END-TERM PROJECT EVALUATION REPORT

Piloting Inclusive Business and Entrepreneurial Models (IBEMs) for Small-Scale Fish Farmers and Pro-Poor Value Chain Actors in Malawi

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ACRONYMS AND ABBREVIATIONS

AQRT	Aquaculture Round Table
AVCP	Aquaculture Value Chain Project
CADECOM	Catholic Development Commission in Malawi
CASA	The Commercial Agriculture for Smallholders and Agribusiness
CGIAR	Consultative Group for International Agricultural Research
DFO	District Fisheries Officer
DoF	Department of Fisheries
FGDs	Focus Group Discussions
FISHCRP	CGIAR Research Program on Fish Agri-Food Systems
FOs	Feed Operators
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HO	Hatchery Operators
IBEMs	Inclusive Business and Entrepreneurial Models
IFFNT	Innovative Fish Farmers Network
JICA	Japan International Development Agency
KIIs	Key Informant Interviews
LUANAR	Lilongwe University of Agriculture and Natural Resources
MALDECO	Malawi Development Company
MEL	Monitoring, Evaluation and Learning
NAC	National Aquaculture Centre
OECD-DAC	Organization for Economic Cooperation and Development – Development Assistance Committee
PDAs	Personal Digital Assistants
SOs	Seed Operators
WF	WorldFish

EXECUTIVE SUMMARY

WorldFish is an international non-profit organization working in Africa, Asia, and the Pacific, and it develops and implements innovative ways of addressing poverty and hunger in a sustainable manner, with a focus on aquatic food systems. In seeking to contribute to building a food-secure future globally, WorldFish is the lead institution for the CGIAR Research Program on Fish Agri-Food Systems (FISHCRP). This end-of-project report is an evaluation of a project known as inclusive business and entrepreneurial models (IBEMs) in which WorldFish piloted inclusive business and entrepreneurial models for smallholder fish farmers and poor value chain actors from May 2019 to December 2022 across six (6) districts of southern Malawi, namely: Blantyre, Mulanje, Mwanza, Phalombe, Thyolo, and Zomba.

Part of sustaining small-scale fisheries includes enhancing inclusivity, resilience, and innovation within the food systems. This evaluation focused on the project's four (4) outputs viz.: i) Inclusive business and entrepreneurial models (IBEMs) established and functional to service local smallholder farmers, ii) Innovation platforms with private and public actors established and functional, iii) Innovative training materials, developed and used, regarding best management practices, business skills development, and entrepreneurship, and iv) Assessments performed evaluating the efficacy of the IBEMs, innovation platforms, and training materials and approaches. The evaluation employed a mixed-method design comprising qualitative and quantitative approaches using secondary data (project reports and publications), survey questionnaires, key informant interviews as well as focus group discussions for fish farmers, feed, and hatchery operators, and observations in the field. The Organization for Economic Cooperation and Development – Development Assistance Committee (OECD-DAC) evaluation tool was used to measure the impact of the project following six criteria.

Findings reflect that the project objectives were met reasonably well by fulfilling the targets of number of farmers involved in the project, establishing IBEMs and associated innovation platforms as well as capacity building through training on best management practices, business skills development, and entrepreneurship. An evaluation of these targets, processes and platforms indicate that the project was inclusive with a fair representation of women but marginal involvement of youths. Despite this, the youth are beginning to show interest in fish farming which presents an opportunity for further engagement in the future especially as there were no statistically significant differences in responses across gender, education, and income levels. Also, several impacts of the project were noted in the categories of access, training, production and productivity, income and profitability, inclusivity, and nutritional diversity.

The project improved access to fish feed and seed to farmers to a great extent (though women farmers seem to have less access as compared to men), and significant portions of project farmers (<80%) were trained and almost all (<98%) who were interviewed found the training beneficial. Resultantly, this increased the production and productivity of fish which was reflected in increased harvesting cycles, fish size, and quality. In turn, this translated to increased sales and therefore improved income and profitability as outputs of the project, while outcomes also entail improved nutritional diversity and increased consumption of fish by farmer households (to a small extent). Other project outcomes include an appreciation of fish farming as a commercial venture and piqued interest by partners such as the government of Malawi.

Despite the seeming success of the project, there is room for improvement as several challenges were noted, such as low fingerling stocking rates and low purchasing rates of feed by a substantial portion of the respondent farmers who cited lack of funds as the main challenge. So, although the project improved access, there are other underlying issues at hand that contributed to less uptake of both fish feed and seed. This presents an opportunity for addressing this gap in future engagements with the fish farmers. For the feed and seed operators (FOs and SOs, respectively), their story was more positive as they were well-represented gender-wise, received training, and felt well-capacitated in proffering the fish feed and hatchery operations beyond the project. This is despite mixed feelings about the sustainability of the FOs and HOs without the project's assistance by some project partners and farmers, particularly as the source of feed is external to Malawi. Both project partners and the FOs and HOs were appreciative of the training undertaken during the project and generally indicated that they would continue using the training and training materials.

The OECD-evaluation matrix reflected the following impacts of the project:

Relevance: Despite the challenges faced especially in accessing commercial feed, the project was relevant to the context of the access to feed and seed and training in aquaculture practice for small-scale fish farmers in the project districts and given the existing demand for both commercial feed and fingerlings. This is especially true for the youth who applauded the project but lamented that they were mostly left out of participating in the project as individuals.

Effectiveness: The project was effective in improving access to feed and fingerlings for farmers who reported having to travel long distances to buy these supplies before the project, as well as being able to train other farmers after having received training themselves. Women cooperatives indicated efficiency in that, before the project, they started the cycle with around 300-450 fingerlings but now they start the cycle with around 800-950 fingerlings. Fish consumption has also increased following the enhanced production levels. Additionally, the training received by project participants as well as the platforms used seemed effective.

Efficiency: Farmers reported a reduction in fish mortality owing to claims that seed is now available from nearby HOs whereas, before, the fingerlings would reach the destination in a frail state. In addition, where they used to fish feed once a day, the fish farmers have transitioned to feeding the fish twice a day due to increased access and availability. As well, there is a claim that fingerlings are now growing faster because of the production know-how as well as commercial feed. In this regard, the IBEMs intervention has been efficient in addressing the access and training gap as well as production deficiencies, among other benefits.

Visibility: Given that WF mainly engaged with IBEMs as opposed to the farmers themselves, the visibility of the project with the farmers appears to be quite an issue. When asked if they knew WorldFish and the project in engagements, some of the farmers expressed ignorance and would talk more about the IBEMs. WorldFish ranked the least on who the training provider was. 'Other' (which mostly was GIZ) was the most common project mentioned. From observations, it did not appear as if there were even any branded WorldFish training materials with any of the respondents.

Impact: The project's impact may be suppressed as highlighted by still low harvests, limited training, and expensive fish feed. However, reports indicate that HOs and SOs have now been empowered to enable farmers to begin to make meaningful contributions to their enterprises. For instance, before the project, they would exclusively feed fish with maize bran and soya in an *ad*

hoc manner. Now they use commercial feed and follow a timetable, leading to a discernible improved quality of harvested fish, which is claimed to taste better and is now bigger in size. Another notable impact of FOs and HOs is the provision of feed and fingerlings which was the main purpose for their involvement in the project. Feed sourced from several commercial feed-making companies in Zambia was made available to the farmers at reasonable prices, something which they (farmers) could not do on their own. Although the IBEMs project produced these impacts in the intervention areas, positive changes in livelihoods cannot be attributed to the project alone due to other interventions in the same areas.

Sustainability: IBEMs also agreed about the profitability of the aquaculture business in selling seed or feed (83.3%), confirming the prospects of the project's sustainability because these institutions will likely continue operating beyond the project's phase. The establishment of IBEMs is in-itself a mark of sustainability (hence a workable project design) as these would continue to provide aquaculture products namely seed, feed, and knowledge beyond the project. The IBEMs model is thus, effective, and sustainable. Since IBEMs had to meet certain criteria as a pre-condition to receiving the initial cost of investment such as feed, broodstock, and technical support, ideally, they should be able to continue providing these services on economies of scale under a business model. For instance, SOs should be able to sell fingerlings and make money within their clusters and educate farmers on how to transport, stock, and manage the fingerlings so that farmers can have good yields and become regular customers.

Recommendations: The inclusion of youth, the specific constraints facing youth in rural Malawi, and what might enable their greater involvement in fish farming, require much more focused attention. There needs to be greater consideration of class differentiation in rural Malawi, including amongst crop-fish farmers, as well as the diverse agrarian histories and pathways across the countryside. This would include understanding how the introduction of fish farming projects becomes embedded in pre-existing class-agrarian systems, to avoid these projects unwittingly reproducing or even heightening rural class differentiation. It appears also, that the project focused almost exclusively on the upstream parts of the value chain, specifically the inputs of seed, feed, training, and equipment, and little attention was paid to the downstream parts of the value chain, including value-adding activities and marketing of fish and fish products. It seems that most support was given to the IBEMs and not to the fish farmers themselves, including regarding training but also, as indicated earlier, with respect to the provision of credit which fish farmers claim is an absolute necessity. This means that, in terms of the value chain, the site or sphere of production (the fish farm) received less attention than the sphere of circulation (i.e., the market, and specifically the input market).

SECTION ONE: INTRODUCTION AND PROJECT BACKGROUND

WorldFish is an international, not-for-profit research organization that works to reduce hunger, malnutrition, and poverty by improving fisheries and aquaculture. With a 45-year track record of leading-edge science, WorldFish generates research evidence and innovations to inform sustainable practices and inclusive policies that enable better livelihoods and healthier diets for millions of poor people, particularly women, who depend on fish for food, nutrition, and income. WorldFish is a member of the One CGIAR, the world's largest global partnership on agriculture research and innovation for a food-secure future. Headquartered in Penang, Malaysia, and with regional offices across Africa, Asia, and the Pacific, WorldFish leads the Aquatic Foods Initiative of the One CGIAR and, before that, led the cross-disciplinary CGIAR Research Program (CRP) on Fish Agri-Food Systems (FISH).

This is an end-of-project evaluation report for the 'Piloting Inclusive Business and Entrepreneurial Models' (IBEMs) for smallholder fish farmers and poor value chain actors in Zambia and Malawi. The project was implemented from May 2019 to December 2022. Although WorldFish implemented the project in Zambia and Malawi, this report focuses solely on Malawi.

The IBEMs project is funded by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. This project intended to pilot and expand the use of inclusive business and entrepreneurship models as a mechanism for the FISH CRP to improve access by smallholder fish farmers to productivity-enhancing quality fish seed, fish feed, and innovative training, thereby delivering improved incomes, increasing women and youth involvement in aquaculture and, importantly, improving fish consumption for healthy and nutritious diets at scale. Working with 30 IBEMs in Malawi, the project aimed to reach approximately 1,000 farmers in Malawi with inputs, services, and training.

The project had the following four outputs:

- **Output 1**: Inclusive business and entrepreneurial models (IBEMs) established and functional for piloting to service local smallholder farmers
- **Output 2**: Innovation platforms with private and public actors established and functional
- **Output 3**: Innovative training materials on best management practices, business skills development, entrepreneurship
- **Output 4**: Assessments evaluating the efficacy of the IBEMs, innovation platforms, and training materials and approaches

Through interactions with regional networks and investors, results from the pilot project will be widely shared, contributing to widening knowledge and informing the scaling of aquaculture technologies within the sub-Saharan African region. The project facilitated progression along the FISH CRP impact pathway through the change mechanism of private sector investment and replication of innovative technologies.

The scale of capture fisheries in Malawi has shown a significant decline over recent years, while aquaculture is increasingly important. Available literature demonstrates that fisheries, including aquaculture (or fish farming), are an important dimension of livelihoods in rural Malawi, including for animal protein intake and nutrition (CASA 2020, Mwapata Institute 2022). Given the growing local consumer demand for fish and the fact that Malawi continues to import fish, developing and consolidating aquaculture on a productive and sustainable basis is critical (WorldFish 2020, 2021a). WorldFish and others have responded to the need by developing inclusive and innovative business models in small-scale fish value chains in Malawi (WorldFish 2021b, 2021c; Manyungwa et al. 2019).

Despite its presence in Malawi for many decades, pond-based aquaculture for small-scale farmers (on approximately 9,000 small-scale fish farms, which are either individually or collectively run), experiences significant challenges. Smallholder farmers experience challenges at the site of production (the fish farm) and challenges in accessing the input and output markets. Key challenges faced by fish farmers include irregular and minimal access to affordable, quality fish seed (fingerlings) and high-quality commercial fish feed, and lack of access to knowledge and information, along with climate variability, which leads to alternating droughts and floods and subsequent loss of fish and low productivity. Using quality inputs and access to relevant, up-to-date knowledge and information would increase the health of the fish stock and smallholder fish-farm productivity. There are also significant problems around the inclusion of women and youth in the aquaculture value chain (notably, in on-farm production), particularly considering gendered and other norms around access to land, information, and other resources. In addition, technical knowledge and equipment amongst smallholder aquaculture farmers have many shortcomings, and more can be done by stakeholders such as the government, the private sector, and research organizations to address these challenges effectively. Finally, private sector support, including financial, input, and marketing support, for the small-scale aquaculture sector in Malawi is also not forthcoming and integrated meaningfully into aquaculture value chains (Mwapata Institute 2022).

1.1 Project objectives, outcomes, and outputs

WorldFish's "Piloting inclusive business models in Malawi" project is deeply aware of these many challenges in planning and actioning the formation and development of inclusive business and entrepreneurial models (IBEMs) to service smallholder aquaculture farmers. The project sought to establish innovation platforms to promote greater linkages between private/public actors with local entrepreneurs (IBEMs) and smallholder farmers to improve training, access to services, and input and output markets. Once established, the innovation platform members were supposed to meet quarterly for regular knowledge sharing and learning and scaling their overall support in helping to develop the smallholder aquaculture sector. Additionally, the innovation platform aimed to bring private and public actors together to determine efficient and sustainable strategies to reach smallholder farmers through the IBEMs and thereby scale their investments. The IBEMs, involving profit-focused seed and feed operators, were designed to kick start and expand the use of inclusive business models as a mechanism to improve access by small-scale fish farmers to the tenets and practices of productivity; enhance the production and use of quality fish seed and fish feed; integrate innovative forms of training into the fish value chain; deliver improved incomes; maximize women and youth involvement in aquaculture; and importantly, improve fish consumption which meets the dietary needs of households.

In pursuing this, the pilot project planned to establish thirty (30) hatchery and feed operators in Malawi to reach approximately 1,000 fish farmers in six districts in the southern region – namely Zomba, Blantyre, Mwanza, Thyolo, Mulanje, and Phalombe (see Figure 1).

The project targeted developing the capacity of project staff and partners using on-the-job training approaches for enhanced delivery of project outputs and achievement of outcomes. The project also aimed to develop innovative training materials that IBEMs and smallholder farmers could use to enhance their business, technical, and management acumen. The project sought to train and provide constant mentoring and support to aquapreneurs to enable them to successfully establish their IBEMs, as well as make a return on their investments. At the same time, this would enable them to adequately target women and youth fish farmers and provide information and support to them and other farmers in their cluster areas to implement best management practices. Through all this, there would be an increased likelihood that fish farmers would adopt and use the seed and feed being made more accessible through the IBEMs and other private sector actors.

The IBEMs project by WorldFish is a crucial development intervention for small-scale fishers in Malawi, as it seeks to address a series of endemic problems embedded in the different nodes of the Malawian fishing value chain. In establishing inclusive fish-based business and entrepreneurial models, this project enabled small-scale fish farmers to become central and productive agents in the fish value chain – along with the commercially-focused seed and feed operators established under the project. The primary outcome envisaged is the emergence, development, and consolidation of pro-poor fish value chains in rural Malawi which meet the main needs of present small-scale fish farmers in a socially and economically sustainable manner, without compromising the ecological needs of future farmers. Consistent with WorldFish's global programs (Lawless et al. 2020; Cole et al. 2020), this entails specific interventions meant to address gender and youth imbalances and inequities in fish production and the fish value chain.

As indicated, the project had four (4) outputs for which it will be evaluated, which incorporate both the establishment of the IBEMs and their expected effects on smallholder fish farmers:

- **Output 1:** Inclusive business and entrepreneurial models (IBEMs) established and functional for piloting to service local smallholder farmers.
    - 30 local women, men, and youth aquaculture entrepreneurs adopting and setting up functional and financially viable inclusive business and entrepreneurial models.

- **Output 2:** Innovation platforms with private and public actors established and functional.
    - 1,000 women, men, and youth fish farmers adopting/utilizing better quality seed and feed and best management practices.

- **Output 3:** Innovative training materials on best management practices, business skills development, and entrepreneurship.
    - 1,000 smallholder households have adopted technologies developed by international agricultural research centres.

- **Output 4:** Assessments evaluating the efficacy of the IBEMs, innovation platforms, and training materials and approaches.

1.2 Purpose of the evaluation

The purpose of this work was to conduct an end-term evaluation of the IBEMs project and provide a concise assessment of the project's achievements against project objectives, outcomes, outputs and impacts. The evaluation included an:

- Assessment of the project's performance in terms of outcomes and impact generated and based on outcomes.
- Identification of the enablers and/or constraints to the attainment of the envisaged results and impacts.
- Generation of lessons learned and recommendations for future interventions.

The evaluation also considered the gender and youth dimensions of the project in relation to the successful initiation of pro-poor inclusive business models.

1.3 Project areas

1.3.1 Mulanje

Mulanje is a district that covers an area of 2,056 sq. km and has a population of 428,322. The district is well known for its tea-growing farms, and Mount Mulanje is one of the highest peaks in Southern Africa and a source for most rivers. Its location is probably one of the districts in Malawi with a high potential for aquaculture despite a shortage of land due to huge coverage by tea estates. Mulanje district borders Mozambique and has an agro-based economy, with the main cash crop being tea grown in industrial-sized farms. The main food crops grown in Mulanje are maize, groundnuts, beans, soya beans, pigeon peas, and other pulses. Mulanje has seasonal temperatures and weather, enabling the growing of horticultural crops like pineapples and bananas exported to other districts in the country

1.3.2 Phalombe

Phalombe district covers an area of 1,394 sq. km and has a population of 231,990. The district has an international border with Mozambique in the east and the south and shares the massive Mulanje Mountain range with the Mulanje district. Phalombe has an agrarian community, with the main cash crop grown being tobacco. Food crops grown include maize, beans, groundnuts, and pigeon peas. Other pulses are also produced.

1.3.3 Thyolo

Thyolo district, which borders Mulanje, is generally a mountainous district with an area of 1,715 sq. km and a population of 458,976. Thyolo has an agro-based economy, with the main cash crop being tea grown on commercial farms. The main food crops grown in Thyolo are maize, groundnuts, beans, soya beans, pigeon peas, and other pulses. Aquaculture is also flourishing due to perennial rivers and streams from the highlands. Thyolo has seasonal temperatures and weather enabling the growing of horticultural crops like pineapples and bananas exported to other districts in the country.

Figure 1: Map of Malawi showing the southern Malawi region (pink) where the six districts lie

1.3.4 Blantyre

Blantyre district is a commercial city in Malawi where most Malawian industrial and business offices exist. The district covers an area of 2,012 sq. km and has a population of 809,397. Blantyre rural is agrarian, with the main cash crop being tobacco, and, and the food crops grown are maize, beans, groundnuts, soya beans, and pigeon peas.

1.3.5 Zomba

Zomba district borders six districts including Blantyre, Mulanje, and Phalombe districts where the IBEMs project was implemented. The district has a total land area of 2,363 sq. km and a population of 746,724. The main agricultural activities of the district are farming tobacco and cotton cash crops, while the main food crops grown are maize, rice, beans, and other pulses. Aquaculture is active in the districts due to perennial streams and rivers from the big Zomba mountain.

1.3.6 Mwanza

Mwanza is a district with an area of 2,259 sq. km and a population of 138,015, and it borders Mozambique. The district's agricultural economy depends on the farming of cash crops of tobacco and cotton, while maize, groundnuts, beans, soya beans, and other pulses are grown for food. Mwanza is also known for its small-scale farms of citrus fruits like tangerines and oranges which are sold throughout the country.

SECTION TWO: METHODOLOGY AND APPROACH

This section details the methodological approach used to conduct the end-term evaluation, including the evaluation process.

2.1.The process

The approach to the assignment was divided into four phases, as illustrated in Figure 2.

