12.36	(1.12)	-0.01	(0.07)	-0.014	(0.06)
Log - Avg. yearly non-food expense per capita	12.05	(1.05)	12.02	(1.01)	-0.03	(0.08)	-0.025	(0.05)
Log - Avg. salary/wages earned by household	6.87	(6.29)	6.63	(6.18)	-0.24	(0.3)	-0.268	(0.27)

Note: *This table presents results from both balance tests and regression analyses. The third column ("Difference") reports regression estimates with clustered standard errors at the EPAS level. The last column presents regression results with district-level fixed effects. Log-transformed monetary indicators are reported toward the end of the table.*
**Significance levels: p < 0.1, p < 0.05, p < 0.01.*

7. Other findings

7.1 Household district-level analysis

In this section, we present key findings related to the IAAM project design and ToC. These findings are descriptive analysis to highlight variation across districts and geographies. We focus on aquaculture productivity drivers, household food security and nutrition outcomes, and women's empowerment. These baseline results provide important insights into where the project is likely to generate the strongest impacts. In addition, we conduct district-level and other heterogeneity analyses to assess how key indicators vary across sub-groups. Some of these results are presented in this section, others are included in Appendix A6.

Strengthening cooperatives and SMEs is one of the main components of the IAAM interventions. At baseline Figure 4, presents the proportion of households that are members of different types of groups—cooperatives, SMEs, and community groups—across IAAM project districts. Overall, community group participation is the most common form of collective engagement among households, particularly in Rumphi (82%), Dowa (70%), Ntchisi and Chitipa (69%). Community groups in Malawi typically serve as informal platforms for mutual support, savings, and information sharing among members. They often include village savings and loan associations, farmer clubs, and self-help groups that pool resources to provide small loans, share agricultural inputs or labor, and support members during social or economic hardships. Such groups play an important role in improving access to finance, strengthening social networks, and facilitating collective action within communities. Membership in cooperatives and SMEs is generally lower and varies across districts, with cooperative participation ranging from 15% in Thyolo to 57% in Rumphi, and SME participation from 18% in Thyolo to 58% in Nkhotakota. These patterns suggest that community-based organizations play a central role in local engagement, while opportunities to increase cooperative and SME participation may depend more on district-level economic activities and institutional presence. The relatively high rates in northern districts such as Dowa and Rumphi indicate potentially stronger local institutional networks compared to southern districts, like Thyolo and Zomba.

Figure 4: Group membership

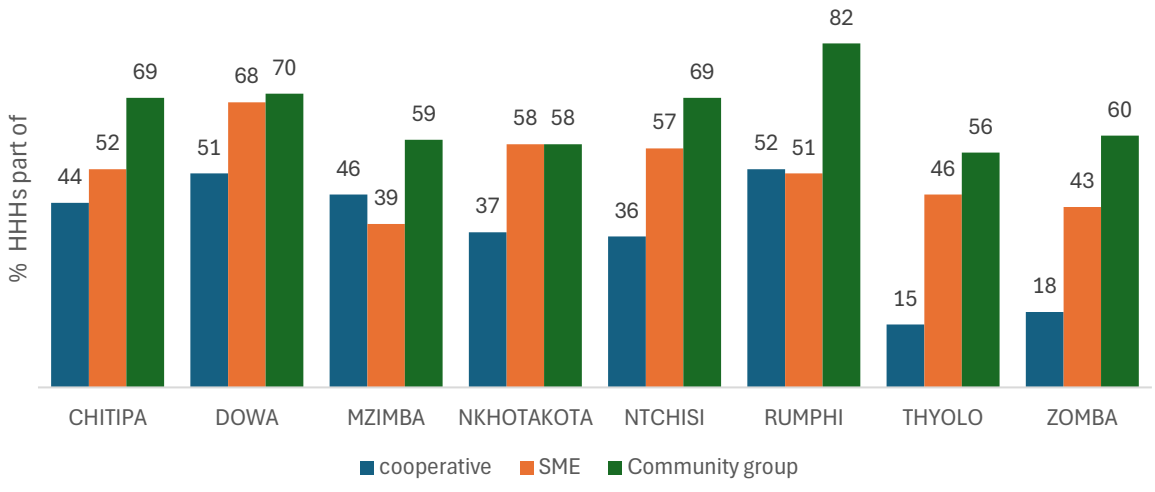


Figure 5 shows the top three crops cultivated by households across IAAM project districts. Maize is the dominant crop in all districts, cultivated by more than 90% of households, underscoring its role as the primary staple in rural livelihoods. The second and third crops vary by district, reflecting local agroecological and market conditions. In northern districts such as Chitipa, Ntchisi, and Rumphi, households frequently cultivate beans, groundnuts, and soybean, with soybean being particularly prominent in Ntchisi (67%) and Dowa (53%). Mzimba also shows a relatively high share of soybean (46%) alongside groundnuts (34%). In southern districts, diversification is more pronounced. Thyolo has a large share of households growing pigeon pea (63%) and rice (54%), while Zomba shows a balanced mix of pigeon pea (51%) and beans (31%). Nkhotakota, on the other hand, stands out with a high share of rice cultivation (54%), reflecting its proximity to wetland and lake areas conducive to rice farming.

Figure 5: Top three crops grown (dist. level)

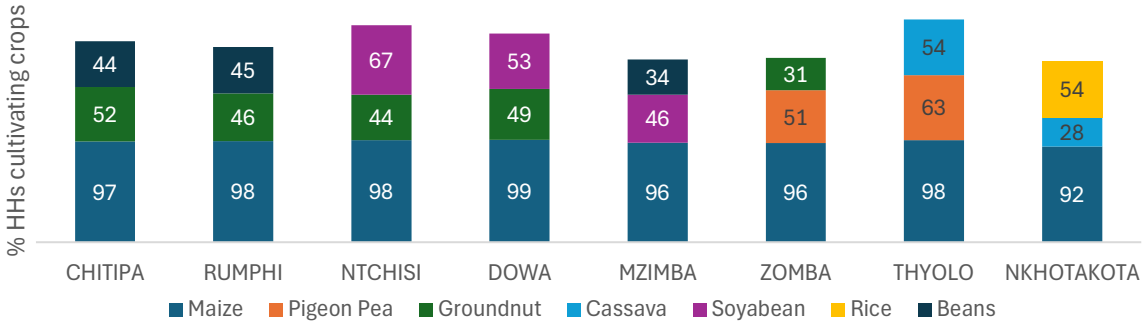


Figure 6 presents average crop productivity for all crops across districts, measured in harvest quantity (kilogram/acre) and sales value (MWK '000/acre). Overall, we see a picture of subsistence farming and low levels of marketization. Productivity is the highest in Nkhotakota (1,475 kilograms/acre) and Rumphi (1,363 kilograms/acre), followed by Dowa and Mzimba, while Zomba and Ntchisi show relatively lower yields. Despite variations in harvest levels, the value of crop sales remains modest across all districts, with Rumphi reporting the highest sales (462 MWK '000/acre). These differences highlight district-level variations in both agricultural output and market participation.

