FINAL TECHNICAL REPORT / RAPPORT TECHNIQUE FINAL

# GENDER INCLUSIVE FINANCING FOR SCALING UP IMPROVED FISH PROCESSING TECHNOLOGIES IN MALAWI

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# Gender Inclusive Financing for Scaling up Improved Fish Processing Technologies in Malawi

**IDRC Project Number:** 108865-001

**Research Organizations involved in the study:**
University of Malawi - Chancellor College
Malawi Department of Fisheries – Fisheries Research Unit
FDH Bank Limited
World Fish

**Location of Study**
Mangochi, Salima, Nkhotakota, and Nkhata Bay districts in Malawi

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**Final Technical Report**

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## 1. Executive Summary

Improved smoking kilns (ISK) and fish solar tent dryers (FSTD), herein termed Improved Fish Processing Technologies (IFPTs), possess great potential in reducing fish postharvest losses along the fish value chain and improving fish supply and consumption. Unfortunately, efforts to scale out the adoption of IFPTs are constrained by lack of access to financial capital and markets by value chain actors. Women face more challenges than men in accessing these opportunities. This creates the need to develop a gender sensitive business model for scaling improved fish processing technologies that consider the challenges raised above. This project was responding to these challenges by developing and promoting an innovative business model to scale-out adoption of IFPTs among men, women, and the youth. The innovative business model is comprised of the IFPTs, a gender inclusive commercial bank loan package, female and male fish processors who are willing to use the loan package, markets for fish products from the IFPTs, certification of the fish products by the Malawi Bureau of Standards (MBS), and supply chains for IFPTs. In pursuing this goal, the project has achieved the following outcomes:

i. A gender inclusive commercial bank loan package has been developed and promoted among the fisherfolk who could not ordinarily access commercial bank financing because of the requirements. The loan package is also friendly to women by charging them an interest rate that is 2% lower than what men are paying.
ii. After promoting the loan package, 60 individuals (25 female and 35 male) applied for loan package to finance building of IFPTs. FDH bank approved loans for 18 applicants (10 female and 8 male) and six of them (three women and three men) have accessed the loan by reporting time.
iii. One fish processor decided to use the loan package to become a bulk buyer/off taker. The processor used the commercial bank loan to support a cooperative of 15 young women to access financing from the government's Agricultural Commercialisation Project (AgCOM). The cooperative accessed about CAD 48,609 (AUD 51,886) from AgCOM. The cooperative sells processed fish products to the bulk buyer who in turn supplies supermarkets.
iv. Local suppliers of construction materials for the IFPTs, including UV treated plastic paper for the solar dryers, have started operating in the project sites.
v. The project has developed two quality regulation standards for processed fish products: one for dry fish (DMS 1435:2018) and another for smoked (MS 117:2018) from the IFPTs. These were approved by Malawi Bureau of Standards and are being used to monitor the quality of fish on the market.

This is a business model that has been developed and has the potential to self-sustain because it provides incentives for all actors to participate.

Alongside developing the innovative business model, new research evidence was generated. We compared the quality of fish processed by different technologies and observed significantly higher microbial population in traditional smoked products (log 5.9 cfu/g) than in improved smoking kiln smoked products (log 2.2 cfu/g) ($P$=0.003). Research findings also show that fish products from improved smoking kilns have longer shelf life (nine weeks) than fish products from the traditional smoking kiln (four weeks). An assessment of the effects of solar tent dryers on fish post-harvest losses showed that total physical losses were higher in open sun dryers (37%) than in solar tent drying (12.8%). Similarly, total quality loss was higher in open sun drying (26.3%) than in solar

tent drying (11.9%). These findings show that solar tent drying reduces physical and quality losses by 24.2% and 15.1%, respectively.