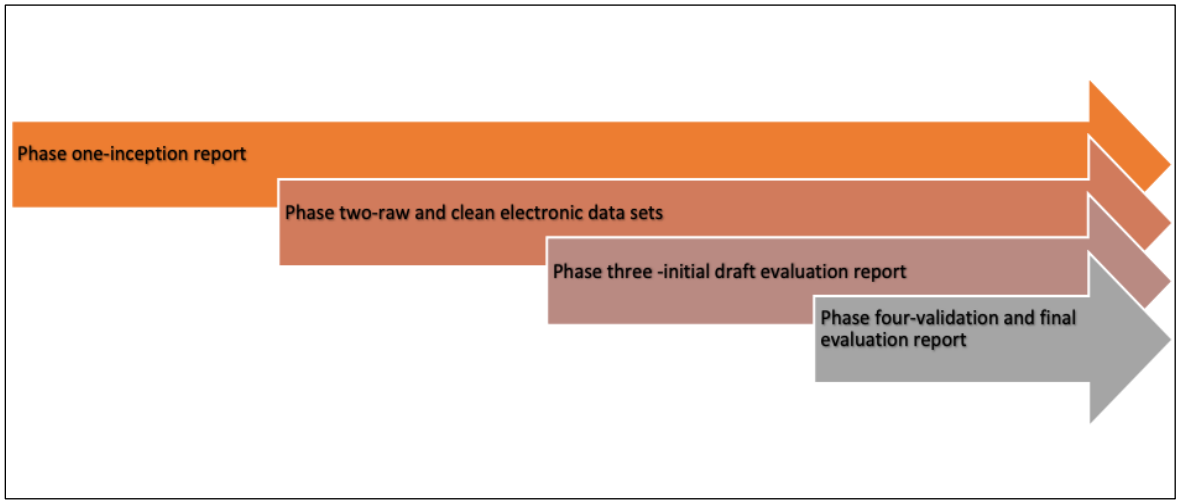

Figure 2: A summary of the evaluation process

In phase one, the consultancy team developed an inception report in close contact with the client. The inception report provided:

- details regarding the methods to accomplish the assignment deliverables
- a preliminary literature review of project documents and reports available from WorldFish and project implementation partners, and
- highlighted the proposed timelines and overall work plan for the task.

Once approval for the proposed methodology and tools was granted, the team incorporated comments and moved to the next phase. In phase two, the evaluation team collected and cleaned data and submitted the raw and clean data sets to WorldFish. In phase three, the team systematically analyzed the data and produced this end-term evaluation report. The report provides details regarding lessons learned and practical recommendations for WorldFish, the donor, and project stakeholders that may help inform the design and implementation of similar future projects (with defined sustainability pathways) and activities in the future.

2.2 Research design

The evaluation employed a mixed-method design comprising qualitative and quantitative approaches. Primary quantitative and qualitative data were collected using survey questionnaires as well as Focus Group Discussions (FGDs) for fish farmers, feed operators (FOs), and hatchery operators (HOs). In addition, Key Informant Interviews (KIIs) with WorldFish staff, their partners,

government officials, and extension staff were conducted. Furthermore, the study used field notes based on pertinent observations, which ran as a crosscutting activity throughout the fieldwork (see Table 1).

Table 1: Data collection techniques for the evaluation

Type of data	Methods	Source of data
Quantitative	Fish farmer questionnaire survey	Project fish farmers in the 6 districts of Zomba, Blantyre, Mwanza, Thyolo, Mulanje and Phalombe.
	FO and HO surveys	Project feed and hatchery operators.
Qualitative	Key Informant Interviews	WorldFish staff and partners (mainly Dept. of Fisheries technical staff), and key stakeholders who contributed to project implementation, including those in the innovation platform.
	Focus Group Discussions	Project fish farmers disaggregated by sex and age.
	Observations	Cross cutting and as part of all the field work activities.
Quantitative & Qualitative	Primary documents and grey literature	WorldFish and other organisations involved in research on aquaculture in Malawi including sourcing documents from the internet.

2.2.1 Secondary data collection

The research team did a systematic search for secondary (scholarly) literature pertinent to this evaluation and has drawn upon and cited some of this literature where relevant. In the main, this literature focuses on aquaculture value chains in Malawi and beyond, including with specific reference to gender inequities.

2.2.2 Primary data collection

Respondent targeted data collection tools were developed during inception. The tool development process also considered project outputs. Farmer and IBEMS surveys were quantitative while focus groups, interviews and observations were part of the qualitative research approach employed. Primary documents and grey literature incorporated both quantitative and qualitative research. The specific methods for data collection are categorized and detailed in the following sub-sections.

2.2.2.1 Primary documents and grey literature

Primary documents and grey literature were used to validate perceptions from respondents and to evaluate project outputs and outcomes. These include documents provided by WorldFish with regard to meetings organised and activities pursued by WorldFish, such as innovation platform meetings and IBEM training programmes. They also include grey literature about aquaculture in

Malawi published by other organisations and institutes (for instance, Mwapata Institute). These documents were drawn upon continuously from the inception report to the final write-up, and the data contained within them served to complement other primary data and validate the results.

2.2.2.2 Farmer Survey

In Malawi, the project piloted thirty (30) feed and hatchery operators to reach close to 1,000 fish farmers with feed, seed, and training in six (6) districts in the southern region of Malawi, namely Zomba, Blantyre, Mwanza, Thyolo, Mulanje and Phalombe. The consultants randomly interviewed 285 fish farmers across the six districts (see Annex 1 for the survey instrument). The population of the fish farmers, as provided by the client, is 1,113 fish farmers (34% women, 66% men), from which farmers were sampled for the survey (see Table 2). The numbers of farmers for each of the six districts are as follows: Blantyre, 239; Mulanje, 270; Mwanza, 73; Phalombe, 98; Thyolo, 191; and Zomba, 242 (see Table 2). As a statistical rule of thumb, the idea was to sample at least 30% of the fish farmers from each district, translating to 71, 81, 22, 29, 57, and 72 farmers for Blantyre, Mulanje, Mwanza, Phalombe, Thyolo, and Zomba districts, respectively. However, due to logistical and other practical realities in the field, the sample target was not reached in two out of the six districts (Blantyre and Mwanza). These logistical challenges include difficulties in locating IBEMs and, in turn, the unavailability of farmers who were in their fields during this period. However, the total number of farmers surveyed satisfied the sampling threshold (see Table 2 for statistics on the final sample). The evaluation used Personal Digital Assistants (PDAs) to collect data during the survey through the Kobo collect tool. This method was used to collect data on impacts generated and, in line with the identified impact and evaluation criteria, enablers and constraints to the attainment of these impacts as well as recommendations to improve outcomes in future projects.

2.2.2.3 IBEMS survey

A questionnaire survey was conducted with 13 Hatchery operators (HOs) who are also fish farmers themselves and 6 Field Officers (FOs) who could be reached. The plan was to interview at least one HO and one FO in each district but, ultimately, the exact number of interviews depended on the availability of the respondents in the respective districts at the time of the fieldwork (see Table 2). Specific data needs for this method were around impacts, enablers, and constraints, as well as the overall experiences of the FOs and HOs for the duration of the project. Two different interview guides were used, one for FOs and another for HOs. These guides differed because of the specific roles played by FOs and HOs in the aquaculture value chain. Though both provided inputs, they were involved in different activities and faced different challenges. For instance, questions for FOs mostly hinged on issues to do with feed and, for the HOs, issues were around equipment and fingerlings, among others.

Table 2: Sampling statistics across the six districts under study

Research technique (and population)	District	Female	Male	Youth	Total	Sample (%)
Farmer survey (1,113)	Blantyre	8	11		19	
	Mulanje	30	50		80	
	Mwanza	10	9		19	
	Phalombe	19	16		35	
	Thyolo	27	28		55	
	Zomba	35	42		77	
	Total	**129**	**156**		**285**	**31%**
HO Survey (18)	Blantyre	1	1		2	
	Mulanje	1	2		3	
	Mwanza	1	1		2	
	Phalombe	0	1		1	
	Thyolo	0	2		2	
	Zomba	2	1		3	
	Total	**5**	**8**		**13**	**72%**
FO Survey (12)	Blantyre	0	1		1	
	Mulanje	1	1		2	
	Mwanza	1	1		2	
	Phalombe	0	1		1	
	Total	**2**	**4**		**6**	**50%**
KII (26)	**Total**	**8**	**13**		**21**	**81%**
FGD (18)	**Total**	**6**	**3**	**2**	**11**	**61%**

The **qualitative research** methods involved focus group discussions, key informant interviews, and observations.

2.2.2.4 Focus group discussions

FGDs targeted fish farmers from the project, and the idea was to run three FGDs per district for men, women, and youths. In the end, the number of FGDs run per district was quite variable due to availability issues on the ground during the fieldwork (as indicated earlier), such that 11 FDGs were conducted. The exact number of people in each group ranged from 8 to 14. Specific data needs for this method were around impacts, enablers, constraints, and lessons that can be drawn from project implementation. The discussion issues hinged on the impact criteria identified for the evaluation. The FGD guide was categorized into five sections (A-E), each focusing on an impact criterion. This guide was designed to indicate the direction for each section around a specific issue instead of asking a list of direct questions in a way similar to an interview to allow for deeper insights into the impact criteria. Plate 2-1 shows an FGD of women (top) and men (bottom) in Phalombe. Annex 2 provides the focus group discussion guide.

Plate 2-1: FGDs with women (top) and men (bottom) in Mulanje and Phalombe (November 2022). **Source: Authors**

2.2.2.5 Key informant and stakeholder interviews

KIIs targeted individuals who could provide in-depth knowledge on the issues under discussion because of their expertise and/or experience, including in direct relation to involvement in the project. Interviews were held using a checklist with selected direct and indirect stakeholders involved in the project. Out of the targeted 26 key informants, 21 were interviewed (see Table 2), among the WorldFish staff, the Department of Fisheries, especially the District Fisheries Officers (DFOs) and Fisheries Extension officers in the target districts, private sector stakeholders, and other NGO staff for example staff from the GIZ AVCP Project. Annex 3 provides the key informant interview checklist, and Annex 5 provides a list of the key informants interviewed. Data

were solicited on lessons and recommendations from the project to improve future interventions and impacts.

2.2.2.6 Observations

Information collected from the focus group discussions and key informant interviews was cross-checked for consistency and accuracy (using questions to check the consistency of the respondent), asking the same questions to different interviewee groups (beneficiaries and key informants or their combinations) and through observations. Participant observation data collection was carried out largely by the three social and economic researchers involved in the fieldwork. Throughout their time in the field, direct participant observation was used to collect detailed information on livelihoods and the factors that influence the livelihoods of the fish farmers.

The team also collected information on culture, traditions and community structures, through informal conversations with the local men, women, and youths and observations of everyday life. The data collectors used a checklist of topics to be investigated in this way, drawn, and adapted from the key informant checklist and the FGD guide. Using the checklist and observations enabled the solicitation of information on how households shaped their livelihood strategies and what motivated them to join the WorldFish project. Information collected was recorded in a daily observational guide, and visual photographic methods were employed by taking photos of the participants, their fields, fishponds, cropping patterns, and their surroundings. This method helped in understanding how the livelihoods of the communities were organized on a day-to-day basis and enhanced by the fish farming project that they joined. The following visual images depict the daily livelihood activities in the fishing communities. Digital cameras were also used for capturing empirical evidence through photographs (Plates 2-2 to 2-3).

Plate 2-2: A yam field intercropped with maize in Thyolo (top) and a fishpond surrounded by a banana field in Mulanje (bottom), November 2022. Source: Authors

Plate 2-3: Blue water pipe transmitting water from the fishpond into a maize field in Mulanje (top) and a group of female fish farmers, Phalombe (bottom), November 2022. Source: Authors

2.2.3 Data analysis

This section summarizes the data analysis of the data collected during the fieldwork. Descriptive statistics were generated and used to present frequency tables with summaries of demographic data. Additionally, emerging themes were summarized using content analysis from transcribed interviews, triangulated by observations to establish patterns and to draw conclusions. Where the data satisfied assumptions for parametric tests, some inferential statistics (Pearson's correlation coefficient) were conducted to infer similarities and differences in responses between gender and different age groups as well as among districts. This analysis was made possible because the data for closed sections of the survey questionnaires were coded. Inferring these differences was important in determining the inclusivity of the project. For project impact assessment, the Organization for Economic Cooperation and Development – Development Assistance Committee (OECD-DAC) based evaluation matrix (see Annex 4) was used to guide the evaluation. The OECD-DAC evaluation criteria matrix is a robust tool used in assessing the extent to which a project achieves its set objectives. The OECD-DAC criteria check to ensure relevance, coherence, effectiveness, efficiency, impact, and sustainability in the project implementation. The following six (6) evaluation criteria were developed in consultation with the client: access, training, production or productivity, income and profitability, nutrition and dietary diversity, and gender and inclusion. Both the quantitative and qualitative data were used to complement the evaluation.

SECTION THREE: EVALUATION FINDINGS

The evaluation findings have been discussed in the context of the project outputs, and impacts (using a combination of the impact criteria-access, training, production, productivity, income and profitability, gender and inclusion, and nutritional diversity) that were agreed upon with the client, as well as the evaluation matrix criteria (relevance, effectiveness, efficiency, impact, visibility, and sustainability) of the OECD-DAC tool. We summarize the findings according to the project outputs to evaluate the project implementation.

3.1 Demographic characteristics in the context of inclusivity

The project sought to proffer inclusive innovation platforms where women, men, and youth would actively engage. Although the majority of the farmers in the project were males (55%), a reasonably significant percentage (45%) of women (Figure 3) were included in the project, which is commendable. It appears that women's participation was an issue right from the beginning, in which case cooperatives had to be engaged instead (details are provided in later sections). The project engaged a significant portion of adults between 36 and 40 years of age, while the involvement of youths from 16 to 35 was marginal (Figure 3).

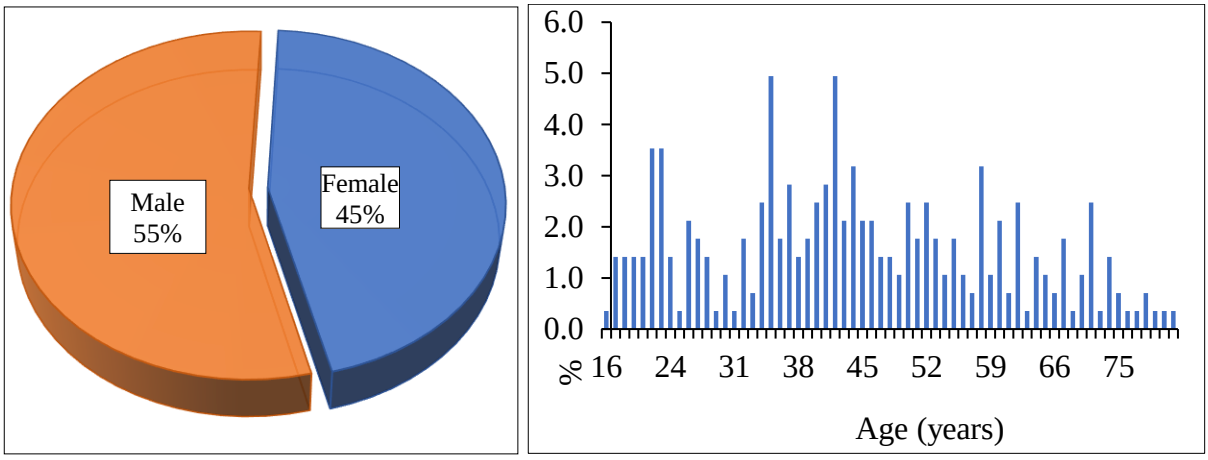

Figure 3: Gender (left) and age (right) representation of respondents and sampled population

There is a general lack of participation of youth in fish farming ventures and associated activities. In one FGD in Thyolo, the youth group confessed that they did not know much in terms of the fish farming business and processes, with one youth having inherited the venture from his grandfather. Findings indicate that 38 (16%) youths aged between 16 and 35 owned ponds. However, many respondents indicated that the youth are beginning to show interest in fish farming. A youthful population presents an opportunity for engaging youths in fish farming and the possibility of projected accelerated aquaculture growth in the future of the country.

Basic education levels (incorporating both primary and secondary levels) are high at 93% (Figure 4), implying the ability to read, write, and comprehend concepts. But there are still significantly lower education levels for females than for males, particularly at secondary and tertiary (post-secondary school) levels. There is a small minority (5%) who do not possess any education qualification, indicating that they may be illiterate. The lack of literacy among certain categories

of fish farmers is an important point of consideration for future interventions in reaching this group since most of the training materials and flyers are in written form.

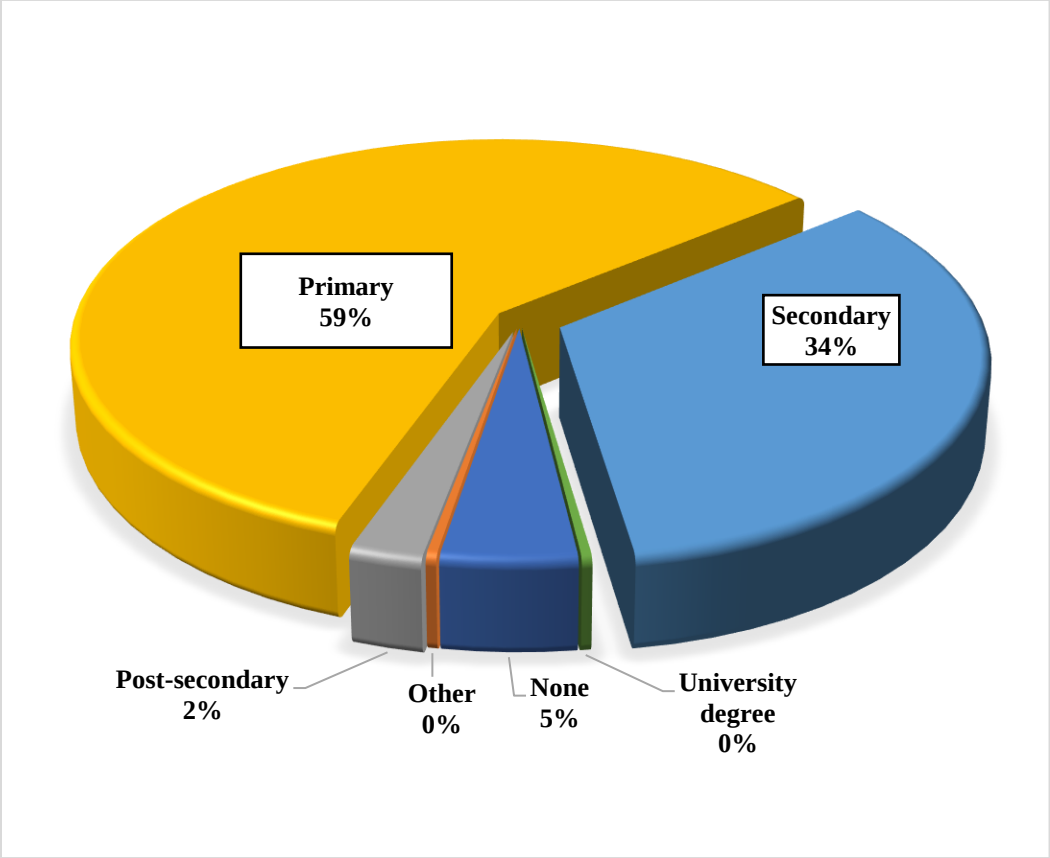

Figure 4: Level of education of the respondents

3.2 Output 1: Inclusive business and entrepreneurial models (IBEMs) established and functional for piloting to service local smallholder farmers

This section highlights the targeted activities under the project's output one and the achievements within the same output. The achievements under this output concern hatchery and feed operators, and the training and mentorship they were provided. Some of the activities targeted by the project under output one include identifying local entrepreneurial individuals (IBEMs) based on clear and focused selection criteria, such as willingness to invest in smallholder aquaculture, good sites with perennial water sources and interest in the fingerlings business and being located near a critical mass of fish farmers (for hatchery operators). Proximity to a critical mass of fish farmers and willingness to invest in smallholder aquaculture were significant factors in selecting feed operators. The project identified and established 32 IBEMs (18 specialised in seed/fingerling production, and 14 in selling and distribution of fish feed). This number exceeds the project target of setting up 30 IBEMs in Malawi. Of these IBEMs, 11 are led by women entrepreneurs, 19 by men and 2 are cooperatives reflecting a well-represented spread across gender.

The project set out to provide knowledge and skills for the identified and selected IBEMs on Better Management Practices for Aquaculture as well as Business Management. This model required that

these IBEMs reach out and train 42 farmers each in these areas. The plan was twofold; to create business opportunities for the IBEMs through selling quality feed and seed to farmers, as well as enhance farmer access to inputs, extension support, and markets closer to their ventures. In this process, the project partners were able to identify IBEMs comprising up to 50% of women and youth. Furthermore, the project fulfilled its target of setting up the IBEMs with aquapreneurs in 6 focal districts in southern Malawi and providing bi-monthly training and constant mentoring and support. The issue of partnerships was also critical as one of the activities, which centred on working with private and public actors to develop quality broodstock available for sale to local aquapreneurs (hatcheries) as well as pro-poor feed products and feed distribution channels through the IBEMs (aquapreneurs).

The target to be inclusive by having men and women represented as IBEMS was fairly met. There was a demand for the project and oversubscription through the registration of more IBEMs than was initially planned. Gender and Social Inclusion (GESI) was considered and contributed to the expansion of the list of selected IBEMs. It emerged that traditionally, females were generally less willing to take on projects and therefore female IBEMs were not easily identified. In this regard, there was flexibility on the part of the project, enough to allow for the incorporation of women's cooperatives into the project. This flexibility to adapt to realities on the ground by the project team through, first, expanding on IBEMs based on need and, second, resorting to cooperatives in order to include as many women as possible, highlights adaptive management as an important aspect of the project implementation. Each IBEM was given a target of training 42 farmers in order to train 1,000 (30% women) farmers by the end of the project. In the end, this evaluation reveals that the IBEMs are functional and have since trained 1,046 (60% women) smallholder farmers thereby meeting the target of 30% farmer trainees being women.