Figure 6: Agriculture productivity and income (dist. level)

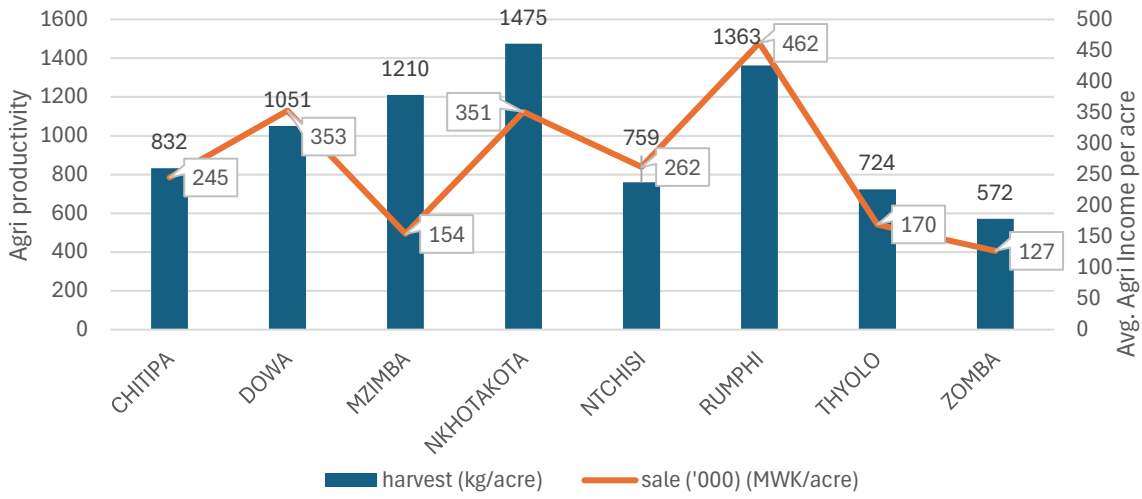
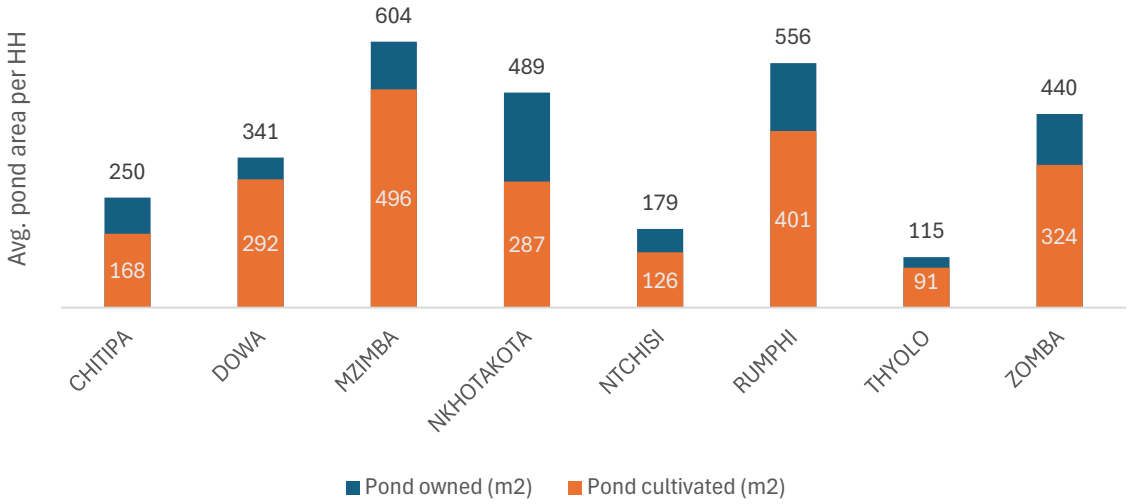


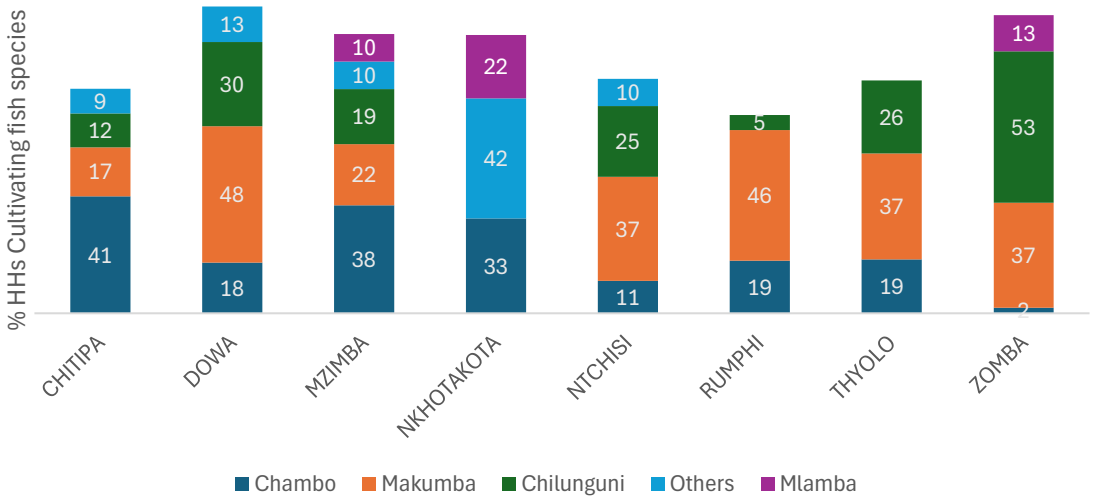
Figure 7 presents district-level variations in pond area, fish species cultivated, and aquaculture productivity. Average pond ownership and cultivation areas vary considerably across districts, with the largest ponds observed in Mzimba (604 square meters and Rumphi (556 square meters), while Thyolo and Ntchisi report the smallest average pond areas (115 and 179 square meters, respectively). In most districts, the cultivated pond area is smaller than the owned area, indicating partial utilization of available resources for aquaculture activities.

Figure 7: Pond ownership and cultivation



Fish species cultivated also differ across regions (Figure 8). Chambo and Makumba are the most commonly farmed species across districts, although their relative importance varies. Dowa and Rumphi show particularly high cultivation of Makumba (48% and 46%, respectively), while Zomba and Nkhotakota stand out for the prevalence of Chilunguni (53 and 42%). Cultivation of Mlamba is relatively limited, observed mainly in Mzimba and Nkhotakota.

Figure 8: Fish species (dist. level)



Aquaculture productivity and income (Figure 9) also vary widely by district. Nkhotakota reports the highest productivity and income (266 kilograms/square meter and MWK 574/square meter, respectively), followed by Zomba and Dowa, while Mzimba and Rumphi record comparatively lower yields and returns. The variation across districts highlights that there might be differences in pond management practices, species composition, and market access, which suggests potential areas for targeted support to enhance aquaculture performance and profitability.