Further, the project has shown that women in fishing communities (Pro-WEAI Score=0.70) are less empowered than women in non-fishing communities (Pro-WEAI Score=0.79). In empowering women in the fishing communities, gender transformative approaches (GTA) were used. We trained 36 gender champions (11 female and 25 males) (details in section 3) to reach out to 319 fellow community members (196 females and 123 males) in a space of five months. Econometric analysis showed that GTA activities increased women empowerment by 3.15 percentage points, and this is statistically significant.

## 2. The research problem

Many Malawians depend on fish as an affordable source of dietary animal protein, and source of micronutrients as well as a source of livelihood. Small fish species, which are eaten whole are a rich source of proteins, calcium, vitamin A, iron, and zinc, which are essential for cognitive and physical development (WorldFish, 2011, HLPE 2014). However, high postharvest losses estimated at 34% (Chiwaula, Kanyerere, and Nagoli, 2017) threatens the contributions of fish to food, nutritional, and income security as well as, livelihoods of many actors of the fish value chain. Our earlier studies have shown that improved fish processing technologies (IFPTs) (i.e., improved smoking kilns (ISK) and fish solar tent dryers (FSTD) possess great potential to reduce fish postharvest losses along the fish value chain.

Women are the main actors in fish processing (Nagoli et al., 2018), hence more likely to benefit from IFPTs. However, women face more challenges than men in accessing knowledge, capital, and markets. More importantly, women have lower control over resources which make it difficult for them to acquire improved technologies and increase production of processed fish. In addition, women have challenges of land ownership within the landing sites, which affects their access to capital investments. Previous studies showed that women have lower willingness to pay for owning IFPTs than men (Chiwaula et al., 2017, Chiwaula et al., 2018, Nagoli et al., 2018). Further, women are more risk averse and are likely not to make risky decisions in financial markets than men (Byrnes et. al., 1999, Chen 2018). These factors affect how women respond to opportunities that promote their financial base such as adoption of improved fish processing technologies.

This project has developed and promoted an innovative business model that is used to scale-out adoption of IFPTs among men, women, and the youth. The innovative business model is comprised of the improved fish processing technologies (IFPTs), a gender inclusive financing mechanism, a bulk buyer (off-taker) of processed fish, fish processors who are willing to use the financing mechanism to adopt the technologies, markets for fish products from IFPTs, standards for certifying products from IFPTs, and linkage to associated supply chains.

In implementing the business model, the project negotiated for a gender inclusive commercial bank loan package with a commercial bank which has been accessed by six individuals (3 females and 3 males), one of the six beneficiaries is operating as a bulk buyer (off-taker), PTC which has shops throughout the country and two other supermarkets are being used to sell processed fish products, we have developed two fish standards(DMS 1435:2018 for dry fish and MS 117:2018 for smoked that have been approved by the Malawi Bureau of Standards to guide the certification process, and there are other individuals who are now selling the materials for constructing solar dryers and improved smoking kilns in the communities.

Our project has also generated scientific research evidence that further assists in the design of the interventions. At the beginning of the project, we planned to use the Women Economic Empowerment Index (WEAI) to measure women empowerment, but we migrated to the project-level Women's Empowerment in Agriculture Index (pro-WEAI) which is a new survey-based index that builds on the WEAI. The pro-WEAI is designed for an agricultural set up and we contextualised it to the fisheries sector by adding fishing assets as well as fisheries livelihoods in the questionnaire. We used the pro-WEAI to measure women empowerment before and after implementing women empowerment activities through gender transformative approaches (GTA).

We find that GTA activities increased women empowerment by 3.15 percentage points. The project has also shown that solar tent dryers reduce physical and quality losses by 24.2% and 15.1%, respectively.

We have implemented the project from 1 October 2018 to 31 March 2021, and we have made variable progress towards the milestones that were set at the beginning of the project. We describe the achievements on the project milestones.