3.2.1. Fish feed operators

The 14 feed IBEMs received mentoring and coaching sessions which included the development of business plans, record keeping, marketing, stock management, basic financial accounting, and financial management to help them learn how to manage their businesses efficiently. In addition, WorldFish provided start-up commercial feed to the feed operators for the first and second business cycles through a “co-financing model” in which the feed IBEMs paid 30% of the cost of feed while the balance (70%) was covered by the project. This constituted a de-risking mechanism, and not a subsidy, as farmers would need to bear the full cost of feed by not selling to fish farmers at a reduced price. Thus, because WorldFish was not subsidizing the feed cost but de-risking the enterprises, all feed was sold at full cost. This arrangement was expected to facilitate a sense of commitment amongst the feed IBEMs to supplying fish farmers within local communities and, importantly, enable the feed IBEMs to establish strong businesses that would be sustainable beyond the project.

In two batches in 2021 and 2022, the project provided 35,2 tonnes of commercial feed valued at USD 31,766. The IBEMs sold 100% of the first batch of feed distributed. The feed was sold at market prices earning revenue of MWK 16,008,000 (USD 19,251). However, most (52%) of the smallholder farmers said that commercial feed was very expensive and or they could not afford it. At baseline, 78% of farmers had difficulties accessing the commercial feed. The farmers imported commercial feed from Zambia hence it was very expensive, coupled with high transport costs. This prompted the project to set up feed IBEMs to address the problem of commercial feed

availability. This evaluation established that despite the inroads made regarding accessibility of feed by smallholder farmers, the problem of commercial feed is still persistent as a majority of the farmers emphasized that commercial feed was not affordable.

The smallholder farmers emphasized that commercial feed was expensive: *"Commercial feed is very expensive, and we do not have the money to buy this good quality feed. Sometimes, we end up using home-made fish feed, and the fish have stunted growth*".

The provision of stock to feed operators in the project was well-planned and done in two batches. The first batch was intended to assess if the plan was working well and to evaluate the performance of the operators in the enterprise. Access to feed was made easy in this endeavour as feed operators were asked to pay only 30% of the total market price of the feed while the rest was paid by the project. These operators would then sell the feed to their network of farmers at the full market price. Fish feed began to be delivered in September 2021, with a second batch delivered in November 2021. In November 2021, feed IBEMs were supplied with 17.5 tonnes of fish feed worth MWK 13,780,800 (USD 17,215.3/ EURO14,508). The**se** IBEMs sold 100% of this first batch of feed distributed. The feed was sold at market prices earning revenue of MWK 16,008,000 (USD 19,251.34/ EURO 17,387.25). IBEMs sold feed at an average market price of MWK 22,000.00 (USD 27.42) per bag in all districts except Blantyre (where bags were sold for MKW 26,000). In November 2022, IBEMs were supplied with an additional 15 tonnes worth EURO 14,551.80. Within a month, they had sold half of the feed at MWK 32,000.00 (EURO 30.20) and the grower at MWK 30,000 (EURO 28.30).

The idea was to enhance access as well as the sustainability of the feed operators by ensuring that farmers would still be able to buy the feed at the full price even after the project ended. This initiative was crucial from the beginning in creating a market base for these feed operators. The market grew significantly as the feed IBEMs were not only selling feed directly to farmers but also to NGOs such as GIZ, Aquaculture Enterprise, Aqualink, CADECOM, and Chambo. The objective of improving access to feed for farmers was clearly achieved. An additional motivation for the feed operators, in terms of maximising sales, was that further batches of feed were provided based on performance after the first disbursement.

3.2.2. Hatchery operators/ Seed IBEMs

The 18 seed IBEMs (hatchery operators) established were designed to provide a sustainable source of high-quality fingerlings to smallholder farmers. The project trained hatchery operators on the production of mono-sex fingerlings, development of business plans, and record management, and provided feed starter packs and equipment such as hapas, which helped them set up good hatcheries. In addition, the project provided 2,918 broodstock/parent fish to hatchery operators with each hatchery operator receiving an average of 160 broodstock on a ratio of 1 male to 3 females. With support from the project, broodstock was screened for fish diseases prior to distribution in various farms (IBEMs) to ensure that it was free from diseases such as tilapia lake virus (TLV) and *epizootic ulcerative syndrome* (EUS). These interventions strengthened the capacity of hatchery operators to produce high-quality fingerlings and provide quality extension service to their clients, the smallholder farmers to a large extent. Thus, the project intervention enhanced the chances of improved yields for these operators and their network of farmers

(WorldFish 2021i, 2021j). The seed IBEMs themselves produced additional broodstock totalling 35,660, which is critical to their sustainability. Notably, at the time of the evaluation, the hatchery operators had produced 1,367,300 fingerlings. Indeed, this provides an indication that the seed IBEMs provided a good pathway to addressing the problem of access to good-quality fingerlings, which has affected the smallholder farmers in Malawi for a long time.

Also notable is the training of five operators on the new technology of production of mono-sex fingerlings, which the project introduced. The technology was introduced to ease planning and facilitate tracking of the growth of stock by farmers. Indications from the evaluation are that the operators obtained a very good yield of 70,240 mono-sex fingerlings, worth EURO 3,300, and that these earnings assisted with many other activities that needed to be funded on their farms. IBEMs used all fingerlings they did not sell on their own farms. By the time the project came to an end, all the seed operators combined had produced 1,367,300 mixed sex fingerlings (see Table 3) and those which were sold totalled 49,720 EURO in price.

Table 3: A summary of the total numbers of fingerling produced and sold

Time	Total number of fingerlings produced	Total number of fingerlings sold
October 2021 to January 2022	80,776	
February to April	353,403	66,964
April to October 2022	460,398	165,581
October 2022 to December 2022	472,623	217,455
Total	**1,367,300**	**450,000**

Source: WF statistics

By setting up the hatchery operators, the project enhanced access to quality fingerlings to farmers. At baseline in 2020, access to quality fingerlings was low at 36%, but the evaluation further revealed that 86% of the farmers who said that they did not have problems with accessing fingerlings were recycling their own fingerlings from their farms. This means that only 14% had access to quality fingerlings at baseline. Respondents in the farmer survey highlighted that more farmers (73%) are now accessing fingerlings. The farmers in all the districts repeatedly pointed out that, "*creating credible fish farming enterprises is being hampered by lack of quality fingerlings, leading to stunted growth*". Therefore, the project was successful in improving access to quality seed for farmers.

3.2.3. Overall project impact for Output 1

The evaluation findings show that the established seed and feed IBEMs provide a reliable source of fingerlings and feed. This has resulted in improved yields for smallholder farmers. Most of the farmers harvested around 20kgs per pond in the first production cycle. Findings also indicate relatively low fish harvests in the first growing cycle. Production did not seem to improve significantly during the second production cycle, and averaged production figures in the third production show some improvement with a significant difference between this and the first production cycle – from 0.05kg to 0.1kg and eventually 0.15 kg per square meter per pond (Figure 5).

Mean fish yield (kgs per m^2) was computed for the last 3 harvests and results are presented in Figure 5.

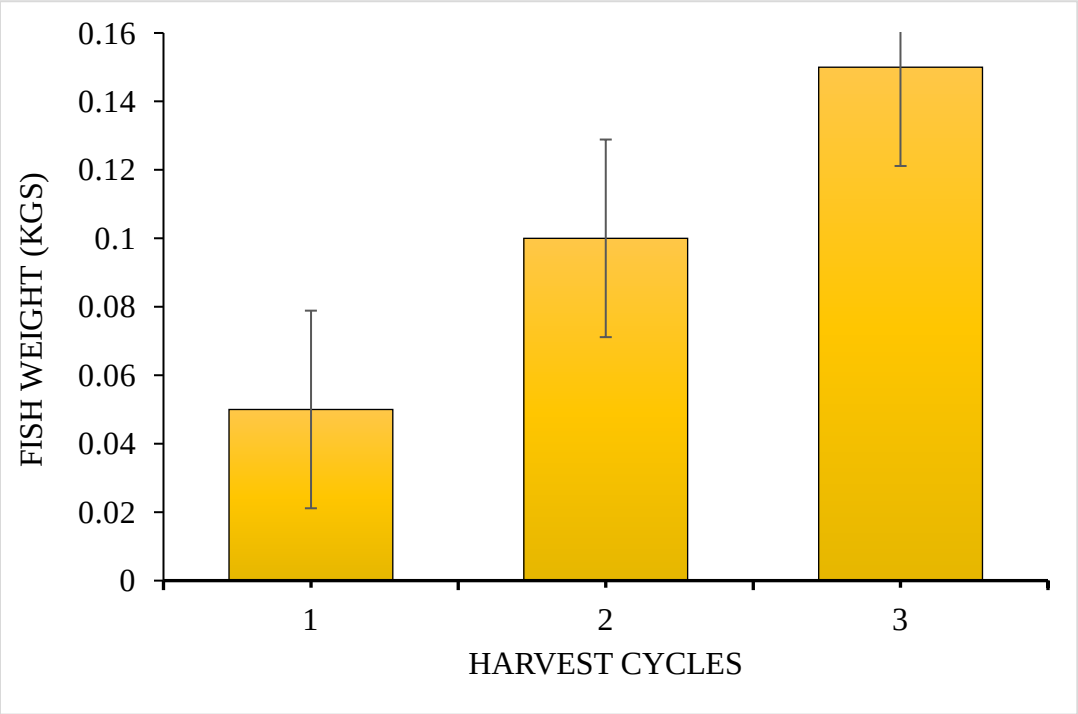

Figure 5: Average harvest (kg m^2) per pond over the three production cycles

Farm productivity is however still affected by some bad practices such as partial harvest. The evaluation findings (see Figure 6) show that 50.5% of the smallholder farmers compared to 66% at baseline were doing partial harvest. Farmers who do partial harvest tend to have a longer production cycle making it more expensive to grow fish because they spend a lot of time feeding the same fish beyond the normal six-month production cycle.

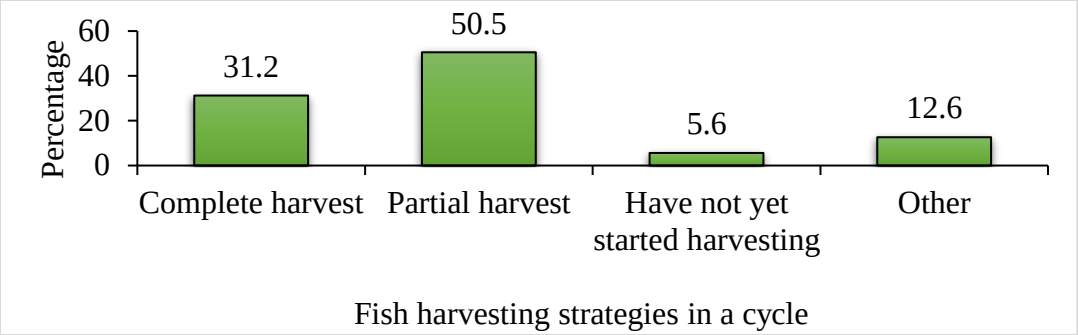

Figure 6: Fish harvesting strategies in one cycle

This relates to the primary reason for engaging in aquaculture as indicated at baseline: the majority (63%) practiced fish farming to earn income and for consumption, 19% for consumption only, 14% for income only and 2% for social status (just to have a fishpond at home). However, as the farmers learn about commercializing aquaculture, many have embraced complete harvest after the growing cycle for selling purposes.

The project impacted nutrition and dietary diversity positively. At baseline, 31% of farmers ate fish once a month while, currently, 43% of the same farmers eat fish once a month, suggesting an increase in farmers eating fish. Presently, there are fewer farmers (n=36) who consume fish frequently, that is, once a week compared to those who consume fish once a month (n=124) and only during harvest (n= 125). Essentially, only 13% of the interviewed farmers are able to eat fish on a weekly basis while – as indicated – nearly half (43%) eat fish once a month (Figures 7R and L show the changes in the amount of fish and the frequency of fish consumption disaggregated by gender). The frequency of fish consumption is not statistically different between men and women across all districts.

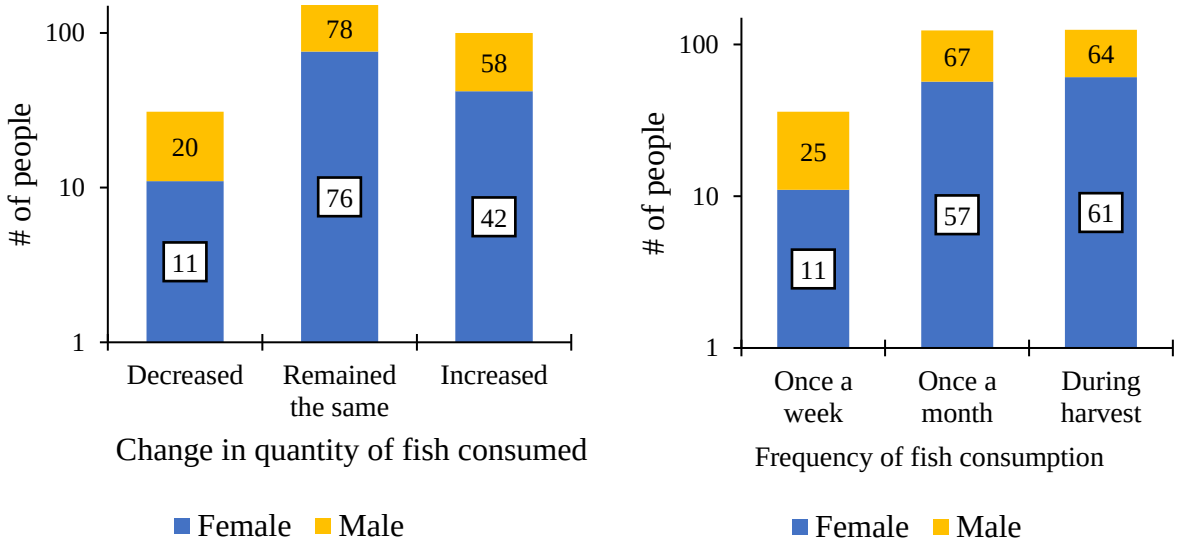

Figure 7: Changes in the quantity of fish consumed (L) and frequency of fish consumption (R) disaggregated by gender

While there is a general upward trend of fish consumption as indicated by a significant percentage of farmers (above 35%), more than half of the farmers' fish consumption patterns have remained the same while 11% of farmers have experienced a decrease in consumption (see Figure 7R for a gender breakdown on this).

Additionally, the project seems to have improved farmers' income. The amount of money realized by the farmers appears to increase with the growing cycles from MK24,000 (US$24), MK30,000 (US$30), and MK45,000 (US$ 45) per farmer from cycles 1 to 3, respectively (Figure 8). Moreover, the purchasing of feed from FOs is significantly associated with an increase in fish income (Chi-square is statistically significant). Importantly, IBEMs are now exploring new markets in other districts and with different institutions for business expansion, and five of the feed operators have now engaged in fish farming as a business to be able to train other farmers efficiently and hold demonstration ponds. Hopefully, this will further enhance fish farming productivity and income in the districts where these feed operators are located.

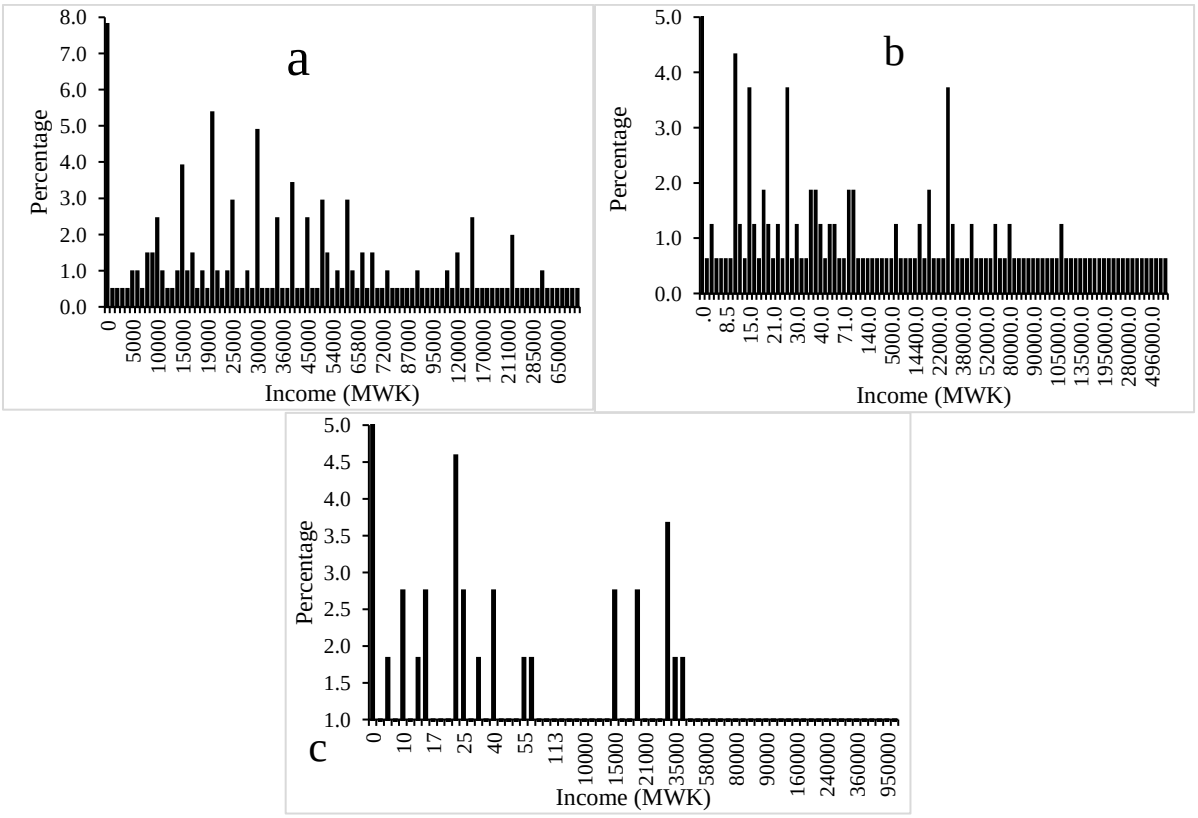

Figure 8: Income earned from fish selling in Malawian kwachas in the 3 production cycles (a, b, and c)

In terms of inclusivity, we discuss the findings herein in the context of decision-making. Most of the respondents are married households (71.6%) with the rest of the categories under 10% (Figure 9), thereby implying a pooled labour force, especially for those households with children.

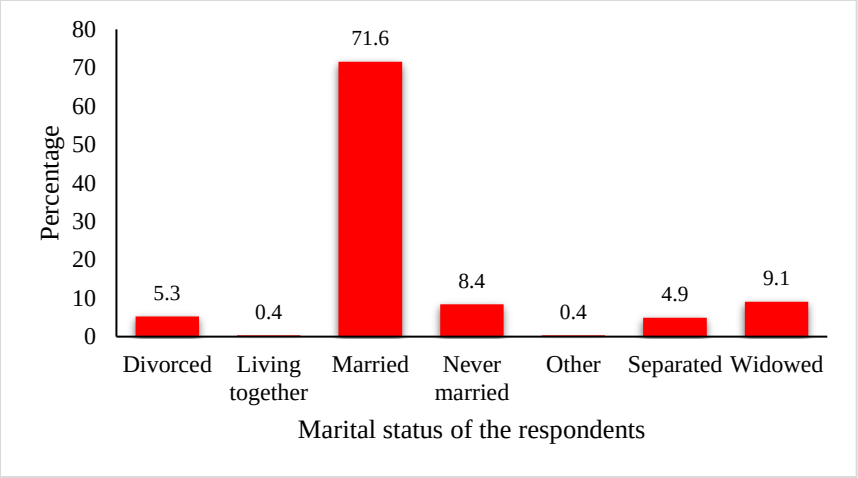

Figure 9: Marital status of the respondents

Statistics show no significant association between the sex of the respondent and the person who generally makes decisions (Figure 10). In addition, there is no significant association between the sex of the respondent (P>0.05) and whether there has been a change in the person who generally makes decisions in the home.