Figure 9: Aquaculture productivity and income (dist. level)

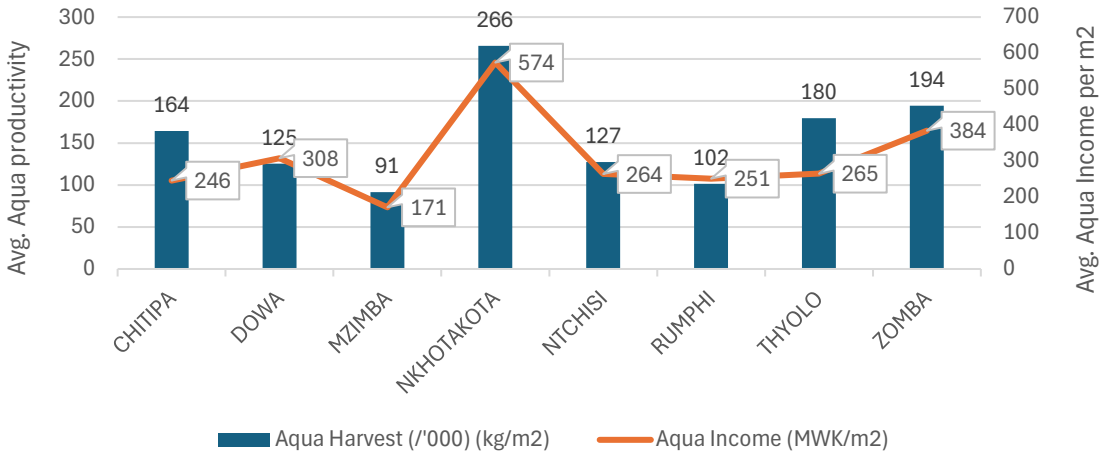


Figure 10 presents district-level fish selling patterns among aquaculture households. The results show substantial variation in market engagement across regions. Chitipa (65%) and Thyolo (54%) have the highest proportion of households selling fish outside their villages, indicating stronger market linkages and possibly higher production volumes. In contrast, a large share of households in Rumphi (59%) and Dowa (53%) do not sell fish, suggesting either lower production for market sale or greater emphasis on household consumption. Intermediate trends are observed in Nkhotakota, Ntchisi, and Mzimba, where a balanced mix of within-village and outside-village sales occurs.

Figure 10: Fish market trends (dist. level)

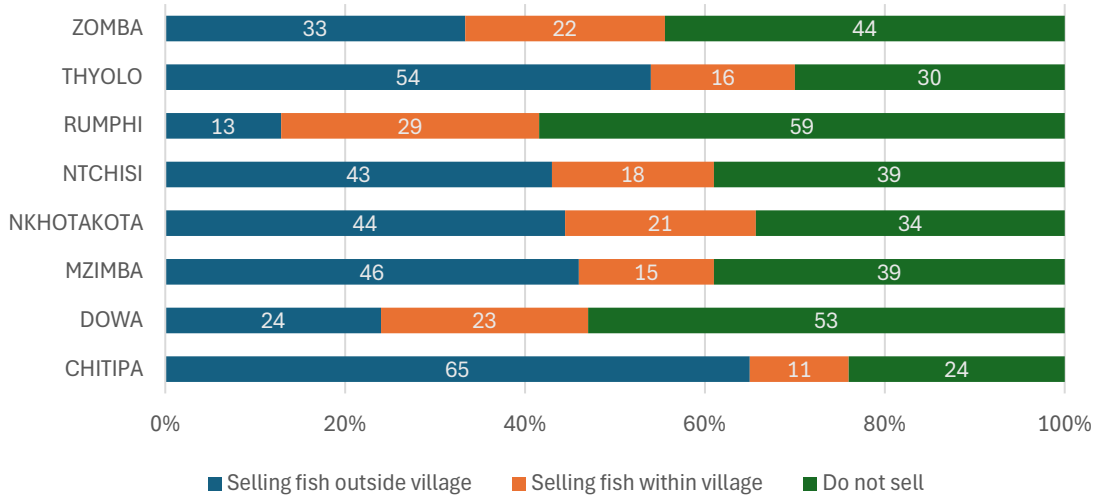
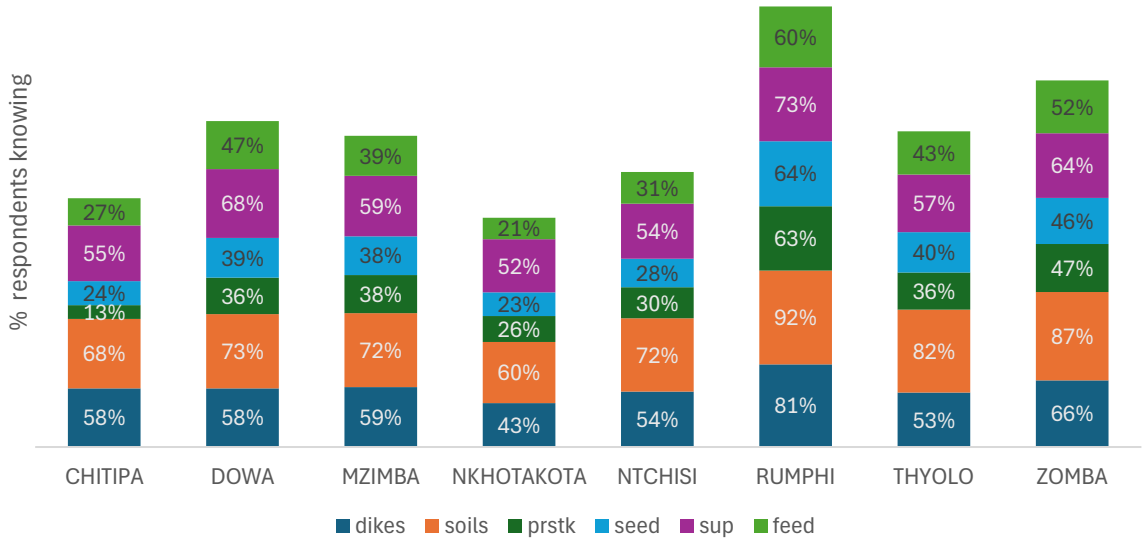


Figure 11 and Figure 12 present district-level patterns of aquaculture-related knowledge and adoption of best practices.