## 3. Progress towards milestones

### 3.1 Developing gender inclusive financing mechanism for increasing adoption of IFPTs

#### *3.1.1 Scientific manuscript on effect of IFTP on fish post-harvest loss submitted*

The aim of this milestone was to establish the magnitude of the PHL reduction effect of the IFPTs. In the first phase, we measured the level of fish PHL, but we did not establish the reduction in fish PHL that is caused by the use of IFPTs. We have assessed the effect of the use of a solar tent dryer in reducing fish post-harvest losses and we employed the load trucking method. We did not assess the same for improved smoking kilns because the level of adoption of ISK in Lake Malawi fisheries were low at the time when we were implementing this study. To this effect, we have developed a manuscript titled "*Effect of solar tent drying on fish post-harvest loss reduction along the fish value chain in Malawi*". We completed this paper, and it is being submitted. The draft manuscript is included in Annex 1.

#### *3.1.2 Develop a gender inclusive commercial bank loan package*

In this milestone, we aimed at developing and testing the effectiveness of innovative financing approaches of scaling of improved fish processing technologies. The financing package is supposed to be gender inclusive and recognise the unique features of the fishing sector, as well as the requirements of the commercial bank. In developing the gender inclusive commercial bank loan package, we began by initially meeting fish processors who were potential users of the loan package to share the idea with them. We engaged them in a meeting where we shared our initial thoughts and we enabled them to provide feedback. FDH Bank Limited and MBS also participated in this meeting. This meeting was also used to collect information about the features of the loan package that will suit the fishing communities. The initial meeting involved 31 potential adopters (15 males and 16 females). We then used the inputs from the potential users to further negotiate with the bank on the attributes of the loan package. This milestone has been achieved and - a loan package that gives women a reduced interest than that of men was negotiated with FDH Bank Limited.

### 3.2 Scaling out IFPTs to increase production and marketing of quality processed fish products

#### *3.2.1 Standards for dried fish developed and promoted*

Standards for fish products are expected to assist the Malawi Bureau of Standards (MBS) in certifying the products as well as regulate the quality of fish that is found on the market. This will protect fish products from the solar tent dryer and the improved smoking kiln when they are placed in supermarkets, since poor quality fish will not meet the standards. In this project, we have

reviewed and developed two standards for two fish products: "Dried small freshwater pelagics – DMS 1435:2018" (Annex 2) and smoked, smoke-flavoured and smoke-dried finfish – MS 117:2018 (Annex 3). These standards have been approved by the Malawi Bureau of Standards. The implementation of the developed and approved standards is voluntary with public awareness on the benefits of purchasing and consuming certified fish products. The approved standards will be reviewed every five years to keep abreast of the progress. Presently, the bulk buyer/off-taker has been provided with a pre-certificate by MBS which has allowed him to sell his products in supermarkets within Malawi.

### *3.2.2 Assess shelf-life of different products and promote vacuum packaging*

This activity was not originally indicated as a milestone. It became necessary to conduct this activity when we noted that we could not develop the standard for smoked fish without generating quality and safety parameters for the product. To assess the shelf life of smoked fish products, we conducted quality and shelf-life experiments with fish products from improved smoking kilns. Our results show that fish products processed using the improved smoking kiln had a higher shelf life (nine weeks) than those processed using traditional kilns (four weeks). Also, packed products from the ISK had reduced enzymatic activity responsible for the primary, secondary and tertiary oxidation process. Additionally, incidences of accidents e.g., burning resulting from exposure to open flame, were reduced. Fish processors using the ISK had more time to attend to other household chores since it does not require a full-time presence of the processor as ISK are not labour intensive. We also found out that the ISK uses less firewood (reduction of fuelwood usage by 59%) to process the same quantity of fish than using the traditional kiln. A manuscript has been developed from the results of this experiment (Annex 4) and we will be submitting this to a journal by June 2021.