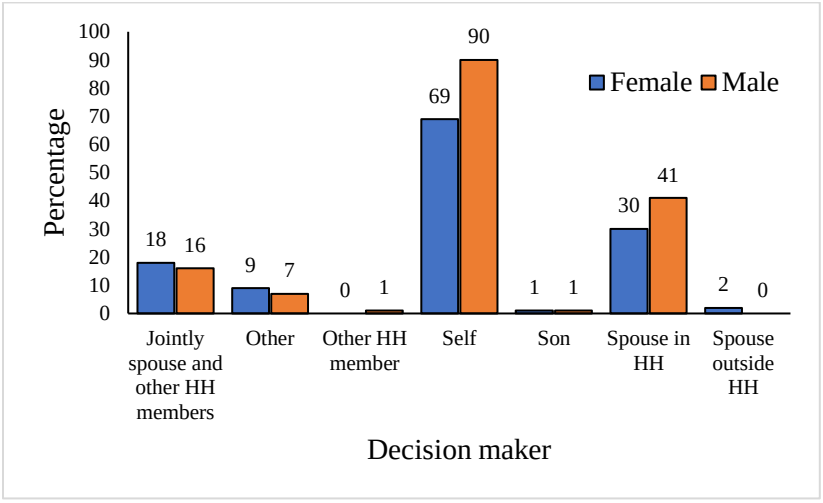

Figure 10: Decision making according to gender

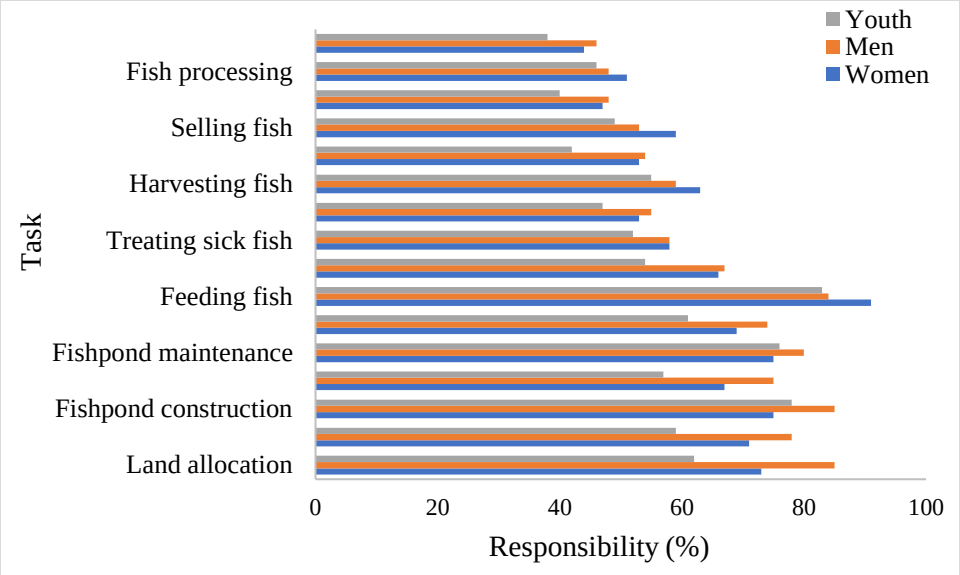

Figure 11: Gender disaggregation of fish farming tasks and decisions

While there are indications that men tend to dominate in decision making regarding aquaculture activities, it is also evident that there are certain activities in which women have an upper hand in decision making (see Figure 11). These activities include fish processing, the selling of fish, fish harvesting, and the feeding of fish. Essentially, there are indications that the dominance of men in decision-making at the household level is not universal; rather, decision-making practices vary across activities in relation to gender. In addition, evaluation findings from farmers indicate that both men and women had a say in decision-making about how to use the money within the household. In the case of married couples, husbands confer with their wives when it comes to decision-making, as well as with regard to the roles, tasks, and processes intrinsic to fish farming (also as indicated in Figure 11). In terms of the fishing business, they all had access to land and the water resources on which the fishponds were erected.

Findings further highlight that a significant number of men had now started involving their elder children, both females, and males, in the fish farming enterprises. This has implications for project planning in terms of ensuring that knowledge on fish farming is focused on the family level and not just on the individual and selected farmers, as fish farming appears to be a family-based venture. In addition, their children now assist when they are not in school as they have begun to appreciate fish farming, especially with benefits emanating from the project. These benefits include a diversified diet for the families, surplus and increased harvests, and derived income and livelihoods from fish farming. A summary of farmers' perceptions of the impact of feed and seed (hatchery) operators is presented in Figure 12.

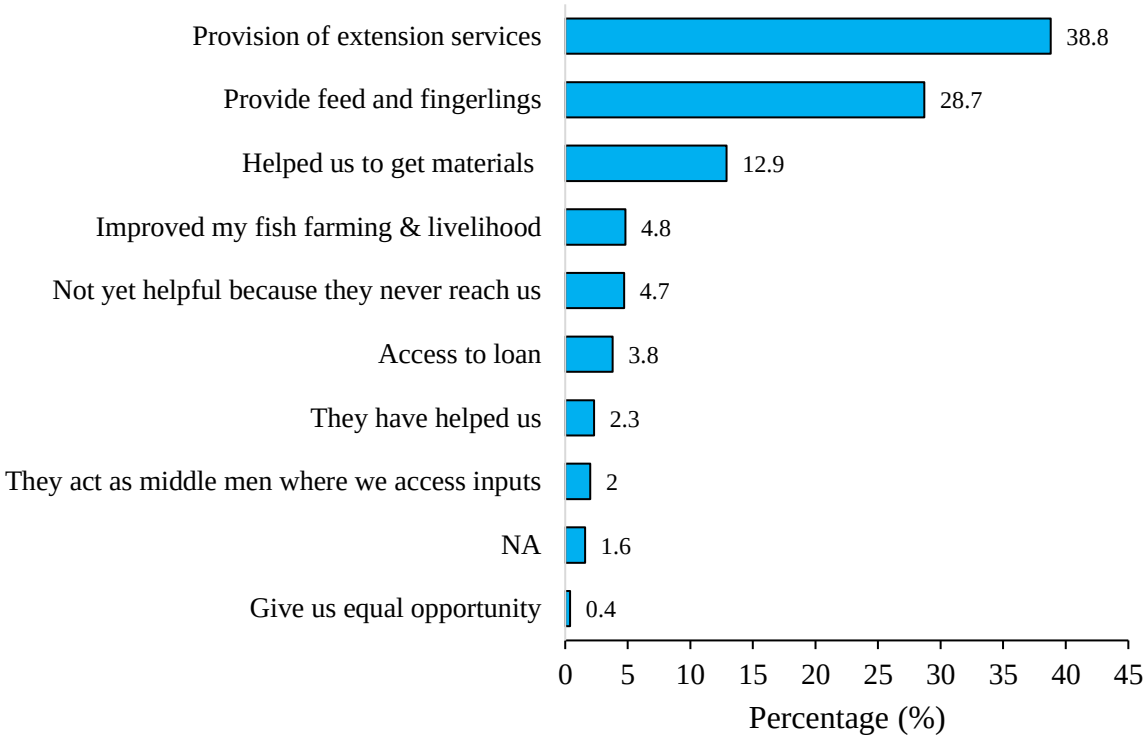

Figure 12: Perceived impact of feed and hatchery operators (IBEMs) on aquaculture activities in project areas

3.2.4. Challenges to achieving Output 1

Despite the highlighted achievements of the project in output 1, there were challenges that the project faced, which may have threatened the achievements to an extent. To start with, there were challenges regarding the appointment of a technical partner for the project. The initially identified partner could not be engaged as funder regulations did not allow further sub-contracting by partners, which is what the identified partner intended to do. By the time approval for an alternative partner came from the funder, there was another bottleneck as the identified alternative organization intended to charge overheads, which was against funder regulations for private companies. In the end, WorldFish sought approval from GIZ to implement the project without a partner, but significant time had already been lost. This set back the project in implementation by close to a year, given that there was still a need to recruit project staff in Malawi.

For feed operations, there were challenges regarding feed importation from Zambia in the context of government regulations. The first batch of feed was delivered to the feed (and seed) operators in September 2021 (WorldFish 2021e, 2021f) after being supplied by Sharick Enterprises. The supply and delivery of the second batch of feed did not go as smoothly, as the Malawian government started raising objections around the need to import feed from Zambia, arguing that suitable feed was available locally. However, at that time there was no suitable feed in Malawi since none of the locally available feed had been certified by the Bureau of Standards in Malawi. Additionally, there was no locally available floating feed. A protracted approval process took place which delayed the second disbursement of the feed (taking place only in November 2022) and led to a lack of feed stock held by the FOs. The project simply could not rely on local feed, which

lacked national certification and did not meet the technical requirements of a good commercial feed. Local feed manufacturers also had very low capacity to meet demand, with most producing for their own farm use and only selling the excess feed.

Less than half of the farmers accessed feed (114, or 40%) from IBEMs, mostly due to the high cost of feed in Malawi (Figure 13L and 13R). Nevertheless, access to feed has improved over the project period.

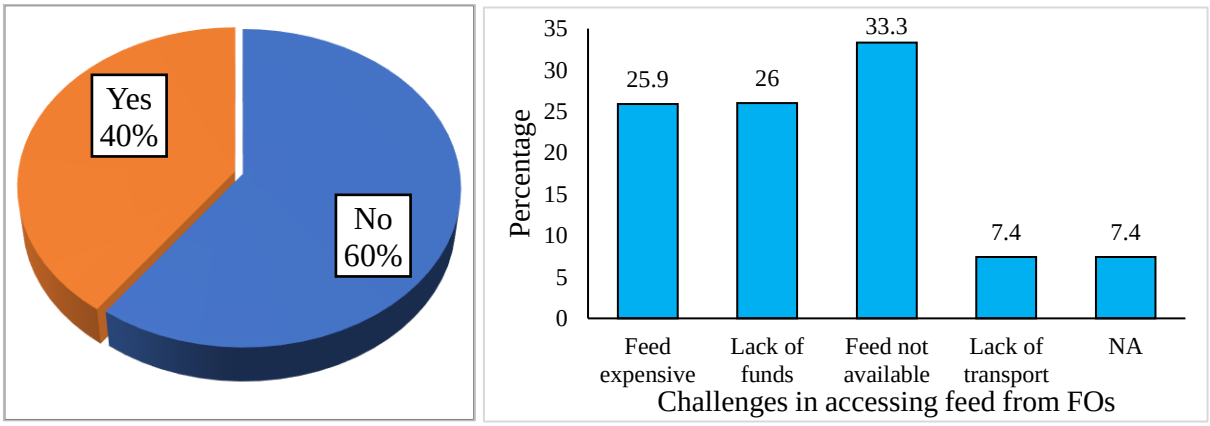

Figure 13: Challenges in accessing commercial feed (L) and reasons for the challenges (R) [Yes = challenges, No = no challenges]

The evaluation found that feed is considered by fish farmers to be expensive (Figure 13R as well as sentiments from FGDs and KIIs). In the same context, even though the IBEMs project helped agro-dealers (feed operators) with commercial feed from Zambia to sell to the farmers, most of the farmers still used their home-made feed (maize bran and soya) (52.6%) while only a few (10.5%) are using commercial feed exclusively (Figure 14). The latter was corroborated by one of the fisheries technical officers from the Mwanza district: *"It hasn't been easy for farmers to access feed. There hasn't been feed since June and the feed only came in September".* At the same time, nearly a third of the farmers used both commercial and home-made feed. Additionally, this resonates well with Munthali *et al*. (2023) who found that the majority (96.6%) of the 738 aquaculture farmers surveyed across Malawi use locally produced, home-made feed which includes maize bran, soya bean, groundnuts, common beans, usipa (*Engraulicypris sardella*), kitchen waste, and/or vegetables and only 10% of the farmers use commercial feeds.

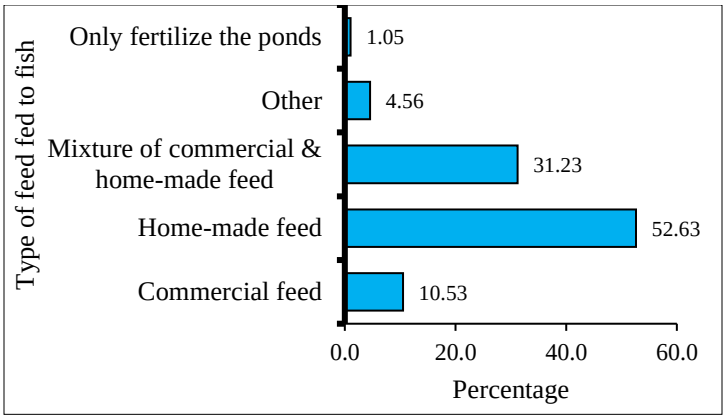

Figure 14: Type of feed used

The baseline study indicates that, before the project, the same percentage of fish farmers were using home-made feed only (52.82%). As well, currently, there is only a slightly greater number of farmers using commercial feed alone (10.53%), as the baseline was 6.97%. However, these figures alone mask an important difference arising from the implementation of the project. At baseline, over one-third (37%) of fish farmers did not feed anything to their fish and, further, only 1.88% used a mixture of commercial and home-feed. Presently, 32.23% of farmers are using a mixture. This means that, at baseline, only 8.85% of farmers were using at least some commercial feed while, now, the respective figure is 83.86%. A vast improvement in the use of commercial feed is thus evident in the context of the project's implementation.

Major reasons for the ongoing challenges experienced in accessing commercial feed were the general high cost of the feed, lack of money, and most importantly, unavailability of the feed from the commercial suppliers (Figure 13R). it emerged that in Thyolo, transport was also another hindrance, particularly for the farmers in the district highlands, which had gradient issues affecting the transportation of feed. This challenge merits targeted infrastructure development efforts that far transcend the scope of the project as these require a national development program. In addition, while significant attention was paid to inclusivity issues, results indicate that men have had statistically significantly higher access to feed than women ($\chi 2 = 6.63$, $p = 0.01$) in the project. This merits consideration for future interventions by further addressing women's access gap. Another challenge met during implementation is that 98 bags of feed expired from the first batch, a factor that offered good lessons for further batch deliveries by directly procuring fresh feed batches from the manufacturer and ensuring networking among feed sellers. In addition, the challenge of independent ordering was addressed through the innovation platform and continuous engagement with manufacturers in Zambia to initiate and establish collective ordering from feed factories.

A number of reasons were given for generally low income-generation from fish farming: most fish are sold locally on farms (30.5%) (Figure 15) indicating the likelihood of lower selling prices and incomes due to the low-income levels of the rural people. Further, the issue of refrigeration was raised by some of the farmers (especially the ones who had more ponds) as they indicated that

refrigeration would help them to store and sell their fish more consistently than through fresh/ farm gate sales.

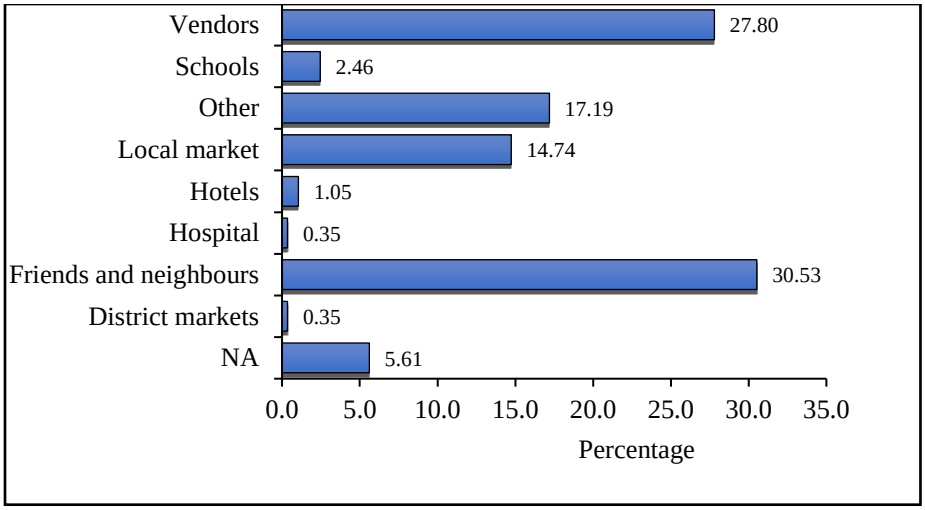

Figure 15: Fish selling outlets

In the context of hatchery operations, there were challenges regarding broodstock recruitment as some were stolen, and others died at the station (a government facility) where they were being kept. This, of course, was beyond the control of the project. In addition, ponds for a few of the hatchery operators dried out during production, and one operator suffered losses due to cyclone IDAI and consequent flooding.

Vendors (27.8%) (Figure 15) also buy a significant portion of the fish from farmers and sell in the urban areas resulting in farmers not realizing the maximum benefit that they could potentially get from these sales if they sold the fish directly to these urban areas. The Department of Fisheries Officer (DoF) for Mwanza was also clear that the productivity, income, and livelihood impacts of this project could only be seen in two to three years to come, given that farmers have only just started adopting the interventions recently. For instance, farmers were not able to reap the benefits from farming in the first cycle because the initial cost of investment is high (particularly the purchasing of feed), but the costs decline in subsequent cycles after setting up the ponds. In this regard, not all farmers had established and available ponds at the start of the project, while others increased pond numbers as the project progressed.

Despite the problems highlighted, the IBEMs have helped change the face of aquaculture in these communities and Malawi at large through providing a sustainable local source of quality fingerlings, feed, and extension services which were not there at baseline, alongside short-term impacts such as ensuring the establishment of aquaculture markets.

In this context, Table 4 shows certain changes arising from the project because of the establishment of IBEMs, and specifically the seed or hatchery operators. The statistics provided in Table 4 are per HO, whereas Table 3 is for all HOs combined. For instance, based on WF statistics, Table 3

shows that the total number of fingerlings sold during the October 2022 to December 2022 period was 217,455. Table 4 indicates that the average number of fingerlings sold 'now' (which can be approximated as equivalent to the October 2022 to December 2022 period) is 14,991.

Table 4: Number of farmers supplied with seed, fingerlings sold in numbers and cash (MKW) as well as the number of ponds and fingerlings therein stocked at baseline and after the project

Descriptive Statistics	N	Min	Max	Mean	Std. Deviation
Number of farmers buying fingerlings from HOs					
Before the project	11	0	50	14	16
Now	13	3	150	30	40
% increase				116	
Number of fingerlings sold					
Before the project	9	0	10000	4931	4129
Now	13	0	43300	14991	14385
% increase				204	
Cash from sale of fingerlings (MK)					
Before the project	8	0	500000	143222	171511
Now	10	0	1300000	370805	359913
% increase				159	
Number of fish ponds per HH					
Before the project	13	2	5	3	1
Now	13	1	8	4	2
% increase				21	
Size of ponds per HO (m^2)					
Before the project	13	30	8067	1323	2084
Now	13	20	8040	1593	2155
% increase				20	
Number of fingerlings stocked					
Before the project	12	3	7500	1834	2253
Now	13	3	30000	4999	8000
% increase				173	
Number of excess fingerlings	7	74	10000	3678	3546

Notable changes from the baseline to now include the average number of fingerlings sold per HO, from 4,931 before the project to 14,991 now. Further, only 1,834 fingerlings on average were stocked before the project, which has increased almost thrice-fold (2.7 times) to 4,999. These trends, including higher numbers of fingerlings stocked per HO, manifest themselves in increases in income arising from the sale of fingerlings, as Table 4 also demonstrates.

3.3 Output 2: Innovation platforms (IPs) with private and public actors established and functional

The project intended to set up an innovation platform (IP) with private and public stakeholders for greater linkages to local aquapreneurs and smallholder farmers in relation to enhancing inputs, training, service provision, and output market linkages. In a one-year continuum, the first stage involved generating interest from potential innovation platform members in the first three months. The project team conducted a stakeholder landscaping/mapping exercise to determine existing (and potential) value chain actors who are interested and willing to invest in input supply and service delivery in project focal areas. The process could, however, have been enhanced by considering existing networks such as the Malawi Innovative Fish Farmers Network (IFFN) which has been in existence since 2004. This would have made it easier for the project to work with and collaborate with stakeholders in Malawi. The next four months involved setting up the platform and its structure, as well as building trust among members, after which the full implementation happened in the last six months. In this IP strategy, the role of the project team was to provide leadership, facilitation, and backstopping.

Under this output, the project was largely successful in that an inclusive IP was set up and meetings held, starting with a virtual one in May 2021 (WorldFish 2021c). Participants in the platform meetings included a diverse group of stakeholders, namely IBEMs, government fisheries officers, the private sector (the fish feed industry for example), farmers, and other stakeholders. The meetings provided an opportunity for feed and hatchery operators to come together for participatory problem identification and solutions. The IP was designed to hold three face to face meetings but had to redesign the first one to make it virtual due to the incidence of COVID 19. This first meeting was intended to elicit valuable information that would be useful to the project and refine how the project was to be implemented. This contributed to the adaptive management of the project in which certain changes were made as necessary (as highlighted under output 1). Further IPs, including a physical one in October 2021 (WorldFish 2021b), were designed to monitor project activities and implementation. In this process, the team used a collaborative and evaluative framework to understand challenges and risks as well as identify solutions as well as to decide how best to move forward with the project. The challenges and risks were discussed in the PESTEL (Political, Economic, Socio-ecological. Technological, Environmental and Legal) framework. This platform was also a form of a training of trainers for project related matters that was very useful for hatchery operators in their day-to-day management of their projects.

At the October 2021 IP meeting, key challenges identified by the seed operators were fish theft, drying of ponds, and recycling of fingerlings, and discussions ensued around how to resolve these problems, with inputs from diverse stakeholders who had specific expertise. For the feed operators, challenges were identified around exchange rate and price fluctuations and high feed transportation cost. It was in this context that the major successes of output 2 emerged; the issue of producing and selling mono-sex fingerlings and the IBEMs learning visit to Zambia (WorldFish 2021b). In addition, important decisions regarding the importation of feed were made following this IP meeting, and collective endeavours were also initiated in the process, such as agreeing on one team of five IBEMs to visit Lusaka for an exchange and learning activity. When the project team realized that there was a small group of IBEMs that were keen to coordinate and collaborate regarding the importation of feed, they organized this visit for this small team to tour Zambia and meet two feed operators in the country: Novatek and Aller Aqua. The idea of facilitating this visit

was to build the capacity of these IBEMs to understand the issues around commercial feed and its supply. What makes this move more notable is that the idea was not initially part of the activities set out in the project, but rather emerged from the discussions during the IP meeting. This highlights the importance of partnerships with the private sector in for example the regular supply of quality commercial feed. This speaks to the nimble and adaptive management aspect that the project embraced in numerous ways as highlighted earlier. A major achievement from the IPs was that five feed operators have indicated that they want to import feed directly and collectively. This is important for the sustainability of these IBEMs as they will not necessarily need the project to continue with their activities.