Figure 11: Knowledge in aquaculture practices



The aquaculture knowledge indicators were based on respondents' awareness of key technical activities conducted over the past 12 months— that is, since *{month_12m} to {month_1m}*— including:

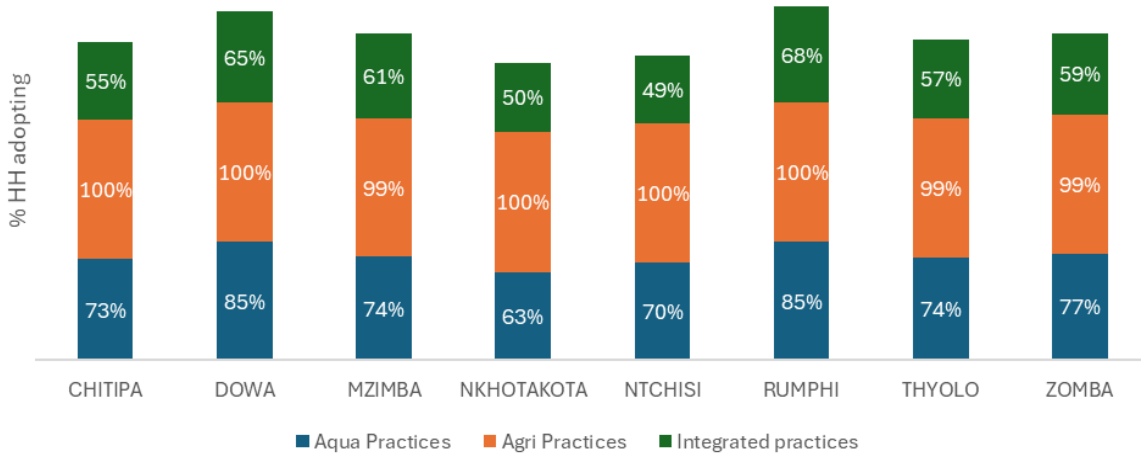
- Construction or repair of pond dikes
- Removal of black soil from pond bottoms
- Pre-stocking liming
- Identification of quality fish seed for stocking
- Use of homemade supplementary feed
- Use of commercial/formulated feed

As shown in Figure 11, knowledge levels vary considerably across districts. Rumphi stands out with the highest proportion of respondents aware of multiple practices—over 80% know about pond dike maintenance and more than 70% are aware of feed and seed management practices. Zomba and Dowa also show strong awareness across most areas, with particularly high knowledge of feed and soil management. In contrast, Nkhotakota and Ntchisi display comparatively lower levels of knowledge across all categories, especially for liming and seed identification. These results highlight geographical disparities in technical know-how, which may influence the uptake of improved aquaculture practices.

Figure 12 presents the adoption of best practices, grouped into three domains:

1. Aquaculture practices – activities corresponding to the knowledge indicators above (e.g., dike repair, liming, feeding)
2. Agriculture practices – such as use of natural pest control, soil and water conservation methods, livestock and seed management, and use of quality supplies (e.g., certified fingerlings, formulated feed)
3. IAAS practices – including integration of fish with crops, livestock, and forestry

Figure 12: Adoption of aquaculture best practices



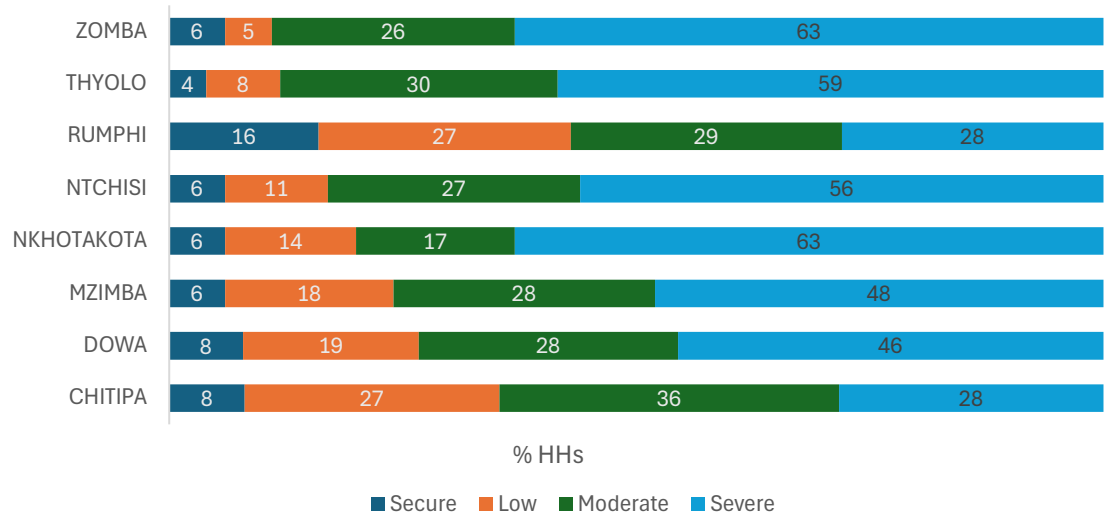
Adoption patterns broadly mirror the knowledge trends. Most households across districts report adopting at least one aquaculture and agricultural practice, while the adoption of at least one integrated practice[14] is more moderate. Agricultural practices such as soil and water conservation, use of improved seed varieties, and pest control show the highest adoption across all districts, with rates above 70%. In contrast, specialized aquaculture practices like use of commercial feed, pre-stocking liming, and pond dike repair have the lowest adoption, typically below 30%. The highest adoption of integrated systems is observed in Rumphi (68%), followed by Dowa (65%) and Zomba (59%), while Ntchisi and Nkhotakota show lower integration levels (below 50%). These patterns suggest that while basic aquaculture and agricultural techniques are widely known and practiced, greater technical support and extension outreach may be needed to expand IAAS, particularly in districts with lower knowledge and adoption levels.

Food-security outcomes[15] as shown in Figure 13 vary sharply across districts. Zomba and Nkhotakota have the largest shares of households in the *severe* category (both 63%). Thyolo (59%) and Ntchisi (56%) also show very high severe insecurity. Mzimba (48%) and Dowa (46%) have substantial severe shares as well. By contrast, Chitipa and Rumphi report much lower severe shares (28% each); Chitipa has the largest *moderate* share (36%), while Rumphi shows the highest *secure* share (16%) and the largest *low* share (27%).

[14] Adoption of practices is defined as adopting one or more out of a bucket of practices. I.e., Aqua practices (pond preparation, liming, stocking, and feeding); agriculture practices (crop, soil, water, livestock, and seed management); Integrated practices (fish–crop, fish–livestock, and fish–trees cultivation). IAAS practices promoted under the project, their definitions and measurements are given in Appendix A2.1.

[15] The FIES scale definition is shown in Appendix A2.3

Figure 13: Household food insecurity experience scale (dist. level)



Dietary diversity scores[16] across districts are shown in Figure 14. Across districts the most common outcome is consumption from 4–6 food groups (the modal band, roughly 42–56% of households depending on district). The 7–9 food-group category is the next largest (varies across districts, up to 48% in Chitipa). Shares consuming only 0–3 food groups range from very low (~3%) up to around 17–19% in some districts. Very few households reach the highest band (10–12 food groups), generally 1–10%.