### *3.2.3 A gender inclusive commercial bank loan package rolled out*

We have implemented a number of face-to-face meetings to introduce a gender inclusive commercial bank loan package to potential beneficiaries as well as equip them with business skills. The training sessions for promotion of a gender inclusive commercial bank loan package also included topics on gender transformative approaches. To date, up to 111 individuals have been reached with information about the financing product. These were reached through sensitisation meetings (31) and business management training (80) with potential adopters. Up to 60 individuals (25 female and 35 male) applied for loans to finance building of IFPTs out of which FDH bank approved loans for 18 applicants (10 female and 8 male). These applications were approved based on their monthly turnovers and the assessment did not use a gender lens. Since the assessment of the applications did not consider the sex of the applicants, this shows that with support, women can compete for financial resources with men. As of now, 6 applicants have accessed their loans after fulfilling requirements by the bank. Three of these were women and three were men.

One of the beneficiaries of the loan package, Nyampesi Fish Products who started using Solar tent dryers in CultiAF 1, obtained a loan to develop his business as a bulk buyer. He used his loan to support a cooperative of 15 young ladies (Fishland Ladies) to apply for matching funds from the government run AgCOM). Fishland Ladies was to develop their fish processing business and become suppliers of processed fish to Nyampesi Fish Products who in turn supplies supermarkets. AgCOM funded Fishland Ladies to the tune of MK36,740,000 (about CAD48,609/AUD51, 886) which they have used to acquire a boat with engine and fishing gear (Chilimira open water seine

net), two solar tent dryers, among others. These are now the largest supplier of processed fish for Nyampesi Fish Products. Fishland Ladies have also employed over 20 people that are involved in the catching and processing of fish thus reducing unemployment.
To support adoption of the loan package, we also organised a study visit for 3 women and one male fish processor from the other scaling districts (Salima and Nkhotakota) to Mangochi to assist them learn from their colleagues who have started accessing the funds.

## 3.3 Evaluating the impact of scaling strategies on economic empowerment of men, women, and the youth

### *3.3.1 Fish processing and certification trainings conducted*

The aim of this activity was to build the capacity of beneficiaries to process fish using improved fish processing technologies as well as obtain certification for the fish products. By the end of the project, we have trained 23 females and 19 males on fish processing methods by using solar tent dryers and improved smoking kilns; as well as packaging, and marketing processed fish products. We also trained 11 females and 8 males in fish standards and certification processes. This is important in supporting and facilitating entry and participation for women and youth in gainful and attractive agro-business opportunities in the fish value chain.

### *3.3.2 GTA tools rolled out*

This activity combined activities that aimed at promoting improved fish processing technologies and gender transformative activities. The activities were implemented in the form of distribution of print materials, roleplay, and presentations about how the IFPTs are constructed and used and the benefits of IFPTs. Value chain actors from seven project sites were invited to attend sensitisation meetings. The meetings were conducted in March 2020, and we reached 189 value chain actors (94 females and 95 males). The project also trained 36 GTA champions (11 female and 25 males) which included Chairpersons of Beach Village Committees, Chairpersons of Village Savings and Loans Associations (VSLAs), Chiefs, and landing site Fisheries Extension Officers. The champions were trained in the following topics: understanding gender and gender concepts, social construction of gender, gender and culture, gender-based violence, gender and economic empowerment (with regard to fish value chains), gender and sexual and reproductive health in the fisheries sector, and facilitation skills. In turn, the GTA champions trained 319 fellow community members (196 females and 123 males) in a space of five months.

### *3.3.3 Impact assessment conducted of scaling out strategies on economic empowerment*

In attaining this milestone, we planned to measure women empowerment before the interventions and then we measure again after the intervention. Three districts Mangochi, Salima, and Nkhotakota are considered as treatment districts while Nkhata Bay has been designated as a control district. We collected data from 721 (186 participants were for focus group discussion) individuals between 17 and 28 February 2020 and the sample distribution is presented in Table 1 below.

*Table 1: Distribution of the sample for the baseline women empowerment survey*

| District | Male | Female | Total |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Mangochi | 69 | 158 | 227 |
| Salima | 17 | 25 | 42 |
| Nkhotakota | 49 | 106 | 155 |
| Nkhata Bay | 71 | 226 | 297 |
| Total | 206 | 515 | 721 |

The report for the baseline level of women empowerment is presented in Annex 5 and summary results in the next section.