3.4. Output 3: Innovative training materials on best management practices, business skills development, and entrepreneurship

As part of the project, the trained feed and hatchery operators had an obligation to train at least 42 farmers each in their area, with the intention for the project to ultimately reach a total of 1,000 farmers in the six districts. The training was a critical component of the project to allow for improved performance in aquaculture. Therefore, the training components administered through a training-of-trainers model of the feed and hatchery operators was supposed to cascade down to the farmers through training facilitation by the operators. The project fulfilled its objective under this training-of-trainers model by focusing on IBEMs where WorldFish staff trained 'trainers' comprising IBEMs. The idea was to enhance sustainability because, if farmers were trained directly by WorldFish, there would be no follow-up to provide training and other services to farmers once the project ended. There was sufficient evidence and indications that farmers were able to implement what they had been trained on. The DoF was also engaged in the training to ensure that the project work aligned with government priorities including ownership, among other issues.

Numerous meetings and workshops for IBEMs took place during the project period, including the main (and first) one , and then later refresher courses, and monitoring and coaching meetings. The first one that was introductory to the project was in fact a series of workshops in May 2021 which took place in different districts (WorldFish 2021g). At these main workshops, 26 IBEMs were trained in small groups at district level about planning in relation to marketing, sales, business, finances (etc.) to develop an entrepreneurial mindset amongst them. Subsequent mentoring in business plan writing was conducted in late September 2021, with business plans submitted by nearly all the IBEMs. Further mentoring and coaching of IBEMs took place, including with regard to feed operators in October 2021, with topics such as financial management and feed technical information covered (WorldFish 2021h). At this meeting, the FOs indicated that they did not expect such a high demand for fish feed from fish farmers, in comparison to what they in fact experienced. The feed operators also had a refresher course in October 2022 (WorldFish 2022). In addition, there were monthly sessions that were held with the project field officer to check and monitor what had been trained. The overall finding regarding these workshops and meetings is that the IBEMs were trained comprehensively with reference to the key tenets of business as well as fish-farming related technical issues.

In the case of fish farmers themselves, most fish farmers (81.1%) indicated to have been trained and expressed high satisfaction with the training (98.7%). General knowledge in fish farming

(64.5%), feed making as well as feeding of fish (20.1%) appear to be training messages that most farmers grasped (Figure 16).

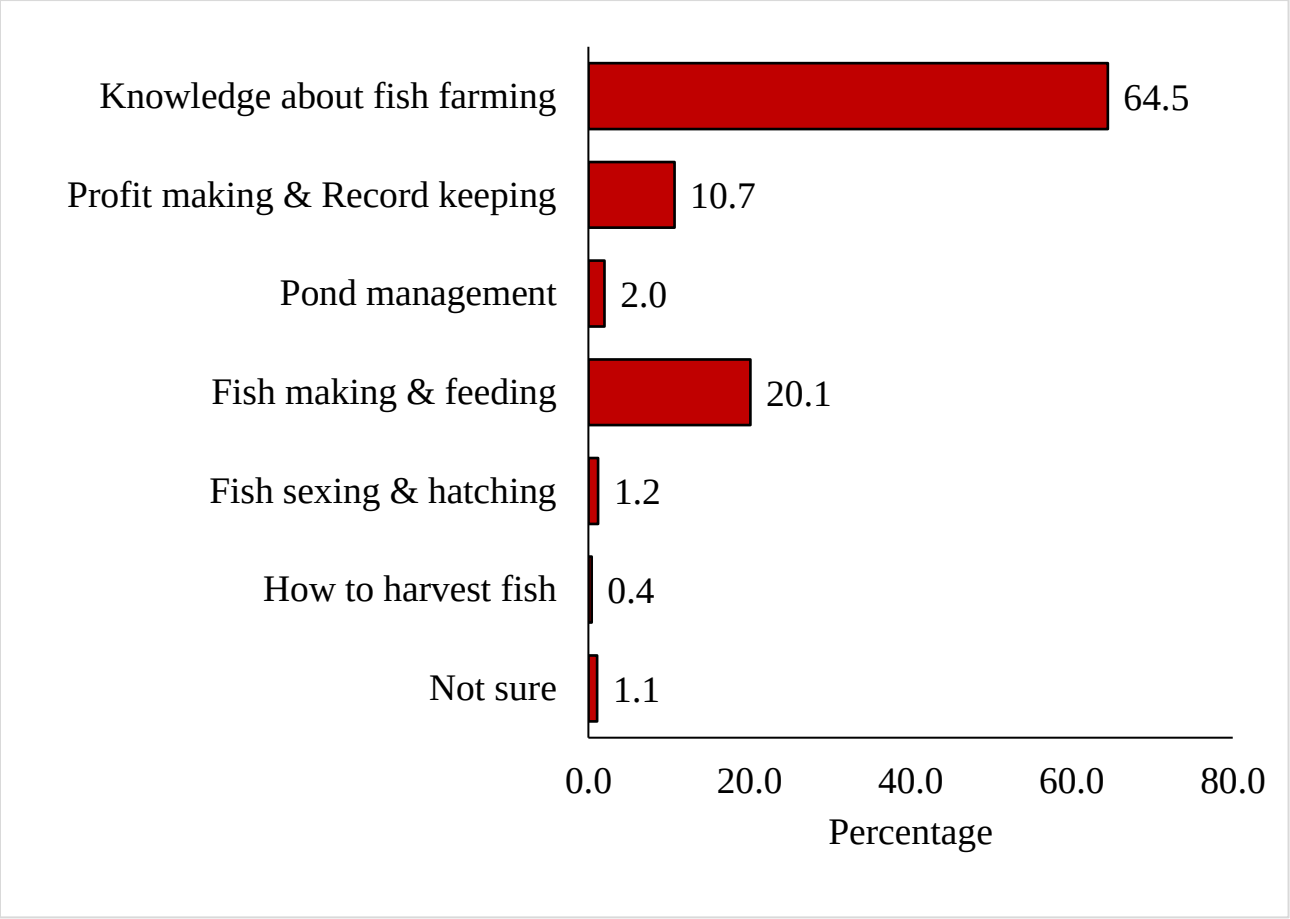

Figure 16: The type of training

When asked about who administered the training to the fish farmers, approximately half of the farmers (51%) indicated that they were trained by the project i.e., the IBEMs (Figure 17). Our interviews with key informants, nevertheless, widely indicate the involvement of government extension officers (DoF) in the training, suggesting that farmers mostly recognized those who spearheaded the training (IBEMs) and not the trainers themselves (including Department of Fisheries staff). Although the project had been planned and, indeed, worked with government extension officers, only 15% of the respondents admitted having been trained by government frontline staff. Other sources of training-related information mentioned by farmers were a couple of NGOs working in various districts such as World Vision International, JICA, and GIZ. The perceptions on training by farmers bode well with the project's intention of training IBEMs and then letting the training cascade down to the farmers. Having IBEMs and extension officers indicates ownership and a likelihood of sustenance beyond the project.

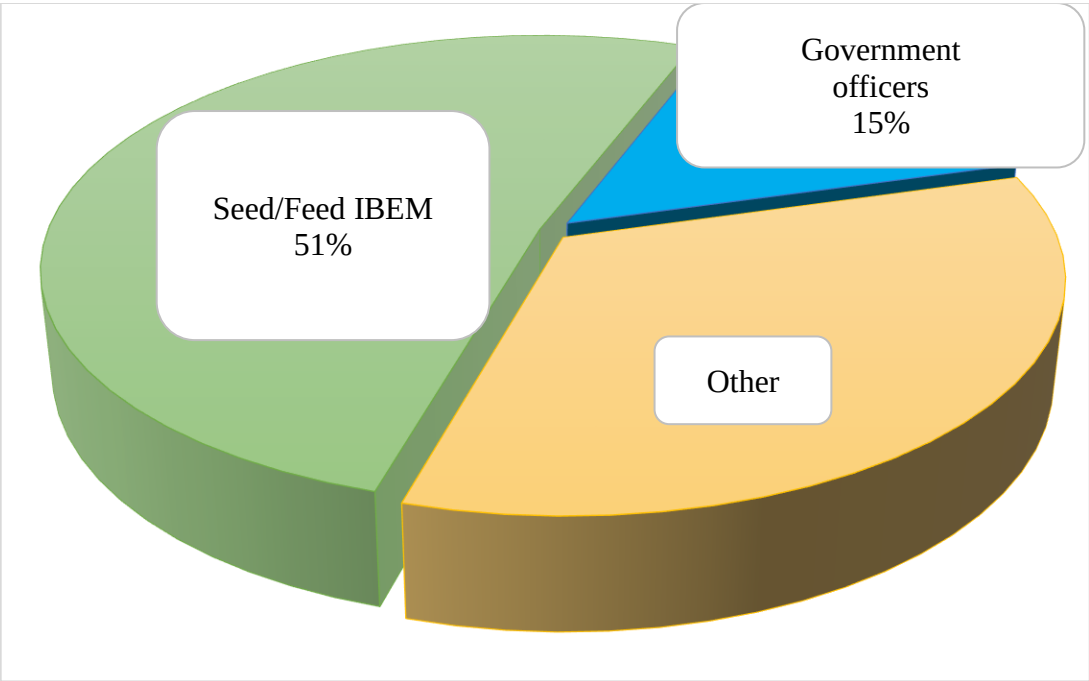

Figure 17: Training of Fish Farmers

Training materials were critical for training fish farmers. In fact, they served a demand by smallholder farmers for accessible materials which they can read in the absence of trainers as well as use for important reference material on an ongoing basis. With regard to training and training materials, both male and female fishers pointed out that the training was conducted in a user-friendly language since Chichewa was the main mode of instruction and they could all understand without any mishaps. A training manual developed by project staff, and presented in vernacular (Chichewa), was ideal for use for farmers in relation to the production and marketing phases of their fish enterprise. What made the manual more useful is that its development process embraced the participation of smallholder farmers and fisheries extension officers in the districts through validation and testing workshops. It emerged that the training was very useful because the farmers could now keep farm records, trace their fingerlings' growth, and run their farm enterprises as business units as they could constantly refer to the training materials that they receive from IBEMs and the government.

One of the main thrusts of the IBEMs project was to deal with the challenge of the unavailability of quality fish feed and seed (fingerlings). Some lead farmers were thus trained to become fingerling producers (hatchery operators). When asked to what extent FOs and HOs were of help, most farmers appreciated in particular the advisory role (extension training and messages) (38.8%) (Figure 19) they received, such as feeding fish and managing fish in ponds. Ninety-two percent (92%) of farmers reported that they had no access to aquaculture management practice training at the beginning of the project. Figure 18 refers to other services provided by the IBEMs, including the importance of providing feed and seed, but the Figure highlights the fundamental significance of the advisory and training roles of the IBEMs for the fish farmers.

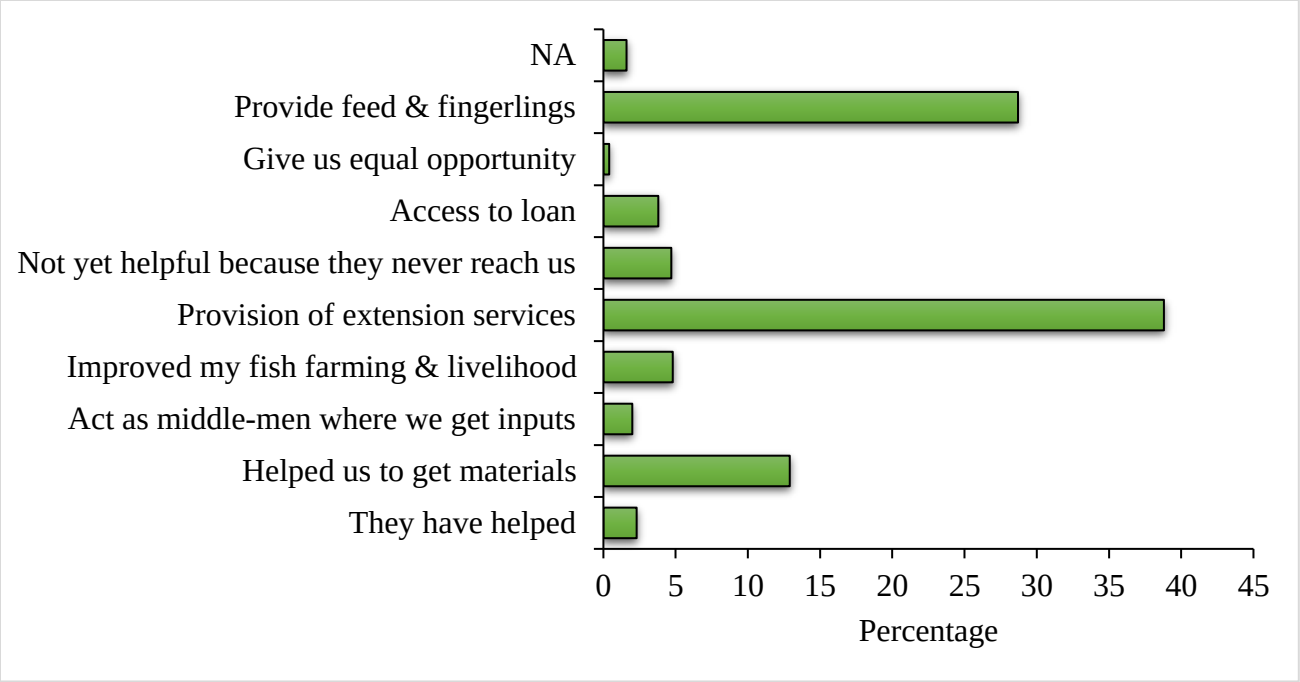

Figure 18: Impact of hatchery and feed operators

However, information, knowledge, and advice alone may not be effective in configuring fish farmers' practices. For instance, there is an indication that the determination of stocking density may have little to do with the provision of technical advice by the project. In this regard, most farmers (68.7%) had stocked fewer fingerlings while others had not yet stocked at the time of the evaluation, citing the lack of funds for purchasing fingerlings (Figure 19).

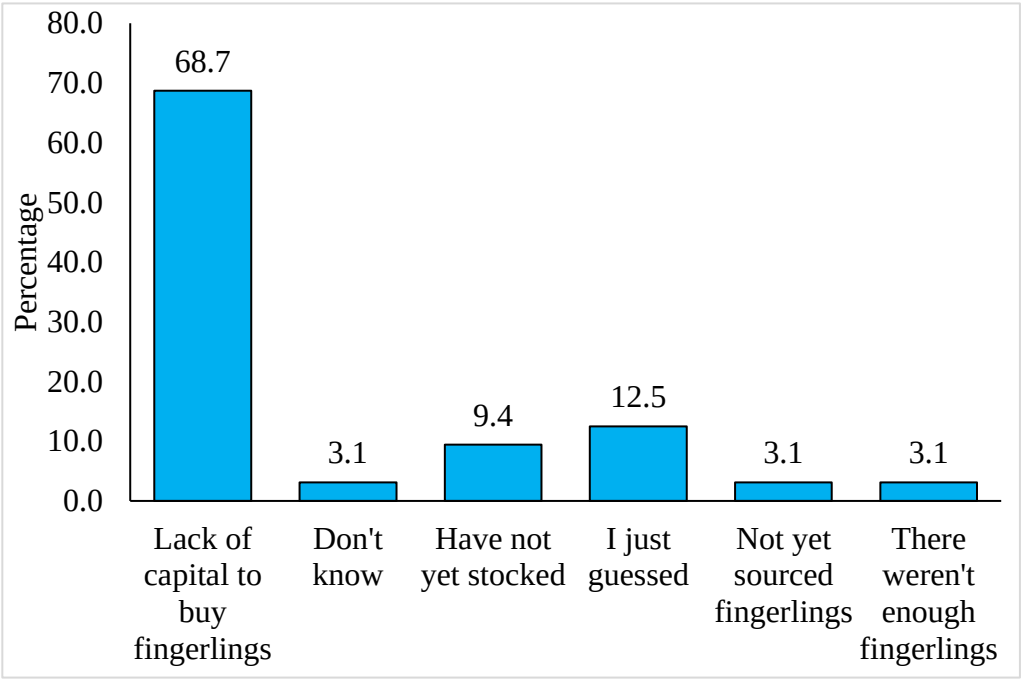

Figure 19: Determinants of stocking density

In terms of gender considerations, the project revealed that both men and women participated in the project. However, there were more men than women who participated in the project. In terms of training, women and men had equal opportunities of accessing training materials. In terms of the fishing business, they all had equal access to land and the water resources on which the fishponds were erected. Gender equity considerations were taken seriously by the communities and the respondents all pointed out that they had received gender training from the IBEMs established by WorldFish. There are also other organizations such as GIZ that were mentioned that provide training. This, therefore, raises the notion that WorldFish has made positive strides in ensuring gender equality procedures and practices in its fish project. In this respect, Mwema et al. (2022) mention that gender inclusion is one of the central tenets of the GIZ project considered.

3.4.1. Challenges to achieving output 3

Challenges regarding training were around the use of one of the key training manuals, about "better management guidelines" for smallholder fish farming, which had been prepared specific to Malawi by WF prior to the project's inception.(WorldFish 2021d). There was little buy-in and ownership of the manual by the Malawian government, which has yet to certify it and allow its distribution, even though it has been translated into Chichewa. Rather, WorldFish was expected to use a manual that was commissioned by the Malawian government but had not yet been finalized by the time the IBEMs project was initiated. Because of this, the project team is making plans to re-engage the government regarding its manual to ensure the manual's general use by smallholder fish farmers in Malawi. There were also criticisms from the government that there was insufficient high-level engagement and consultation during the preparation of WorldFish's training manual.

In addition to this major unresolved problem, most of the respondents reported having not attended any training (50.9%) (Figure 20). While there could be other reasons, one possibility is that these were newly joined farmers in the project. Additionally, this number is much less than the 92% figure of farmers who reported that they had never received training in aquaculture management at the baseline.

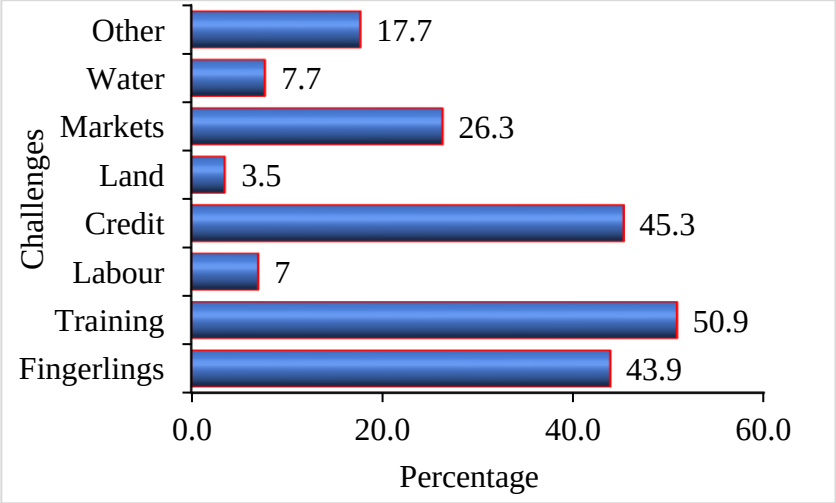

Figure 20: Challenges faced in the project

3.5 Consideration of evaluation criteria

Below we consider the project in terms of the OECD evaluation criteria (see Annex 4).

3.5.1. Relevance

It appears that despite the challenges still faced regarding access to commercial feed as highlighted, the project was relevant to the context of the small-scale fish farmers in the project districts, given the existing demand for both commercial feed and fingerlings. Evaluation findings highlight the importance of the project in addressing challenges faced by smallholder fish farmers. This is especially true for the youth who applauded the project for enhancing access to feed, seed, and training but lamented that they were mostly left out from participating in the project as individuals. Respondents were asked to state three major problems they face in their fish farming business. Access to credit, feed, and fingerlings are among the top three challenges (Figure 21) that farmers face, making the project relevant in addressing the real needs of beneficiaries. However, the provision of credit was not incorporated into the project and should be strongly considered in future projects.