Figure 14: Household dietary diversity score (dist. level)

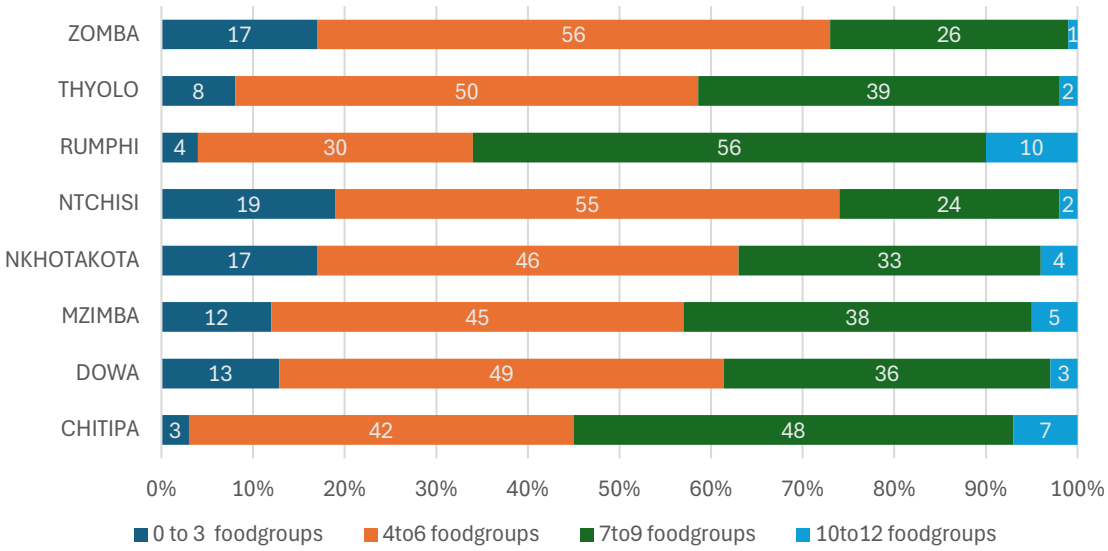
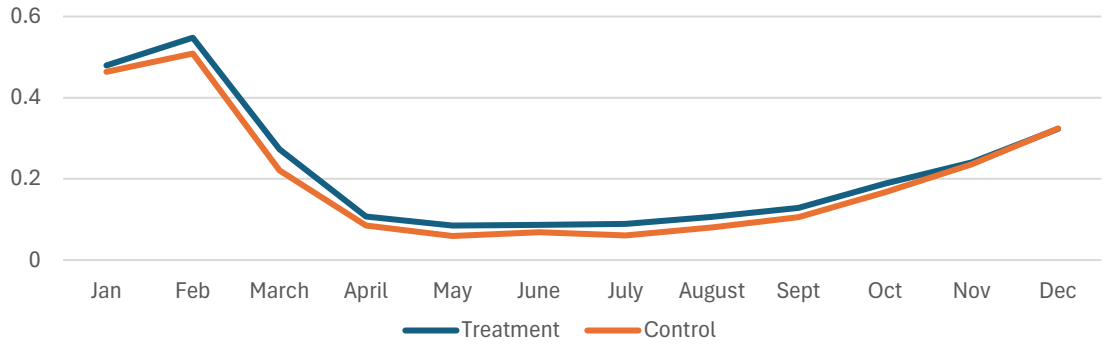


Figure 15 shows a clear seasonal pattern for both Treatment and Control groups. Values peak early in the year (January–February), decline sharply through March–May, and remain low during mid-year before rising steadily again from August to December.

[16] The household dietary diversity score definition in shown in Appendix A2.2

Across all months, the treatment and control groups present similar values and trends closely track each other.

Figure 15: Inadequate food pattern across the year (2024-2025)



Severe food insecurity is concentrated in Zomba, Nkhotakota, Thyolo, and Ntchisi, while Chitipa and Rumphi show relatively better food security profiles; dietary diversity is dominated by the 4–6 group band in all districts, with notable variation in the share reaching 7–9 groups.

Across all surveyed districts, exposure to shocks remains widespread, with 70–87% of households reporting at least one form of disruption in the past period, as seen in Figure 16. Food scarcity and agricultural price fluctuations are the most frequently reported shocks, affecting over two-thirds of households in most districts. Districts such as Nkhotakota and Ntchisi show the highest exposure (84–87%), primarily driven by combined agricultural and food-related stresses. Agricultural shocks and illness-related events represent additional major sources of vulnerability, while job losses and family or other shocks occur less frequently but remain non-negligible.

Figure 16 presents the proportion of respondents expressing liberal (gender-equitable) attitudes toward women's participation and rights in aquaculture, based on a series of questions assessing social norms and role perceptions. These questions explored whether respondents agreed that women can engage full time in aquaculture, be owners or joint owners of ponds, and take part in activities traditionally dominated by men, such as transporting fish, selling fish in markets, purchasing inputs, and attending aquaculture training. The figure also includes attitudes toward gender equality in labor roles, control over income, and equal treatment in IAAS activities. The results reveal that liberal attitudes are the strongest for issues of ownership, equal treatment, and control over income, where over 90% of respondents in both groups endorse equality. Similarly, awareness of equal labor rights and support for women's participation in training are relatively high, although slightly lower than for ownership or ethical domains. In contrast, questions involving women's physical mobility or public-facing roles—such as transporting and selling fish—show lower agreement levels, particularly among control group respondents (around 50–51%) compared to treatment (up to 60%). This pattern suggests that while respondents broadly support women's right to own, control, and benefit from aquaculture resources, social acceptance of women working outside the home or in market-oriented roles remains more limited. Overall, these findings indicate a mixed but progressive baseline, with strong liberal attitudes on equality and ownership but lingering conservatism around women's external engagement in aquaculture.

Figure 16: Shocks (dist. level)