## 4. Synthesis of research results to date

Below we synthesize research results that have been generated in the course of implementing this project. The results are presented for each of the research objectives.

### 4.1 Developing gender inclusive financing products for increasing adoption of improved fish processing technologies

#### *4.1.1 The gender inclusive commercial bank loan package*

The first objective of this project was to develop a gender inclusive financing product that could be used to assist fish processors to adopt solar tent dryers and improved smoking kilns. Following views from fish processors and negotiations with the FDH Bank Limited, a gender inclusive financing product was developed and adopted by the bank.

Key characteristics of aspects of the gender inclusive innovative financing product are as follows:

1) The financing was made available to individuals who are ordinarily unbankable because of low or absent collateral, as well as low literacy levels.
2) The interest rate for the facility is 23% per annum for men and 21% per annum for women.
3) The loan charged a 2.0% arrangement fee on the loan amount to be recovered upfront, repayment is done in 12 months payable in equal monthly instalments.
4) Upon request from the customer the payments can be aligned to coincide with peak fishing months only, but full repayment to be made within a period of 12 months.
5) A cash cover equivalent to 20% of the loan amount is to be provided by the borrower as security for the loan.

The characteristics show that the loan facility is accessible to individuals who would not access loans, has a pricing that favours women, and applies a flexible repayment schedule.

#### *4.1.2 Financial inclusion in the fisheries Sector*

Development and promotion of the innovative finance product assumed that value chain actors in the fish value chain face some form of financial exclusion. The extent to which the fisheries sector is financially excluded has not been generated and we aimed at generating this information when we were conducting the baseline survey. This assessment was done by an MBA student in the project. The survey included questions that assessed the level of financial (ex)inclusion in the fisheries sector. In Figure 1, we show that 26.7% of the respondents save money at a formal bank, while 8.5% save money with microfinance organisations and 1.6% save money with SACCO. Aggregately, 36.8% of the respondents are using formal financial institutions for their savings which is lower than 55% target in the National Strategy for Financial Inclusion. However, only 4.8% of the value chain actors obtained a loan from a bank during the current project initiative. We attribute this low disbursement to the prevailing history between banks and the fisheries sector

where issues of loan safeguard were considered a problem. Banks regard fishing as a fragile business and that most fishers or processors do not have a "savings" culture and so recovering a loan would be challenging when beneficiaries default. The current project identified and linked stable fish processors with the FDH Bank, and it is expected that in future the number of beneficiaries will increase based on performance of the present beneficiaries.