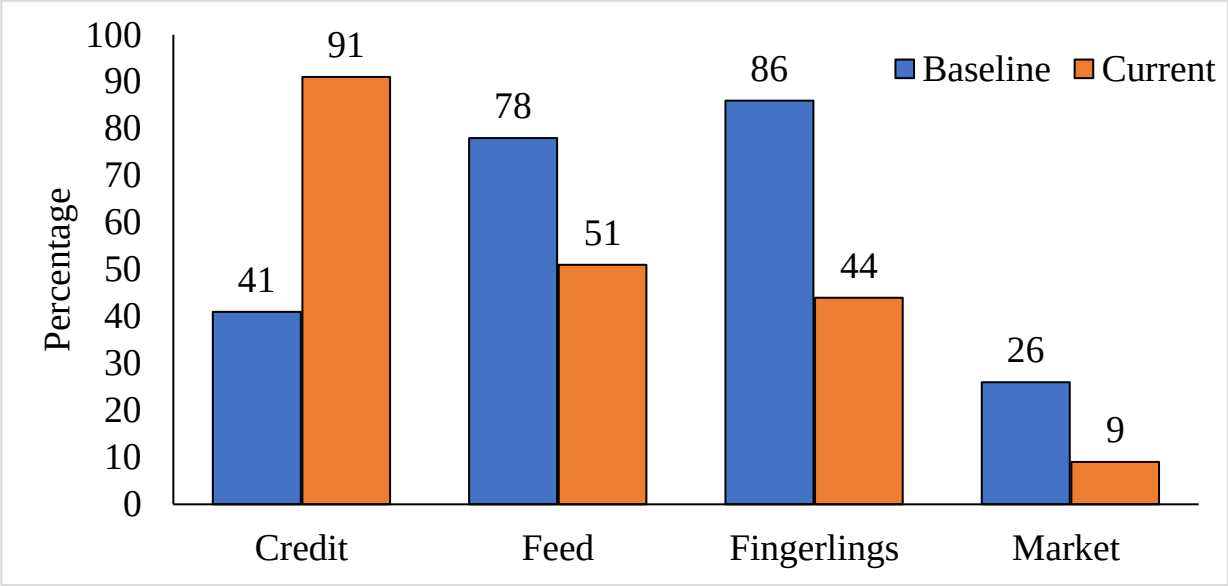

Figure 21: Challenges faced in accessing fish feed and fingerlings

3.5.2. Effectiveness

In addition, the effectiveness of the project is shown by the change in proximity for accessing feed and fingerlings for farmers who reported having to travel long distances to buy these supplies before the project. The farmers even spoke about being able to train other farmers after having received training themselves. Before the project, production was lower than it is now and, even then, there was stunted growth for the fish. For instance, women cooperatives highlight effectiveness in that, before the project, they would start the cycle with around 300-450 fingerlings but now they start the cycle with around 800-950 fingerlings. There also are clear indications from qualitative engagements that, for a portion of the farmers, fish consumption has increased, following the production levels.

3.5.3. Efficiency

We discuss the project efficiency in line with the overall project design. The information collated reveals that the project was successful in its design when it comes to efficiency. The project funds were disbursed timely, as the farmers had their training during the same periods. It was also pointed out that the project design was successful because the number of farmers targeted by the project was quite significant. The women-centered approach of the project also ensured that a considerable number of women were part of the project. The financial outlay of the project proved to be a success in terms of project management because the finances were disbursed timely to Malawi. The expenses incurred in setting up the IBEMs in Malawi have been matched already by the value of the fingerlings produced by the seed operators. As indicated, though, there are problems with ensuring a steady availability of commercial feed.

Regarding efficiency, project fish mortality has declined as emerged from the research, with seed now collected from nearby HOs whereas, before, the fingerlings would reach the destination in a frail state. In addition, where they used to feed fish once a day, the fish farmers have transitioned to feeding the fish twice a day due to increased access and availability. In addition, there is a wide claim that fingerlings are growing faster because of production know-how (through training) as well as commercial feed. There is anecdotal evidence to the effect that the fish that farmers now produce is much bigger, tastier, and more nutritious than before, enhancing their sales and markets.

3.5.4. Visibility

Given that WF mainly engaged with IBEMs as opposed to the farmers themselves, the visibility of the project with the farmers appears to be quite an issue. When asked if they knew WF and the project in their training and other engagements, some of the farmers expressed ignorance and would talk more about the IBEMs, as if disconnected from WF. Some of the farmers who indicated that they know the project would then confuse it with other organizations such as GIZ. WF ranked the least on the identity of the training provider (Figure 22). ‘Other’ (which mostly was GIZ) was the most common response. From observation, it did not appear as if there were any branded WF training materials with any of the respondents, a factor that will need consideration in future projects.

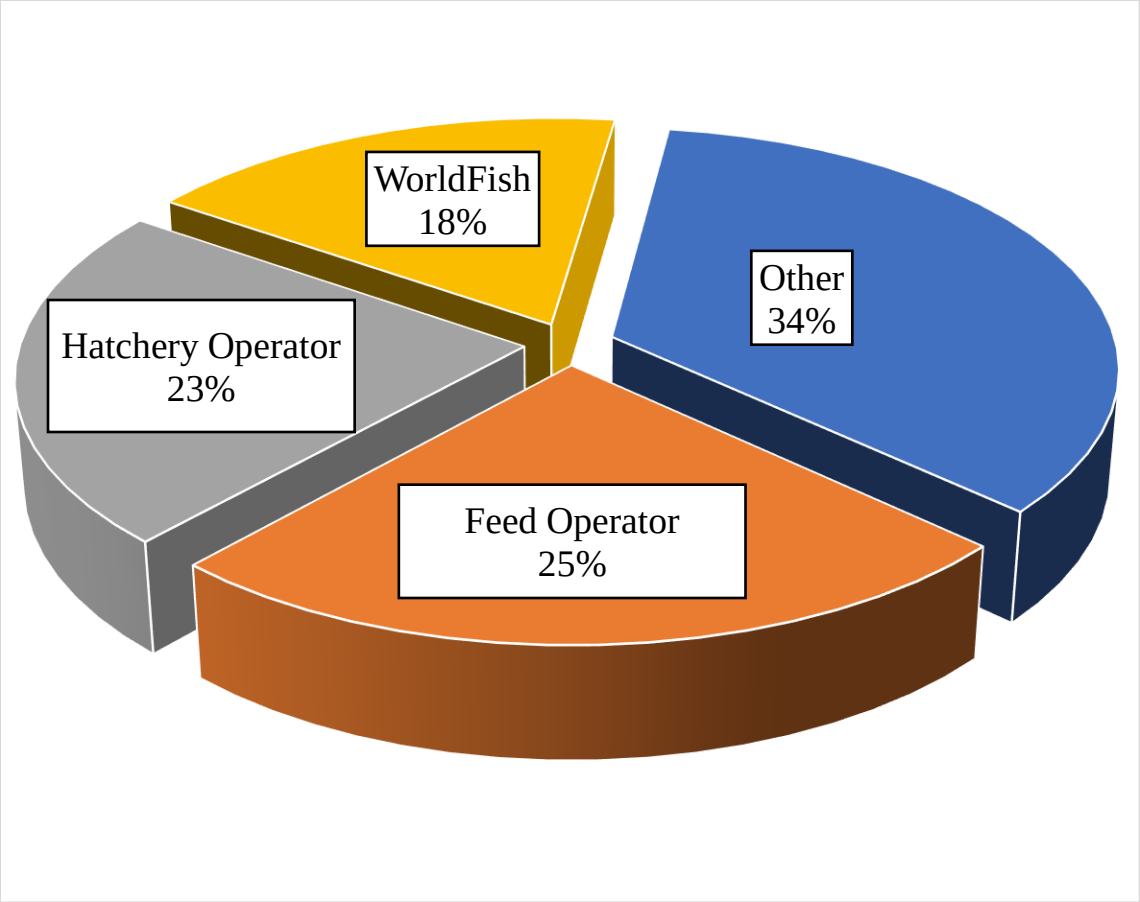

Figure 22: Training trends for feed (FO) and hatchery operators (HO)

3.5.5. Impact

3.5.5.1 Feed

The goal of this project was to establish innovation platforms and business models through training and with a target number of IBEMs and farmers in mind. Results show that these objectives have been achieved, and have started contributing to impact namely, improved access to feed as well as to nutritional diversity by the smallholder farmers in Malawi (Figure 23, which highlights gender as well).

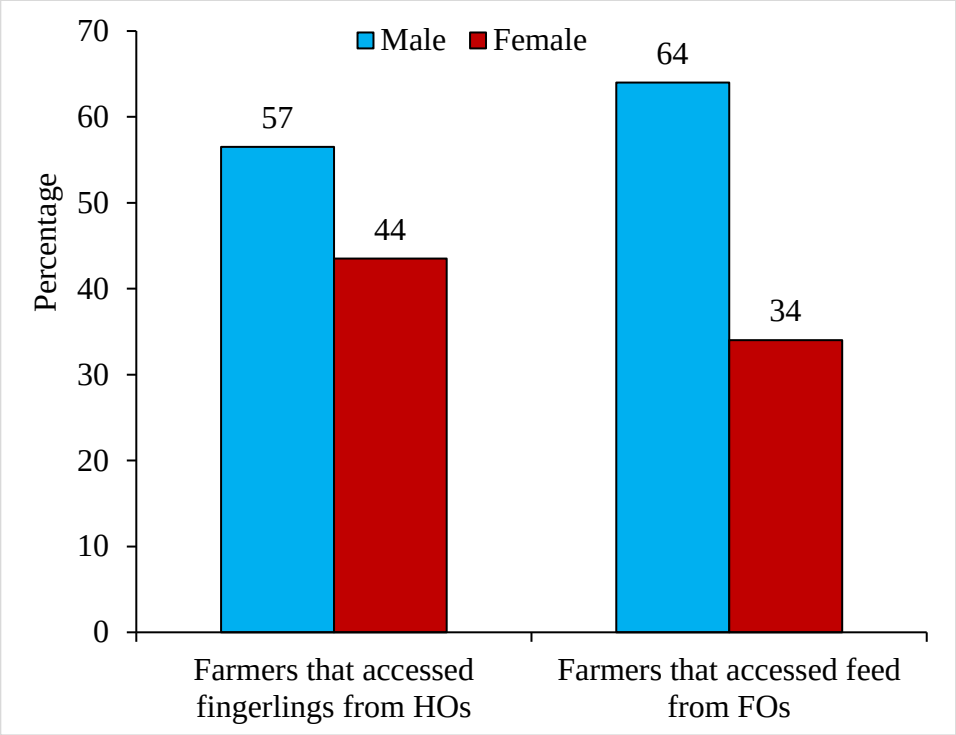

Figure 23: Access to fingerlings and feed across gender
(FOs = 114, $\chi^2 = 6.63$*; HOs = 207, $\chi^2 = 0.97$)

The impact may be suppressed by still low harvests, limited training, and expensive fish feed (which is beyond the control of the project). However, it is clear that feed operators have now been empowered to enable farmers to begin to make meaningful contributions to their farms/enterprises through improved access to seed and feed. For instance, before the project, farmers would exclusively feed fish with maize bran and soya in an *ad hoc* manner but now many use commercial feed and follow a timetable, leading to a discernible improved quality of harvested fish, which is claimed to have a better taste and is now bigger in size than before. Feed sourced from several commercial feed-making companies in Zambia was made available to the farmers at reasonable prices, something which they (farmers) could not do on their own. In terms of impact, the project was commended by farmers who highlighted that they have improved production and productivity to a large extent, given the increase in yield from around 10-25kg to 40-200kg.

3.5.5.2 Fingerlings (seed)

The notable impact of HOs included the improved provision of fingerlings (28.7%) which was the main purpose for their availability in the project. Evaluation findings indicate improved access to seed that reaches farmers under significantly lower mortality rates as the distances the farmer travels to collect them are now much shorter. In some districts, like Phalombe, the SO have cylinders that help in transporting the fingerlings and this ensures that the fingerlings remain alive and vigorous during transportation. The project, therefore, has proved effective in improving access to good-quality fingerlings for farmers in the pilot areas.

3.5.6. Sustainability

Although sustainability encompasses many things, the general consensus among respondents, and especially IBEMs, was an affirmation of their desire to continue with the activities beyond the project. Evaluation findings point out benefits from the project such as improvement in livelihoods mainly due to increased access to quality seed and feed and resultantly improved harvests and income from fish sales. The project's sustainability mechanisms deliberately worked with IBEMs to place them as conduits for continuing operations even after project closure. By project design, sustainability was seen through the establishment of reliable IBEMs that continue to provide aquaculture markets such as seed, feed, and knowledge beyond project life. IBEMs had to meet certain criteria for them to be provided with the initial cost of investment such as feed, broodstock, and technical support. It is therefore expected that they should be able to continue providing these services especially given that they identify an economic benefit in this business model: that is, for the SOs for instance, they sell fingerlings and make money within their clusters and educate farmers on how to transport, stock and manage the fingerlings so that farmers can have good yields and become their regular customers. At the same time, farmers are provided a sustainable source of fingerlings and knowledge, that is, if the IBEMs continue running.

With the phasing out of the project, though, nearly half of the respondents (49%) indicated that access to finance would become a major issue of concern. The sustainability of the project's activities and benefits may be compromised in this context. Reports from FGDs support this position and indicate that, for the benefits to be sustainable, WF should consider giving a hefty once-off grant to IBEMs. This is by far one of the key impediments to the development of aquaculture and a transition from small-scale to semi-commercial or commercial aquaculture. The continued availability of quality fingerlings (43.9%) was mentioned as yet another challenge faced by the farmers in the project.

3.6. Challenges

Indeed, although the IBEMs project has produced an impact in the intervention areas, it is not straightforward and easy to attribute such positive changes in livelihoods to the project alone due to other NGOs also working in the same areas and, in some cases, doing similar interventions. Other players includ lead farmers, fellow farmers, Aquaculture Enterprise, and Maldeco Fisheries Company. FOs reported increased sales of feed (Figure 24) from a baseline value of zero (before the project), but there are a number of factors (as indicated in preceding sections on challenges to the achievement of outputs) to consider in order to enhance sustainability.

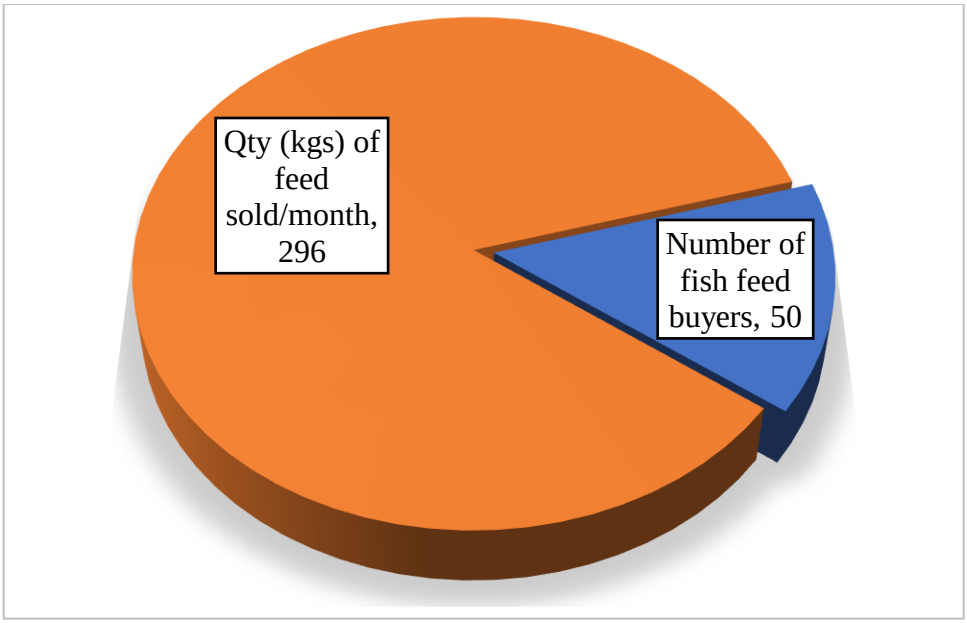

Figure 24: Number of buyers and fish feed sold (kgs)

When asked if they have a regular and sufficient supply of feed for sale, FOs (66.7%) indicated that they do not. Indications are that the project is coming to an end at a time when each FO is selling on average 296 kg of feed per month (Figure 24). A project phasing out with the supply issue facing the FOs would likely be unsustainable. Other problems though not serious (17.7%) (Figure 26) cannot be taken lightly as the issues mentioned are important challenges in fish farming development. Other problems included access to equipment and inputs for use at the pond e.g.,, harvesting nets, fish predation, theft, lack of training, climate change, high pond construction costs, destruction of ponds due to floods, expensive feed, fish diseases mainly epizootic ulcerative syndrome (EUS), high fish mortality, vandalism, lack of access to fertilizer and lime, etc. It is interesting that water scarcity, land, and labour availability were not among the most important mentioned by the farmers despite mentioning climate change in "other problems"..

3.7 Conclusions

The WorldFish project in Malawi has accomplished its objectives and goals for instance by surpassing the 1,000 target for farmers with 1,113 farmers who now have better access to feed and seed involved in the project. The project also accomplished its target to work with 30 IBEMs (32 on the ground) who increased their knowledge and production capacity through training and other kinds of support for their operations. Despite the farmers' and project stakeholders' confidence that the HOs and FOs seem very likely to continue operating beyond the project, the majority of the FOs (66%) felt otherwise. This is something that the project could address in the future as it implies a lack of confidence by the FOs in them operating independently outside of the project.

The project was also fairly inclusive with a fair share of women, and men represented across the value chain as farmers and IBEMs. Despite this, the participation of youths was largely marginal. There is hope though as it seems that the project has piqued the youths' interest as they have begun to realize the value of quality feed and seed through benefits such as increased production and

greater nutritional value and diversity and increased fish consumption at the household level. The project can capitalize on this to increase the involvement of youths and for sustainability.

Farmers across the board decried the lack of capital and loans to sustain their ventures, particularly for purchasing feed. The project needs to seriously consider how to address the issues of capital deficiency, particularly for women who feel vulnerable with less access to feed and fingerlings. This is despite the seemingly fair participation of women in decision-making and the matrimonial system of land tenure in Malawi which explains how mostly the women owned the land and ponds. The lack of capital funds resulted in a significant portion of the farmers (over 80%) not using commercial feeds consistently during the project. This is a huge cause of concern given that feeds are highlighted as the most expensive input and a significant contributor to increasing productivity in fish farming.

Therefore, we conclude that the project has improved access to and the quality of feeds and seeds by sufficiently building the capacity of FO and HOs. However, there are capital issues for farmers which prevent them from purchasing commercial feeds. despite this, the project has helped to increased size, quality, and quantity as well as the frequency of harvests as reflected by an increased number and sizes of ponds as these were limited to a few farmers and particularly FOs and HOs who played a dual role as fish farmers. It is important to note that the full impacts of the project need to be measured a year or so after its ending as these will be realized in time and beyond this evaluation which occurred just after the closure of the project.

SECTION FOUR: SYNTHESIS

4.1 Summary

This report evaluated WorldFish's project piloting Inclusive Business and Entrepreneurial Models (IBEMs) for smallholder fish farmers and poor value chain actors in six districts in southern Malawi. In particular, the evaluation focused on the four main outputs embedded in the goals of the project, relating to the functioning of the IBEMs in providing quality seed and feed to small-scale fish farmers, the training provided by WorldFish to the IBEMs and by the IBEMs in turn to the farmers; the relevance of the innovation platforms established; and the overall efficacy of different elements of the project. In addition, the project had a pronounced focus on inclusivity in relation to gender and youth and in relation to both IBEMs and fish farmers. The evaluation examined these outputs in relation to the criteria of relevance, effectiveness, efficiency, visibility, impact, and sustainability, with a particular focus on impact as measured in terms of issues around access, production, training, improved income, and nutritional diversity as well as the sustainability of the project. The evidence suggests quite strongly that the project was relevant, effective, and efficient to a large extent. It also has had significant impacts on both feed and seed operators as well as fish farmers and shows signs of sustainability.

4.2 Enablements and Constraints

At a general level, that is, with reference to the key indicators for the four main outputs, the project was quite successful. But, when the evaluation criteria are considered more directly and specifically, including the multiple dimensions of impact (such as access and production), a more variegated understanding emerges.

A discussion of enablements and constraints demonstrates this, while also contributing to identifying lessons learned and making recommendations. The project sought to provide enablements for IBEMs and fish farmers, and more specifically for women and youth, with the decentralized feed and seed supply system as well as multiple forms of training being central in this respect. The various dimensions of the project, including the establishment of the IBEMs, the innovation platforms and training, acted as enabling conditions for both the IBEMs and fish farmers. These enabling conditions were activated by both the IBEMs and fish farmers by their becoming directly and actively involved in the project. But the enablements were not fully activated, particularly by fish farmers, because of ongoing constraints including access to credit which still need to be addressed if the impact and sustainability of the project are to be enhanced. This is the case regarding the different measurements of impact we set out in Section 3, which we summarise below in tabular form (Table 5).

Table 5: Enablements and constraints for impact criteria

Impact Criteria	Enablements	Constraints
Access – Fish feed and fingerlings access for fish farmers	-Establishment of IBEMs -Decentralized location of IBEMs, close to the farmers -Innovation platforms connecting farmers to private sector, including feed suppliers	-Prohibitive costs of feed -Erratic availability at times of feed -Perceived lack of confidence by farmers on continued provision of both feed and seed past the project -Transport problems
Training of IBEMs and fish farmers	-Training on a diverse array of topics, with specific reference to aquaculture and business management -Innovation platforms for raising challenges and discussing possible solutions	-The presence of levels of illiteracy amongst fish farmers may inhibit the capacity of some farmers to use written materials provided.
Production and productivity	-Effective setup of IBEMs regarding both the supply of fingerlings and feed, and suitable training to enhance fish farming and business skills	-Shortfalls in the use of quality fingerlings -Water challenges in the light of climate change -Insufficient use of commercial feed as some farmers were not able to purchase and therefore use supplementary feed -Lack of access to capital
Nutrition and dietary diversity	-Increasing levels of fish production and harvesting because of the project, and larger, healthier and more nutritious fish for purposes of household consumption	-Failure to engage in ongoing harvesting of fish for immediate consumption purposes -No refrigeration for storage of harvested fish

Income	-Increasing levels of fish production and harvesting because of the project and larger, healthier and more nutritious fish to increase sales of fish	-Limited off-farm sales to increase profit margins -No added-value activities to expand involvement in value chain nodes

We narrate one example here to illustrate the argument about enablements requiring activation, namely, the establishment of IBEM feed operators. In this regard, the presence of a few IBEM feed operators in a particular district, as put in place through the project, does not mean that all fish farmers will then purchase feed from one of the operators in the district. This requires identifying and establishing the most optimal conditions to maximize the activation of enablements, that is, to minimize constraints further – in this instance, this means addressing the multiple reasons why fish farmers continue to use farm-based feed some, most, or all the time.