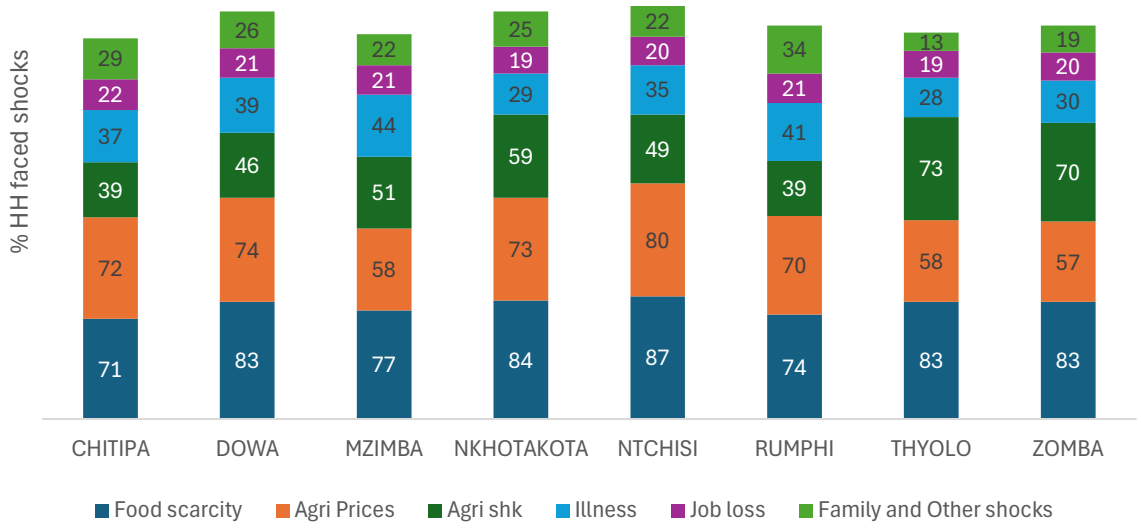


Figure 17: Attitudes toward women's participation in aquaculture

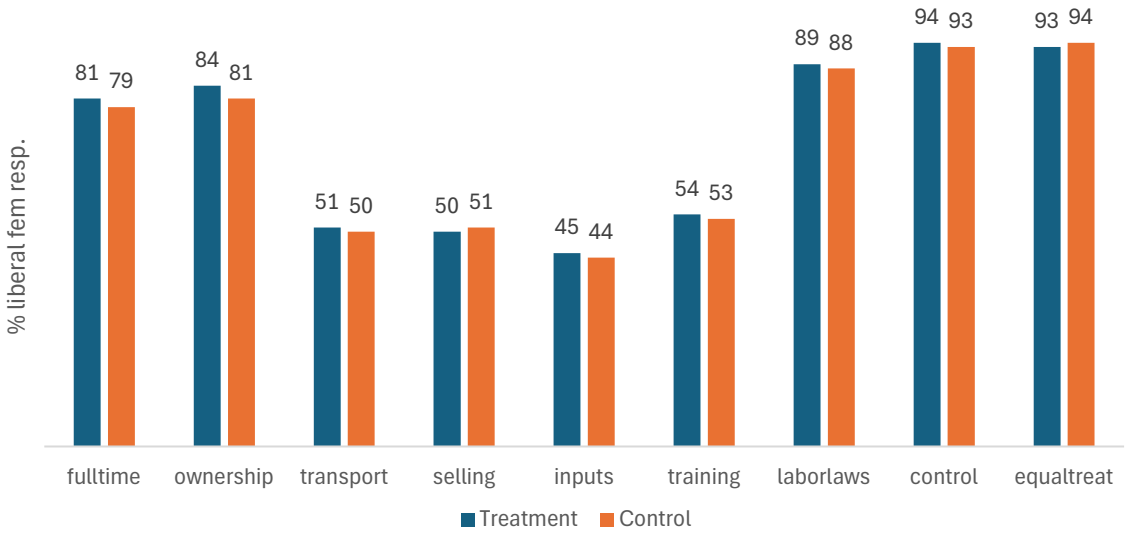


Figure 18 to Figure 21 above summarize patterns in pond accessibility, vegetation cover, and water presence. Figure 19 shows that most people live close to a pond, with the majority reporting walking times under 15 minutes and only a small fraction traveling more than 30 minutes, indicating generally good physical access. Figure 20, an NDVI histogram, displays the distribution of vegetation greenness around ponds. Most values fall between 0.2 and 0.4, suggesting moderate vegetation density typical of semi-rural aquatic landscapes, while very low and very high values are rare. Figure 18 and Figure 21 use AI-based image classifications to capture pond conditions. The water visibility graph indicates that water is visible in most pond images, with a smaller share showing no visible water, which likely reflects dry or drained ponds. The pond fill graph similarly shows that most ponds are classified as filled, suggesting favorable hydrological or

management conditions, with fewer ponds unfilled at the time of observation. These on-the-ground images were captured between February and April 2025, at the time of baseline data collection. Together, these graphs provide an integrated view of the pond environment, showing that ponds are generally accessible, moderately vegetated, and largely filled, offering insight into seasonal water availability and the landscape's suitability for aquaculture and other rural uses. Apart from this, the SME and community surveys also revealed the market- and EPAS-level characteristics across the treatment arms. The SME surveys are specific to the program, hence only at the treatment level. The results from the SME and community surveys are provided in Appendix A3.

Figure 18: Time taken to walk to pond (by HH)

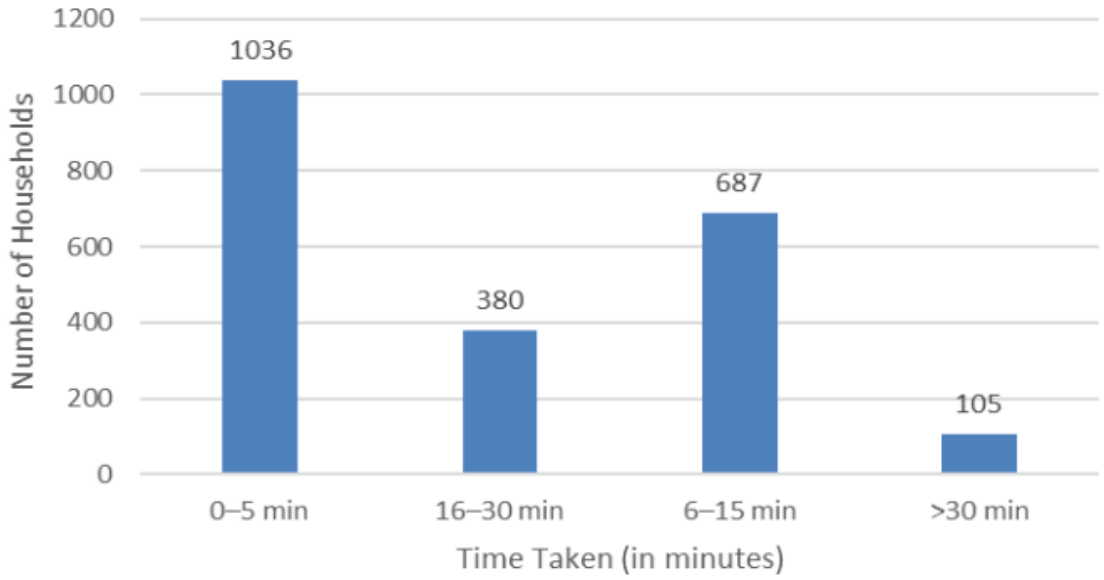


Figure 19: Pond fill (GPT classification)

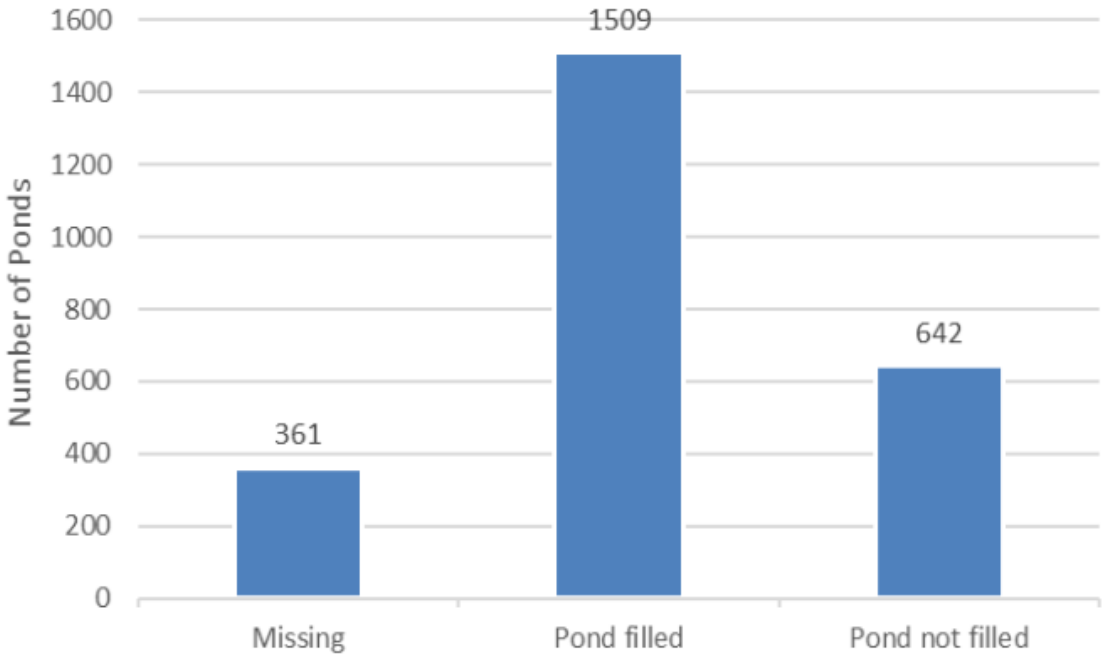


Figure 20: Mean NDVI

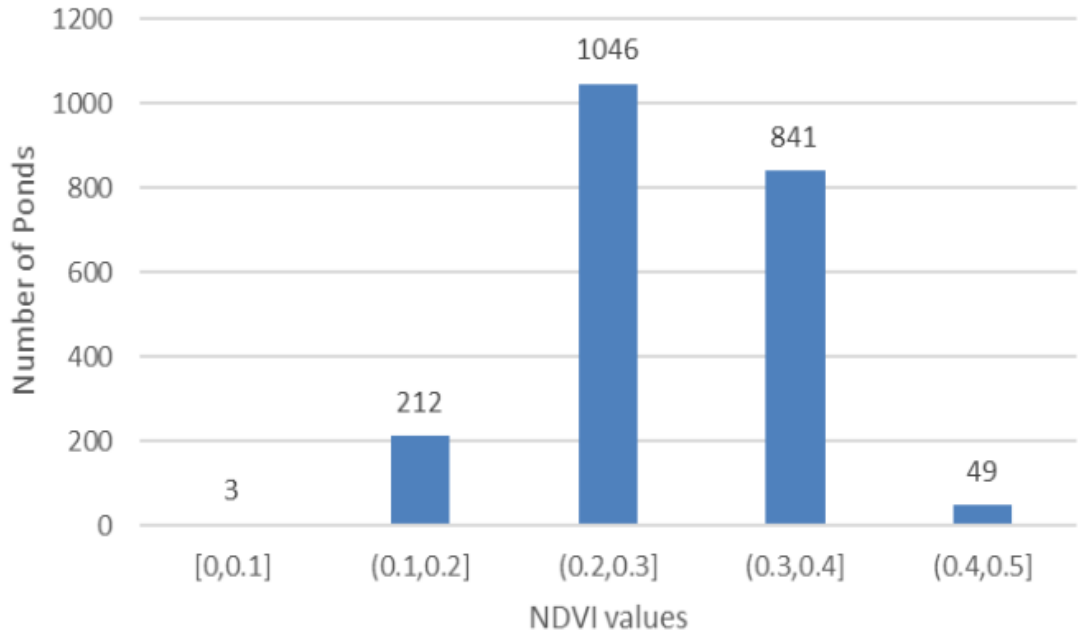
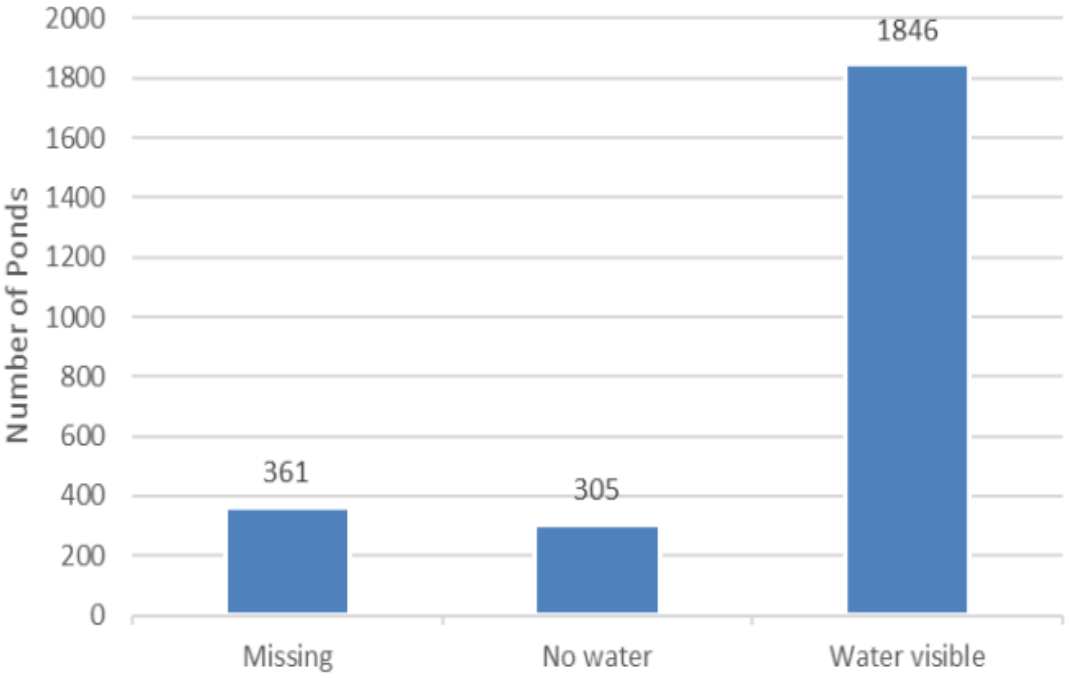


Figure 21: Water visibility in ponds



8. Ethics

As discussed above, ICL, a survey firm based in Blantyre, Malawi, conducted data collection for the project. With over 10 years of experience managing qualitative and quantitative data for organizations like the Government of Malawi, World Bank, and USAID, ICL trained all staff and surveyors in research ethics using the Collaborative Institutional Training Initiative Program. Additionally, 3ie investigators provided human subjects ethics training to ICL surveyors and obtained ethics approval from the Malawi National Council of Science and Technology's Institutional Review Board.

Our goals are to: (1) generate and disseminate high-quality, policy-relevant evidence about what works in aquaculture, for whom, how, why, and at what cost, and (2) strengthen the "culture of evidence" in Malawi by engaging key stakeholders—including policymakers, beneficiaries, and downstream partners—throughout the project, with representatives serving in an advisory role in the interpretation and use of high-quality evidence for making policy and programming decisions. In addition to ethics, we have and will adhere to high standards of quality assurance and research transparency.