The enablements listed arose directly from the WorldFish project intervention, in collaboration with private sector and government partners. The constraints listed are mainly those which go beyond the mandate and capacity of WorldFish to overcome – including among others, illiteracy, the cost of imported commercial feed, hilly terrain restricting transport, and climate change.

4.3 Lessons Learnt

Key, broad lessons arise from the pilot project and need to be taken into consideration when scaling up the project or designing and implementing similar future projects. We set these out briefly below.

The project and intervention were largely successful as an innovative and entrepreneurial approach to improving access to feed and seed as well as ensuring inclusivity across gender and marginalized groups such as the youth. The approach of working with IBEMs generally worked well in keeping with the project objectives. We briefly note two issues about youth and gender.

a) While it is true that improvements took place through the project regarding access to feed and seed, gender equity, and inclusivity, local systems and practices of patriarchy remain a constraint, and more intensive, deeper, and long-term gender-transformative agri-food systems programs are required if the changes witnessed are to be consolidated rather than merely fleeting and even reversed.

b) The inclusion of youth, the specific constraints facing youth in rural Malawi, and what might enable their greater involvement in fish farming, require much more focused attention. For this project, it appears that youth became somewhat side-lined by the more explicit focus on gender. Youths reported that they were not given their own projects where they can make their own decisions. Youth-based criteria for their involvement requires a more targeted approach of involving them in projects such as aquaculture. This may mean using knowledge and awareness campaigns and co-designing programs for their involvement along the value chain. Now that the project has demonstrated value in terms of farmers realizing increased production, income and IBEMs, the youth's interest has been piqued and it will be easy for any follow-on work to be established with the youth.

There are also two issues pertaining to Malawi's fish farming value chain:

a) It appears that the project focused almost exclusively on the upstream parts of the value chain, specifically the inputs of seed, feed, training, and equipment. Little attention was paid to the downstream parts of the value chain, including value-adding activities and marketing as well as storage of fish and fish products – with storage facilities mentioned by farmers in the FGDs. Some attention needs to be paid to these issues, as small-scale fish farmers may remain trapped within specific parts of the value chain and will not able to accumulate. This point is about having the communities become more involved along the aquaculture value chain in future and not necessarily through the current WF project or by WF. These issues are pertinent when considering any post project work.

b) As well, considering that fish farmers are also cropping farmers, and seemingly mainly crop farmers according to the study results, the ways in which fish farming (including inputs and outputs) is or becomes integrated into crop farming in a complementary manner requires some thought in future project implementation. Rural homesteads in Malawi have diverse and fluctuating livelihood portfolios – because of this, isolating one livelihood practice for project purposes fails to comprehend holistically the basis on which homesteads make livelihood choices as well as their overall livelihood pathway.

4.4 Specific Recommendations

Table 6 details some of the recommendations that can be taken up for future work and general reflection and learning from the project.

Table 6: Recommendations emerging from the evaluation

Recommendation	WorldFish and/or donors	Government and/or the private sector
Feed access:		
-Each EPA should have a feed operator to make it even easier in terms of access for the fish farmer.	X	
-There is need for greater efforts to ensure locally manufactured feed.		X
-Provide feed as a grant or on credit until the farmers become more accustomed to commercial feed, after which they should buy on a cash basis.		X
-To enhance transport infrastructure for the collection of feed by fish farmers from FOs, as the terrain traversed remains problematic for many fish farmers.		X
Fingerlings access:		
-Oxygen cylinders should be provided.	X	
-There should be greater liaison with the private sector, including Maldeco, in relation to ensuring the provision of higher quality fingerlings.	X	X
-To enhance transport infrastructure for the collection of seed by fish farmers from SOs, as the terrain traversed remains problematic for many fish farmers.		X
Training:		
-It would be helpful to have the Fisheries Department increase its extension visits as well as its training activities. This would entail enhancing the overall capacity of the Department as part of a broader state-building project, to ensure more long-term support for fish farming.		X
Production and productivity:		
-There may be a need to provide loans in the future so that farmers are able to produce at a larger scale and with more reliability.		X
-Exchange visits to other districts, particularly where fish farming may be thriving, would be useful so that they can improve their own fish farming practices		X
Nutrition and dietary diversity:		
Encouraging farmers to consume some of the fish they farm through training them about the nutritional benefits of fish		X

consumption, nutritious recipes for cooking fish and producing more fish for household consumption.		
Income: -It would be helpful to be connected to formal markets such as supermarkets. Currently, they have no market linkages of this kind, nor do they meet the required conditions for entering these markets such as having relevant certificates. -Electricity would help reduce post-harvest losses and to increase shelf life, as part an overall process of enhancing the quality of life of fish farmers.	X	X X

4.5 Conclusion

The project had several positive tenets particularly in meeting its goals and targets. However, some issues were noted with lessons and recommendations proffered to address the challenges beyond the project. Blue transformation focuses on sustainable aquaculture expansion and intensification, effective management of all fisheries, and upgraded value chains. In this regard, the project attempted a holistic and adaptive approach that was gender centered, considering the complex interaction in agri-food systems and supporting multi-stakeholder interventions using existing and emerging knowledge in inclusive business models, tools, and practices. It succeeded to a large extent, therefore assisting in securing and maximization of the contribution of aquatic food systems to the local food security and nutrition and small-scale rural economies in Malawi.

SECTION FIVE: ANNEXES

Annex 1: Survey Questionnaire for Fish Farmers

Name of Enumerator:_____

CONSENT FORM

We are a research team from WorldFish. We are currently conducting a survey of fish farmers in your district. This information will help us inform the development of aquaculture interventions in this area and the district as a whole. If you would like to participate, we will ask you questions about your demographic characteristics, fish farming background, fish farming activities, access to aquaculture input and output markets, production constraints, and other topics. These questions in total will take approximately 1 hour to complete. Your participation is entirely voluntary. If you agree to participate, you can choose to stop at any time or skip any questions you do not want to answer. Your answers will be completely confidential. This study largely has no risk. The study will however have benefits for the development of the aquaculture sector in Malawi. The results of the study will be shared with the government and private sector which can collaboratively develop policies geared towards improving the sector and addressing the constraints identified.

Do you have any questions about the study or what I have said? If in the future you have any questions regarding the study or interview, or concerns or complaints, we welcome you to contact the Principal Investigator, Dr. Netsayi Noris Mudege at N.Mudege@cgiar.org. You can also contact Dr. Orton Msiska at omsiska@gmail.com, Country Research Leader for Malawi. If you have any questions related to this study, or questions related to your rights, or seek to report a violation of your rights as a participant in this study, you can contact the National Committee on Research in the Social Sciences and Humanities of the National Commission for Science and Technology through the address below. Committee Address: Secretariat, National Committee on Research in the Social Sciences and Humanities, National Commission for Science and Technology, Lingadzi House, City Centre, P/Bag B303, Capital City, Lilongwe3, Malawi. Telephone Nos: +265 771 550/774 869; E-mail address: ncrsh@ncst.mw

Do you consent to be part of this study?

1. Yes.
2. No.
3. If 'No', please provide your reason _____

I _____, the enumerator responsible for the interview taking place on _____, 2022 certify that I have read the above statement to the participant and they have consented to the interview. I pledge to conduct this interview as indicated in the instructions and inform my supervisor of any problems encountered during the interview process.

Starting Time of Interview _____ Ending Time of Interview _____

SECTION A: HOUSEHOLD DEMOGRAPHIC DATA

Variable	Response
A1: Name of District	1=Zomba, 2=Blantyre, 3=Mwanza, 4=Thyolo, 5=Mulanje 6=Phalombe
A2: Name of Traditional Authority	
A3: Name of Village (GVH)	
A4: Name of EPA	
A5: Name of Respondent	
A6: Phone Number of Respondent	
A7: Gender of Respondent	1 = Male, 2 = Female
A8: Age of Respondent (in years)	
A9: Marital Status of Respondent	1 = Never married, 2 = Married, 3 = Separated, 4 = Divorced, 5 =Widowed, 6 = Living together
A10: Education of Respondent	0 = None, 1 = Primary; 2 = Secondary, 3 = Post-secondary, 4 = Adult literacy, 5 = University degree, 7 = Other, specify
A11: Total Number of People in Household	
A12: Is the Respondent Household Head?	1 = Yes, 2 = No
A13: If 'No' to A12, Relationship of Respondent to Household Head	1 = Spouse, 2 = Son/daughter, 3 = Brother/sister, 4 = Uncle, 5 = Aunt, 6 = Parent, 7 = Grandparent, 8 = Other (specify)
A14: Sex of Household Head	
A15: Age of Household Head	

SECTION B: FISH FARMING

Variable	Response
B1: Does the household have its own fish pond (ponds directly owned by the household)?	1 = Yes, No = 2
B2: Do you own the land on which the fish pond(s) are located?	1 = Yes, No = 2
B3: Is the respondent the owner of the fish farm (or fish ponds)?	1 = Yes, No = 2
B4: Who owns the fishpond(s)?	1 = Husband, 2 = Wife, 3 = Jointly owned by wife and husband, 4 = It is a family fish pond, 5 = Son, 6 = Daughter, 7 = Other (specify)
B5: Has ownership of the fishpond(s) changed over the past few years?	1 = Yes, No = 2
B6: If yes to B5, how?	
B7: What is the marital status of the fish farm owner?	1 = Never married, 2 = Married, 3 = Separated, 4 = Divorced, 5 =Widowed, 6 = Living together
B8: How old is the fish farm owner?	
B9: How many fish ponds do you own?	1= 1 2= 2 3= 3 4= 4 5-10= 5 11-15= 6 15-20= 7 20+= 8
B10: Do you operate any fish ponds as a cooperative? or any other fish farmers platform?	1 = Yes, 2 = No
B11: If yes, what is the name of the platform/cooperative?	1=Feed IBEM, 2=Seed IBEM, 3=Fish farmer innovative platform, 4=Other cooperatives specify?
B12: What is the total size of your fish pond(s) in square metres?	1 = small ($100m^2$) 2= medium (101-$400m^2$) 3= large (>$400m^2$)
B13: Do you own the land where the pond(s) are?	1 = Yes, solely 2 = Yes, jointly with my spouse, 3 = Yes, jointly with another person, 4 = No.
B14: How many years have you been involved in fish farming?	1= <1 year 2= 1-2 years 3= 2-5 years 4= 5-10 years 6=>10 years
B15: What is your aquaculture system?	1 = Earthen ponds, 2 = Concrete ponds, 3 = Tank, 4 = Other (specify)
B16: What was your main reason for starting to fish farm?	1 = Home consumption, 2= Source of income, 3 = Both income and consumption 4= Other e.g., hobby, passion
B17: What is your main reason for continuing to fish farm?	1 = Home consumption, 2= Source of income, 3 = Both income and consumption 4= Other e.g., hobby, passion
B18: What is your stocking density per m^2 (if the farmer doesn't know the stocking density, ask for the number of fingerlings stocked in 1 pond and calculate the stocking density using pond size)?	
B19: What determines your stocking density?	1=pond size, 2=I don't know, 3=other specify_____
B20: If one is selected above, where did you learn this information?	1=WorldFish, 2=Seed/Feed IBEM, 3=Government extension officers, 4=Other extension service providers
B21: What is the main source of water for your fish farming activities?	1 = Borehole, 2 = Furrow from the river/lake, 3 = Underground water/spring, 4 = Others (specify)

B22: Is water available all-year round for fish farming?	1 = Yes, 2 = No
B23: What is your main harvest strategy?	Cycle 1 1 = Complete, 2 = Partial Cycle 2 1 = Complete, 2 = Partial Cycle 3 1 = Complete, 2 = Partial
B24: If partial harvest, why?	1 = Harvest for consumption only, 2 = Recycle seed/fingerlings, 3 = To match harvested quantities to market demand, 4 = To promote availability of natural feed for fish left in the pond, 5. Other (specify)
B25: Have you been trained in tilapia/aquaculture better management practices through this project?	1 = Yes, 2 = No
B26: Did you find the training helpful?	1 = Yes, 2 = No
B27: If yes, who conducted the training?	1 = Seed IBEM, 2=Feed IBEM, 3=WorldFish 4=Others specify
B28: Provide any other comment regarding the training that you received	_____

SECTION C: ACCESS TO INPUT AND OUTPUT MARKETS AND INCOME

Variable	Response
C1: What is the main source of your fish fingerlings?	1 = Private hatchery/seed IBEM, 2 = Government hatchery, 3 = Wild sources, 4 = Recycle own fingerlings 5 = Fellow farmers, 6 = Given by WorldFish, 7 = Given by other NGO
C2: Has this changed from the past two years?	1 = Yes, 2 = No
C3: If yes, how?	=It is easier to access fingerlings now 2=quality fingerlings are readily available now 3=others (specify)
C4: If purchased, how much did you pay for fingerlings that were stocked in the last growing season in MWK?	
C5: If purchased, how much is the price of 1 fingerling in MWK?	
C6: How much did you incur in transportation of the fingerlings? (input zero if no transport cost incurred)?	Categorise after responses
C7: Do you use sex-reversed fingerlings?	1 = Yes, 2 = No
C9: If yes, explain	1=high mortalities, 2=slow growth rate 3=others (specify)
C10: Did you purchase any fingerlings from hatchery operators supported by WorldFish?	1 = Yes, 2 = No
C11: What do you mainly feed your fish?	1 = Commercial feed, 2 = Home-made feed, 3 = Mixture of commercial and home-made feed, 4 = Just fertilize the ponds only, 5 = Others (specify)
C12: Did you purchase any commercial feed from feed operators working with WorldFish?	1 = Yes, 2 = No
C13: If yes, how?	1=I know where to find commercial feed now 2=commercial feed is readily available at a nearby source, 3=others specify
C14. What is the main reason for not using commercial feeds?	1 = Commercial feeds are expensive, 2 = Commercial feeds are not available, 3 = I do not see the benefits of using commercial feeds, 4 = I don't know how to use commercial feeds, 5 = Other reasons (specify)
C15: How many kgs of commercial feed did you buy in the previous growing cycle for your household-owned pond?	Categorise after responses
C16: What was the price of feed per KG (MWK)?	Categorise after responses
C17: How much did you spend in transportation of the feed (to and from)?	Categorise after responses
C18: How much did you spend in buying fertiliser/manure for your household-owned pond?	Cycle 1 Cycle 2 Cycle 3
C19: How much did you spend in transportation of the fertiliser (to and from) (If no transport incurred input zero)?	Categorise after responses

C20: How much did you spend in buying non-commercial feed for your household-owned pond?	Cycle 1 Cycle 2 Cycle 3
C21: How much did you spend in transportation of the non-commercial feed?	Categorise after responses
C22: Have you purchased feed from WorldFish's feed operators?	Cycle 1 1 = Yes, 2 = No Cycle 2 1 = Yes, 2 = No Cycle 3 1 = Yes, 2 = No
C23: If yes, are there any challenges in accessing the feed operator? If yes, explain.	1 = Yes, 2 = No
C24: If yes, does the feed operator provide clear instructions about using the fish feed?	1 = Yes, 2 = No *Probe for both answers
C25: How many Kgs of fish did you harvest from the pond owned by your household in your growing cycles?	Cycle 1 Cycle 2 Cycle 3
C26: How much kgs of fish did you sell in your growing cycles in your own household ponds?	Cycle 1 Cycle 2 Cycle 3
C27: How much did you make from selling fish in your growing cycles from your own household ponds (MWK)?	Cycle 1 Cycle 2 Cycle 3
C28: How many fingerlings did you sell in your growing cycles?	Cycle 1 Cycle 2 Cycle 3
C29: How much money did you earn from selling fingerlings in MWK?	Cycle 1 Cycle 2 Cycle 3
C30: Where did you mainly sell fish from your own pond?	1=To traders in the local market (Traders came to buy) 2=To traders outside the local market (Traders came to buy to sell outside) 3=Sold in the local market (Farmer sold in the local market) 4=District/provincial markets (Farmer sold in the district market) 5=Friends and neighbours 6=Schools 7=Hospital 8=Church 9=Hotels 10=Other (specify)
C31: Has this changed from project inception to date?	1 = Yes, 2 = No
C32: If yes, how?	
C33: Where did you sell the most volume of fish in the last growing cycle?	1=To traders in the local market (Traders came to buy) 2=To traders outside the local market (Traders came to buy to sell outside) 3=Sold in the local market (Farmer sold in the local market) 4=District/provincial markets (Farmer sold in the district market) 5=Friends and neighbours 6=Schools 7=Hospital 8=Church 9=Hotels 10=Other (specify)

C34: What is the average cost you incurred in transporting fish to and from your main selling point (MWK)?	
C35: Did you experience any problems finding markets for your fish?	1 = Yes, 2= No
C36: If Yes, has this problem been solved?	1 = Yes 2= No
C37: How often do you eat fish from your own pond?	1=Once a week 2= Once a month 3= Other specify
C38: Have fish consumption trends changed for your household during the project period?	1=increased 2=decreased 3=remained the same
C39: What is the main source of income for your household?	1=Crop income 2=Large Livestock income 3=Income from poultry 4=Income from fish farming 5=Business income (Shops) 6=Salary from employment 7=Farm wages (Working as hired labour) 8=Non-farm wages Remittances (money shared by relatives) 9=Other (specify)
C40: Have fish income trends changed for your household during the project period?	1=increased 2=decreased 3=remained the same
C41: How much do you generate per month from your main source of income (if income is not generated per month, ask according to appropriate reference period, e.g per season/year as in the case of income from agriculture products such as maize?)	
C42: Has this changed from project inception to date?	1 = Yes, 2 = No
C43: If yes, how?	Categorise after Responses
C44: Have you taken a loan of cash or items for your fish farming?	
C45: If yes, what?	Cycle 1 1=cash 2=items 3=both cash and items Cycle 2 1=cash 2=items 3=both cash and items Cycle 3 1=cash 2=items 3=both cash and items
C46: How much?	
C47: Who paid back the loan?	1=Self 2=Spouse 3=Jointly with spouse 4=Other HH member 5=Clan 6=Non-HH member
C48: Do you have a bank account?	Cycle 1 Yes=1 No=2 Cycle 2 Yes=1 No=2 Cycle 3 Yes=1 No=2
C49: If no, why?	1= I did not need a loan 2=I do not have enough collateral 3=My family disapproves of me taking a loan 4=I cannot pay back the money, afraid of losing my collateral 5=Interest rates, other costs too high 6=Location of lender too far away
C50: Do you think you will be able to continue practising aquaculture in the next one year?	1 = Yes, 2= No

SECTION D: EXTENSION SERVICES AND TRAINING

Variable	Response
D1: Have you ever met with a fisheries extension service officer in the past 12 months? (could be government or others)?	1 = Yes 2= No
D2: Have you received extension services from hatchery operators?	1 = Yes 2= No
d3: you received training from feed operators?	1 = Yes 2= No
D4: How many times did you meet with a fisheries extension service office in the past 12 months? Number of visits	1= once 2= weekly 3= monthly 4= quarterly 5= never6= other (specify)
D5: How do you access information regarding fish farming?	1=Government extension officers 2=Fellow farmers Media 3=Private sellers 4=Agriculture shows 5=NGOs 6=Other (specify)
D6: Have the trends in access to information changed during the course of the project?	1 = Yes 2= No
D7: If yes, how?	1=increased 2=decreased 3=remained the same
D8: In the past 12 months, have you received any training on fish farming from an organisation outside your community?	1 = Yes 2= No
D9: If yes, were the trainers men or women?	1=Men 2=Women 3=Both men and women
D10: What were the training topic (s)?	1=Fish pond construction 2=Fingerling management 3=Fish feeding 4=Fish harvesting 5=Nursery/seed production 6=Brood stock management 7=Fish marketing 8=Fish processing 9=Biosecurity management 10=other specify
D11: Did you receive any extension or support services?	1 = Yes, 2 = No
D12: If Yes, who provided this to you?	1 = Staff from DoF 2 = Staff from WF 3 = Staff from NGO (name) 4 = Other (specify)
D13: What benefits did you receive from the extension and support services?	1= Learnt best management practices 2=learnt business skills 3=learnt entrepreneurial skills
D14: What specific skills did you learn?	Categorise after responses
D15: Did you receive any training materials?	1=Yes 2=No
D16: If yes, what training materials did you receive?	Categorise after responses
D17: Have you read the training materials?	1=Yes 2=No
D18: If yes, were they useful for your fish farming practices?	1=Yes 2=No
D19: Were they reader friendly?	1=Yes 2=No
D20: If no, why?	Categorise after responses
D21: What specific skills did you acquire from the reading material?	Categorise after responses
D22: Are there certain skills that you are still lacking?	1=Yes 2=No
D23: Please state them	Categorise after responses
D24: Do you find the training beneficial for future expansion of your business?	1=Yes 2=No
D25: Why (whether yes or no)	Categorise after responses
D26: Were you comfortable with the language used during training?	1=Yes 2=No
D27: Have you during the course of the project asked for additional support from the following?	WF 1=Yes 2=No Ho and SO 1=Yes 2=No Government 1=Yes 2=No

SECTION E: INCLUSIVITY AND DECISION MAKING

Variable	Response
E1: Who generally makes decisions in your household?	1=self 2=spouse in HH 3=spouse outside HH 4=jointly spouse and other HH members 5=son 6=daughter 7=other HH member 8=non HH member 9=gvt or other institutions 10=clan
E2: Has this changed over the period?	1=Yes 2=No
E3: If yes, how?	Categorise after responses
E4: Are women responsible for any of the following in the household?	1=land allocation 2=fishpond construction decision making 3= fishpond construction 4=decision to hire labour 5=fishpond maintenance 6=decision for fishpond maintenance 7=feeding fish 8= decision to feed fish 9=treating sick fish 10= decision to treat sick fish 11= harvesting fish 12=decision to harvest fish 13=selling fish 14=decision to sell fish 15=fish processing 16=decision to process fish
E5: Has this changed over the period?	1=Yes 2=No
E6: If yes, how?	Categorise after response
E7: Are men responsible for any of the following in the household?	1=land allocation 2=fishpond construction decision making 3= fishpond construction 4=decision to hire labour 5=fishpond maintenance 6=decision for fishpond maintenance 7=feeding fish 8= decision to feed fish 9=treating sick fish 10= decision to treat sick fish 11= harvesting fish 12=decision to harvest fish 13=selling fish 14=decision to sell fish 15=fish processing 16=decision to process fish
E8: Has this changed over the period?	1=Yes 2=No
E9: If yes, how?	Categorise after response
E10: Are youths responsible for any of the following in the household?	1=land allocation 2=fishpond construction decision making 3= fishpond construction 4=decision to hire labour 5=fishpond maintenance 6=decision for fishpond maintenance 7=feeding fish 8= decision to feed fish 9=treating sick fish 10= decision to treat sick fish 11= harvesting fish 12=decision to harvest fish 13=selling fish 14=decision to sell fish 15=fish processing 16=decision to process fish
E11: Has this changed over the period?	1=Yes 2=No
E12: If yes, how?	Categorise after response
E13: Are women responsible for any of the following in the household?	1=food crop farming 2=decision to farm food crops 3=livestock raining 4=decision to raise livestock 5=poultry farming 6=decision for poultry farming 7=farm processing 8=decision for farm processing 9=non-farm activities 10=decision for non-farm activities 11=routine household purchase 12=decision for routine purchases 13=large household purchase 14=decision for large purchases
E14: Has this changed over the period?	1=Yes 2=No
E15: If yes, how?	Categorise after response
E16: Are men responsible for any of this in your HH?	1=food crop farming 2=decision to farm food crops 3=livestock raining 4=decision to raise livestock 5=poultry farming 6=decision for poultry farming 7=farm processing 8=decision for farm processing 9=non-farm activities 10=decision for non-farm activities 11=routine household purchase 12=decision for

	routine purchases 13=large household purchase 14=decision for large purchases
E17: Has this changed over the period?	1=Yes 2=No
E18: If yes, how?	Categorise after response
E19: Are youths responsible for any of this in your HH?	1=food crop farming 2=decision to farm food crops 3=livestock raining 4=decision to raise livestock 5=poultry farming 6=decision for poultry farming 7=farm processing 8=decision for farm processing 9=non-farm activities 10=decision for non-farm activities 11=routine household purchase 12=decision for routine purchases 13=large household purchase 14=decision for large purchases
E20: Has this changed over the period?	1=Yes 2=No
E21: If yes, how?	Categorise after response
E22: Do you hire labour?	1=Yes 2=No
E23: Has the rate of hiring labour changed over the period	1=increased 2=reduced 3=remained the same
E24: Who do you normally hire?	1=female adult 2=male adult 3=both female and male adult 4=young females 5=young males 6=both young male and female adults
E25: Have your views regarding the following inclusivity issues changed over this period? (Indicate code for each) 1=Disagree 2=Somewhat agree 3=Agree	No women ownership of fishponds No women ownership of hapas and nets Only women to clean and process fish Primarily women to trade and market fish Primarily men to transport fish to market Primarily men to control earnings from fish Primarily women to prepare meals Primarily men to engage in hatchery business Primarily men to belong to fisheries clubs Primarily men to engage in fish business
E26: Has your opinion over these changed over the period?	1=Yes 2=No
E27: If yes, how?	Categorise after response

SECTION F: PROJECT REFLECTIONS

Variable	Response
F1: In what ways do you think that HOs and FOs were helpful to you?	Explain
F2: In what ways do you think they could be more helpful?	Explain
F3: Did you ever request any additional support in any form from the project?	1 = yes, 2 = no
F4: If Yes, what was it?	Explain
F5: What are the key challenges you are currently facing in fish farming (DO NOT select beyond 3)	1 = Access to fingerlings 2 =Access to feed Training 3 = Access to labour 4 = Access to credit facilities 5 = Access to land 6 = Access to market 7 =Access to loans 8 = Access to water
F6: In what ways could feed operators and hatchery operators working with WorldFish assist you in overcoming these challenges?	Explain

G. GLOBAL FOOD DIETARY EXPERIENCE SCALE (household level)

Yesterday during the day or at night, did you eat or drink:			
	Food categories	**Description/examples to be adapted** **Replace the example foods below with items commonly consumed in the survey area(s).**	**Consumed** Yes = 1 No = 0
G1	**Any foods made from grains, like:**	*Porridge, bread, rice, pasta/noodles or other foods made from grains*	___yes (1) ___no (0)
G2	**Any vegetables or roots that are orange- coloured inside, like:**	*Pumpkin, carrots, squash or sweet potatoes that are yellow or orange inside [see **Appendix 2** for other less-common vitamin A-rich vegetables]*	___yes (1) ___no (0)
G3	**Any white roots and tubers or plantains, such as:**	*White potatoes, white yams, manioc/cassava/yucca, cocoyam, taro or any other foods made from white-fleshed roots or tubers, or plantains*	___yes (1) ___no (0)
G4	**Any dark green leafy vegetables, such as:**	*List examples of any medium-to-dark green leafy vegetables, including wild/foraged leaves*	___yes (1) ___no (0)
G5	**Any fruits that are dark yellow or orange inside, like:**	*Ripe mango, ripe papaya [see **Appendix 2** for other less-common vitamin A-rich fruits]*	___yes (1) ___no (0)
G6	**Any other fruits**	*List examples of any other fruits*	___yes (1) ___no (0)
G7	**Any other vegetables**	*List examples of any other vegetables*	___yes (1) ___no (0)
G8	**Any meat made from animal organs, such as:**	*Liver, kidney, heart or other organ meats or blood-based foods, including from wild game*	___yes (1) ___no (0)
G9	**Any other types of meat or poultry, like:**	*Beef, pork, lamb, goat, rabbit, wild game meat, chicken, duck, other birds*	___yes (1) ___no (0)
G10	**Any eggs**	*Eggs from poultry or any other bird*	___yes (1) ___no (0)
G11	**Any fish or seafood,**	*Fresh or dried fish, shellfish or seafood*	___yes (1)

	whether fresh or dried		___no (0)
G12	**Any beans or peas, such as:**	*Mature beans or peas (fresh or dried seed), lentils or bean/ pea products, including hummus, tofu and tempeh*	___yes (1) ___no (0)
G13	**Any nuts or seeds, like:**	*Any tree nut, groundnut/peanut, or certain seeds or nut/seed "butters" or pastes*	___yes (1) ___no (0)
G14	**Any milk or milk products, such as:**	*Milk, cheese, yoghurt or other milk products, but NOT including butter, ice cream, cream or sour cream*	___yes (1) ___no (0)

Now I would like to ask you some questions about food. During the last 12 MONTHS, was there a time when:	
G15. You were worried you would not have enough food to eat because of a lack of money or other resources?	0 No 1 Yes 98 Don't Know 99 Refused
G16. Still thinking about the last 12 MONTHS, was there a time when you were unable to eat healthy and nutritious food because of a lack of money or other resources?	0 No 1 Yes 98 Don't Know 99 Refused
G17. You ate only a few kinds of foods because of a lack of money or other resources?	0 No 1 Yes 98 Don't Know 99 Refused
G18. You had to skip a meal because there was not enough money or other resources to get food?	0 No 1 Yes 98 Don't Know 99 Refused
G19. Still thinking about the last 12 MONTHS, was there a time when you ate less than you thought you should because of a lack of money or other resources?	0 No 1 Yes 98 Don't Know 99 Refused
G20. Your household ran out of food because of a lack of money or other resources?	0 No 1 Yes 98 Don't Know 99 Refused
G21. You were hungry but did not eat because there was not enough money or other resources for food?	0 No 1 Yes 98 Don't Know 99 Refused
G22. You went without eating for a whole day because of a lack of money or other resources?	0 No 1 Yes 98 Don't Know

Annex 2: Focus Group Discussion (FGD) Guide (for fish farmers)

This FGD guide is categorised into two: **impact** and **process** issues. The former category is divided into five discussion sessions (A-E), each focusing on an impact criterion. This guide is designed to indicate the direction in terms of guiding discussion sessions around a specific issue instead of asking a list of direct questions in a way similar to an interview, allowing for deeper insights into the impact criteria. In addition, this guide will be used for three separate categories of respondents (male, female, and youth).

A. Access issues

This session will initiate a discussion and guide it around:

1. Access to key input (fish seed/feed) and output markets at the beginning and at the end of the intervention
2. Participation and involvement in training and extent of knowledge/extension enhancement for productivity and profitability at the end of the intervention as compared to the beginning of the project
3. Indicators and examples of adoption and enhancement of access, income, etc
4. Perceptions regarding access and participation for other specific socio-economic categories (outside their own female, male, or youth) in terms of numbers
5. Support provided by socio-economic category from actors within the value chain
6. Training at baseline and changes in training from aquapreneurs or private sector

B. Production

This session will initiate a discussion and guide it around:

1. Production levels (yields per harvest and any changes over the period) both at the beginning and end of the intervention amongst their community and specifically for other specific socio-economic categories (outside their own female, male, or youth)
2. Any changes over the period from the beginning to the end in terms of total sales accrued by both individual and cluster farmers
3. Any production related opportunities and challenges over the period and how they have been leveraged and addressed respectively. How these opportunities and challenges have varied by gender and age
4. Perceptions regarding changes in fish consumption in the community with specific examples and indicators highlighted

C. Income

This session will initiate a discussion and guide it around:

1. Changes in markets, buyers and consumers accessing fish from the farmers
2. Changes in total income coming from the sale of fish
3. Market and other opportunities and challenges to increased income
4. Decision making over use, where, when and who to sell fish
5. Linkages to service providers and other actors

D. Nutrition/dietary diversity

This session will initiate a discussion and guide it around:

1. Access and consumption and related changes of diverse nutrient-rich food, fish included and variances by gender and age as well as vulnerability
2. Frequency of fish consumption (daily, weekly, monthly…)

E. Productivity

This session will initiate a discussion and guide it around:

1. Influence of inclusivity on productivity and fish consumption

F. Perceptions regarding project issues

This session will initiate a discussion and guide it around:

1. Continuity of activities after the project
2. Adequacy of extension visits/training by hatchery and feed operators
3. Observed changes in adoption of practices for aquaculture management

Seed operator guide

1. Name of the Seed 0perator (SO)

_____

2. Name of the respondent

_____

3. Location

_____

4. Sex of the respondent

○ Male
○ Female

5. Age of the respondent _____

6. Marital status of the respondent

○ Married
○ Never married
○ Divorced
○ Widowed
○ Separated
○ Living together

7. Are family members involved in the SO business? _____
8. Who owns the SO business? _____
9. Who manages and makes the important decisions? _____
10. What are the important tasks required to operate the SO_____
11. Who undertakes these tasks? _____
12. Number of farmers you supplied before the project 1 = 1-20, 2 = 21-50, 3 = 51-100, 4 = More than 100
13. Number of farmers you supply now 1 = 1-20, 2 = 21-50, 3 = 51-100, 4 = More than 100
14. Number of farmers you supplied by gender before the project Male 1 = 1-20, 2 = 21-50, 3 = 51-100, 4 = More than 100 Female 1 = 1-20, 2 = 21-50, 3 = 51-100, 4 = More than 100
15. Number of farmers you supply by gender now Male 1 = 1-20, 2 = 21-50, 3 = 51-100, 4 = More than 100 Female 1 = 1-20, 2 = 21-50, 3 = 51-100, 4 = More than 100

16. Number of farmers you supplied by age before the project 18-30 1 = 1-20, 2 = 21-50, 3 = 51-100, 4 = More than 100;
17. Number of farmers you supply by age now 18-30 1 = 1-20, 2 = 21-50, 3 = 51-100, 4 = More than 100;
18. Number of fingerlings sold before the project <1,000= 1, 1001-2000 = 2, 2001-3000 =3, 3001-4000 =4, 4001-5000 = 5, >5000 = 6
19. Number of fingerlings sold now <1000= 1, 1001-2000 = 2, 2001-3000 =3, 3001- 4000 =4, 4001-5000 = 5, >5000 = 6
20. Cash from sold fingerlings before the project$10/1,000= 1 $20/1000= 2 $30/1000= 3 $40/1000 = 4 $50/1000= 5 >$50/1000= 6
21. Cash from sold fingerlings now $10/1,000= 1 $20/1000= 2 $30/1000= 3 $40/1000 = 4 $50/1000= 5 >$50/1000= 6
22. Number of fishponds before the project 1= 1 2= 2 3= 3 4= 4 5-10= 5 11-15= 6 15-20= 7 20+= 8
23. Number of fishponds now 1= 1 2= 2 3= 3 4= 4 5-10= 5 11-15= 6 15-20= 7 20+= 8
24. Size of ponds before the project 1 = small (100m2) 2= medium (101-400m2) 3= large (>400m2)
25. Size of ponds now 1 = small (100m2) 2= medium (101-400m2) 3= large (>400m2)
26. Number of fingerlings stocked before the project 1/m2= 1 2/m2= 2 5/m2= 3 10/m2= 4 >10/m2= 1
27. Number of fingerlings stocked now 1/m2= 1 2/m2= 2 5/m2= 3 10/m2= 4 >10/m2= 1
28. Number of excess fingerlings categories based on responses
29. Growth performance of the supplied fingerlings 10 and below%= 1 10-20%= 2 21-30%= 3 30-50%= 4 51-100%= 5 >100%= 6
30. Do you have a regular and sufficient supply of broodstock?
31. What are your main costs as a SO?
32. Is there a ready market for your fingerlings?
33. Do other fish farmers in the area purchase your fingerlings? If not, why not?
34. Are fish farmers satisfied with the quality of your fingerlings?
35. Do you have a steady supply of feed for your fingerlings? What feed do you use?
36. Do you provide any training to fish farmers about how to raise fingerlings?
37. Have you participated in the innovation platform?
38. What type of training and mentoring have you received from WF?
39. Are you able to work out the profit you make from your business?
40. What part of your income is generated from selling fingerlings?

Feed operators guide

1. Name of the Feed Operator (FO)

_____

2. Name of the respondent

_____

3. Location

_____

4. Sex of the respondent

◯ Male

◯ Female

5. Age of the respondent _____

6. Marital status of the respondent

- ◯ Married
- ◯ Never married
- ◯ Divorced
- ◯ Widowed
- ◯ Separated
- ◯ Cohabiting

7. Are family members involved in the FO business?

- ◯ Yes
- ◯ No

8. Who owns the FO business? _____
9. Who manages and makes the important decisions? _____
10. What are the important tasks required to operate the SO? _____
11. Who undertakes these tasks? _____
12. Type of feed supplied 1=Fingerling 2 = Broodstock feed
13. Quantities of feed sold/month before the project
14. Quantities of feed sold/month now
15. Number of farmers buying feed before the project by gender Male 1=1-20, 2=21-50, 3=51-100 Female 1=1-20, 2=21-50, 3=51-100
16. Number of farmers buying feed now by gender Male 1=1-20, 2=21-50, 3=51-100 Female 1=1-20, 2=21-50, 3=51-100
17. Number of farmers buying feed before the project by age 18-30 1=1-20, 2=21-50, 3=51-100 31-50 1=1-20, 2=21-50, 3=51-100 above 50 1=1-20, 2=21-50, 3=51-100
18. Number of farmers buying feed now by age 18-30 1=1-20, 2=21-50, 3=51-100 31-50 1=1-20, 2=21-50, 3=51-100 above 50 1=1-20, 2=21-50, 3=51-100
19. What are your main costs for the FO business?
20. What percentage of your overall business is supplying feed to fish farmers?
21. What markup do you put on your fish feed?
22. What income do you generate from the FO business?
23. Are you able to work out the profits arising from the SO business?
24. Is being a FO profitable?
25. Do you sell all types of fish feed?
26. Do you have a regular and sufficient supply of feed for sale?
27. Do you have a regular number of customers amongst fish farmers?
28. Are there local fish farmers who do not buy commercial feed?
29. Are fish farmers satisfied with the quality of the feed supplied?
30. Do you provide any training to fish farmers about the use of the fish feed?
31. Have you participated in the innovation platform?
32. What type of training and mentoring have you received from WF?

Annex 3: Key Informant Interview (KII) checklist (for WorldFish and partners)

These interviews will be conducted with project team members

Questions will be asked details required around:

1. IBEMs developed
2. Innovation platforms established
3. Training material developed
4. Youths integrated into the IBEMs
5. Women integrated into the IBEMs
6. Assessments carried out on IBEMs
7. Realistic project objectives in line with time, budget, institutional context?
8. Project activities and outputs aligned with objectives?
9. Delivery of project outputs
10. WorldFish and government collaboration
11. Quality of feed
12. Women and youth involvement and benefits
13. Private sector commitment
14. Quality of seed- fingerlings
15. Decision making in IBEMS in terms of marketing, distribution, and selling
16. Inclusivity and Changes in livelihood status

Annex 4: Project Evaluation Matrix using the OECD-DAC Quality Standards for Development Evaluations

OECD Criteria	Evaluation Questions	Source of data	Data collection methods	Data collection Tools
Relevance	To was extend was the project relevant?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
Effectiveness	How effective were the project delivery mechanisms?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
	Were the activities of the project implemented on time?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
Efficiency	To what extend was the project implementation efficient?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
	To what extent did WorldFish work with partners contributing to greater efficiencies in the program delivery?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
Visibility	Was communication and dissemination of project outputs adequate?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
Impact	To what extent did the project contribute to the intended impact?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories

	What real difference(s) has the project made on male and female beneficiaries?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
Sustainability	How sustainable are the project benefits?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
	What systems, structures and procedures were put in place to sustain the gains from the project?	Fish farmers, WF, DoF, NGO & academia staff; other stakeholders, document review	Desk study, survey, FGDs, KIIs	FGD guide, KII checklist, Observations, Success stories
Recommendations	What are the recommendations for the future and for scaling activities and models?			

Annex 5: List of Respondents of the Key Informant Interviews (KIIs)

Name	Gender	Contact	District	Category
Mary Lundeba	F	Aquaculture Scientist	Zambia	WorldFish
Keagan Kakwasha	M	M&E Specialist	Zambia	WorldFish
Chrissy Banda	F	District Fisheries Officer	Thyolo	Gvt, DOF
Grace Chijere	F	District Fisheries Officer	Mwanza	Gvt, DOF
Netsayi Mudege	F	Project Leader	Zambia	WorldFish
Irima Gondwe	F	District Fisheries Officer	Blantyre	Gvt, DOF
Alinafe Maluwa	M	Research Assistant	Malawi	WorldFish
Catherine Mwema	F	Value Chain Expert	Zambia	WorldFish
Rodrick Mbirizi	M	Agribusiness Officer	Blantyre	Gvt, DOF
Clessencio Likongwe	M	District Fisheries Officer	Mulanje	Gvt, DOF
Chimwemwe Tembo	M	District Fisheries Officer	Phalombe	Gvt, DOF
Florence Namala	F	Fisheries Extension Officer	Phalombe	Gvt, DOF
Timothy Kamthunzi	M	Irrigation Officer (Acting as a District Fisheries Officer)	Mwanza	Gvt, DOF
Titus Phiri	M	Officer in Charge-National Aquaculture Centre	Zomba	Gvt, DOF
Hassib Sainani	M	Officer in Charge-Kasinthula Fisheries Research Unit	Chikwawa	Gvt, DOF
George Mwazanga	M	Department of Fisheries	Zomba	Gvt, DOF
Mr Denish Chinkhata	M	Innovative Fish Farmers Network trust (IFFNT)/Sherick Enterprise	Lilongwe	Private sector
Mr Moses Simwaka	M	Aqualink	Lilongwe	Private sector
Mr Supriano	M	Maldeco/Aquaculture Enterprise	Blantyre	Private sector
Miss Thandiwe	F	CADECOM	Blantyre	Private sector
Messias Mecuane	M	GIZ	Blantyre	Private sector

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