9. Fieldwork challenges

Fieldwork faced significant logistical and accessibility barriers across the study areas. Poor road conditions and difficult terrain were common challenges in nearly all districts. Roads in remote and hilly areas were often impassable due to heavy rain, mud, or poor infrastructure. In several instances, vehicles got stuck, forcing teams to abandon them and cover long distances on foot to reach respondents.

Weather-related disruptions further compounded accessibility issues. Seasonal rains repeatedly hindered planned activities and limited access to certain areas, while in Thyolo, rains from Tropical Cyclone Jude that hit Malawi between March 10 and 12, 2025, made navigation especially difficult. These conditions caused delays, forced rescheduling of interviews, and in some cases, prevented access to respondents altogether.

Another recurring issue was the long distances and scattered populations in many districts. Households were widely spaced, which significantly reduced the number of interviews that could be completed in a day. In some areas, vehicle access points were far from households, requiring enumerators to walk long distances, especially in hilly terrain like Ntchisi and Dowa.

There were also notable verification and sampling challenges. In several cases, respondents listed in the sample did not own ponds, were using ponds belonging to others, or were registered under one EPA while residing in another. These issues complicated verification processes and affected sampling targets, particularly in Nkhotakota and Dowa.

Communication barriers further delayed coordination. Poor mobile network coverage in districts like Mzimba and Nkhotakota made it difficult to confirm appointments or stay in contact with local stakeholders, reducing efficiency in fieldwork operations.

10. Conclusion

Fieldwork was completed despite significant logistical and accessibility challenges across the study areas, which required repeated adjustments to field plans and schedules. Poor road conditions, difficult terrain, and weather-related disruptions were common in nearly all districts, with some areas becoming impassable due to heavy rain, mud, or poor infrastructure. These conditions caused delays, rescheduled interviews, and in some cases, prevented access to respondents altogether; yet, data collection was still successfully completed.

Overall, we find that our randomization process achieved balance across most baseline variables. Household characteristics such as household size, educational attainment of men and women, land ownership, and pond size are broadly comparable across the two experimental arms. Looking at our primary outcomes of interest—productivity, income, women's empowerment, and nutrition—we find only one weakly significant difference in forestry income, with treatment households reporting slightly higher sales. Agricultural productivity, aquaculture outcomes (including pond area and fish productivity), and key welfare indicators such as dietary diversity and food insecurity scores show no statistically significant differences between treatment and control groups. This overall balance suggests that our estimates of program impacts at endline will capture causal treatment effects, although sensitivity analyses remain important to account for the small differences observed in select outcomes.

A few key findings related to operating context of the project may be useful in informing project design and implementation.

- Food security and nutrition levels are low among fish farmers, presenting a critical opportunity for the project to make a difference by enhancing aquaculture productivity.
- Fish farming is primarily a subsistence production. With the exception of two districts, households mostly do not sell their harvest or do so within their village. Compared to agriculture, income from and expenditure on aquaculture is much lower. Farmers have limited knowledge of quality inputs such as fish seed and feed. This is a critical gap the project may target through training sessions. Shifting from subsistence to market-oriented production will require more targeted productivity and market development strategies. SMEs and cooperatives could be strengthened to facilitate value chain development and promote market access. The findings from the SME and community surveys are provided in Appendix A3.
- Related to the above, however, membership in cooperatives is low and with significant variations across districts. Community group membership is relatively higher and may provide a potential platform to reach out to farmers and integrate them with cooperatives.
- Knowledge and uptake of at least one IAAS practice—such as intercropping, integrating trees, or integrating livestock—is present. Full knowledge and application of all three practices remain less common, suggesting room for further strengthening IAAS knowledge and practice.
- Cultivated fish species vary by district. Local variations and conditions should be considered in deciding which fish species to promote.

- There is support for women's right to own, control, and benefit from aquaculture resources. However, agreement on women working outside the home or in market-oriented roles remains more limited. Thus, the project's gender integration component should focus particularly on addressing constraints around women's market participation.
- Certain enabling factors are worth highlighting: (1) ponds are generally accessible, moderately vegetated, and largely operational; and (2) most farmers are adopting at least one aquaculture and agriculture best practice. These factors may be leveraged to enhance project implementation and design.

Online Appendix

Online appendix A: IAAM ToC intermediate/final outcomes and measured indicators

https://3ieimpact.org/sites/default/files/2026-05/WP69-Integrating-Aquaculture-Agriculture-Malawi-Baseline-Report-Online-appendix-A.pdf

Online appendix B: Description of scores/variables used in report

https://3ieimpact.org/sites/default/files/2026-05/WP69-Integrating-Aquaculture-Agriculture-Malawi-Baseline-Report-Online-appendix-B.pdf

Online appendix C: SME and Community survey findings

https://3ieimpact.org/sites/default/files/2026-05/WP69-Integrating-Aquaculture-Agriculture-Malawi-Baseline-Report-Online-appendix-C.pdf

Online appendix D: Balance tests

https://3ieimpact.org/sites/default/files/2026-05/WP69-Integrating-Aquaculture-Agriculture-Malawi-Baseline-Report-Online-appendix-D.pdf

Online appendix E: Fixed effect regressions of main outcomes at baseline

https://3ieimpact.org/sites/default/files/2026-05/WP69-Integrating-Aquaculture-Agriculture-Malawi-Baseline-Report-Online-appendix-E.pdf

Online appendix F: Heterogeneous effects

https://3ieimpact.org/sites/default/files/2026-05/WP69-Integrating-Aquaculture-Agriculture-Malawi-Baseline-Report-Online-appendix-F.pdf

References

Bilinsky, P., and A. Swindale. 2010. “Months of Adequate Household Food Provisioning (MAHFP) for Measurement of Household Food Access: Indicator Guide (Version 4).” Washington, D.C.: FHI 360/FANTA.

Commercial Agriculture for Smallholders and Agribusiness (CASA) Programme. 2020. “Aquaculture value chain analysis in Malawi.” Lilongwe, Malawi: CASA.

Government of Malawi. 2022. “Malawi Annual Economic Report 2022.” Lilongwe, Malawi: Ministry of Finance and Economic Affairs.

IPC Global Support Unit. 2022. “Malawi IPC Chronic Food Insecurity Report – February 2022.” Lilongwe, Malawi: Government of Malawi, FAO, WFP, UNICEF, and FEWS NET.

One Acre Fund. 2023. “Annual Report 2023: Smallholder Farmers and Food Security in Africa.” Kakamega, Kenya: One Acre Fund.

Ragasa, C. 2018. “Agricultural Extension Reforms and impacts in Malawi: Insights from Implementation.” Washington, D.C.: International Food Policy Research Institute (IFPRI).

World Food Programme (WFP). 2023. “Malawi Country Strategic Plan (2023–2028): Building Resilience and Food Security.” Lilongwe, Malawi: World Food Programme.

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