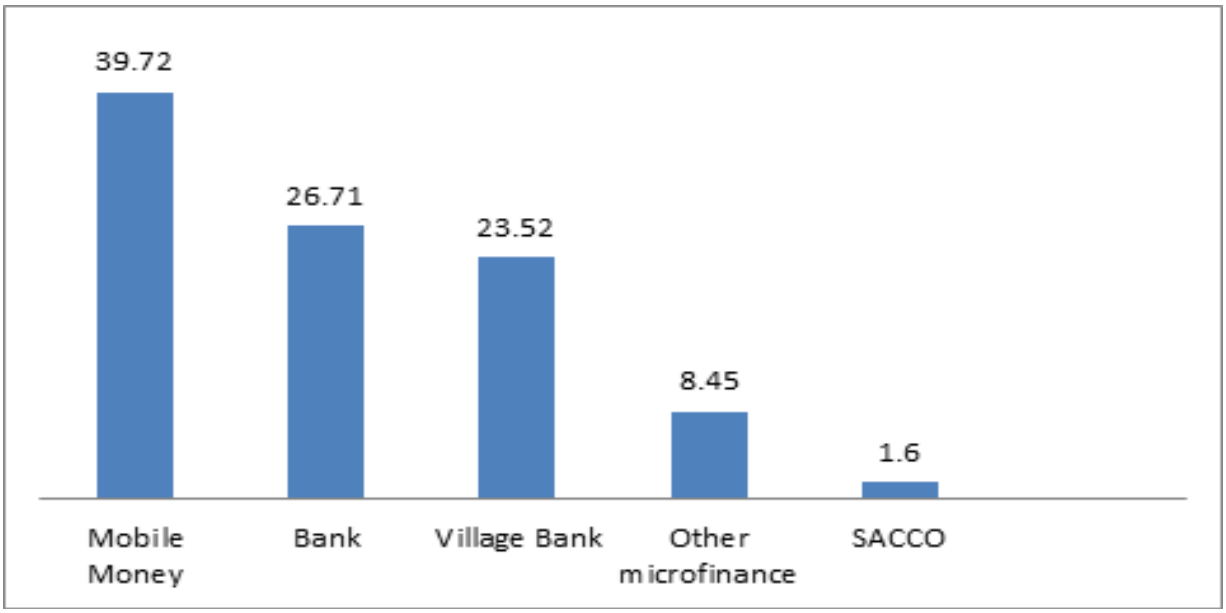


*Figure 1: Means of saving money*

### *4.1.3 Quality and safety of smoked fish products*

We assessed the quality and safety of smoked fish products to assist in the development of standards for smoked fish. Quality and safety attributes assessed include microbiological, sensory, and physicochemical. In Table 2, we present results of microbiological assessment. We observed a significantly higher microbial population in traditional smoked products log 5.9 cfu/g, which were above acceptable norms $10^5$ than in improved smoking kiln log 2.2 cfu/g ($P$=0.003). Pathogenic enteric bacteria species such as specific spoilage organisms, *Escherichia coli*, *Salmonella*, *Vibrio*, *Listeria monocytogenes* and *Staphylococcus aureus* were present in significant amounts ($P$=0.001, $P$=0.021, $P$=0.000 and $P$=0.004, respectively) in traditional smoked fish products than in improved smoking kiln. It is evidenced that these bacteria populations are likely to prove difficult to control once the fish products are with consumers. This is a cause for worry in the fish value chain as product quality and safety is becoming a concern as trade in fish products increases due to increase in demand for smoked fish products. Since there is no traceability capability of such products, any health effects on humans will be difficult to trace for proper treatment.

***Table 2: Bacteria species isolates (Log colony forming units per gram) from fresh and smoked products***

| Treatment | Fresh Fish | Traditional Smoking Kiln | Improved Smoking Kiln | *P-value* |
|---|---|---|---|---|
| TVC | 4.2 | 4.0 | 2.2 | 0.003 |
| SSO | 2.9 | 4.2 | 2.3 | 0.001 |
| *E. coli* | 2.5 | 5.1 | 0.0 | 0.021 |
| *Salmonella* | 2.2 | 4.1 | 0.0 | 0.000 |
| *L. monocytogenes* | 0.0 | 5.0 | 0.0 | 0.004 |
| *S. aureus* | 1.9 | 3.5 | 0.0 | 0.031 |
| *C. perfringens* | 0.0 | 0.0 | 0.0 | 0.602 |
| *Vibrio* | 2.8 | 4.8 | 0.0 | 0.011 |

Sensory properties such as smell, texture, colour, and overall quality of the smoked fish products assessed by volunteers showed that products from ISK had significantly ($P<0.05$) higher sensory quality scores than products from TSK (Table 3). This suggests that the sensory quality of smoked products was better with ISK.

***Table 3: Sensory quality characteristics of smoked Diplotaxodon species (ndunduma fish)***

| Treatment | Smell | Texture | Colour | Overall quality |
|---|---|---|---|---|
| Traditional Smoking Kiln | $4.51\pm0.092^{a}$ | $4.06\pm0.144^{a}$ | $4.64\pm0.09^{a}$ | $4.85\pm0.81^{a}$ |
| Improved Smoking Kiln | $3.49\pm0.144^{b}$ | $3.41\pm0.144^{b}$ | $3.61\pm097^{b}$ | $3.42\pm0.189^{b}$ |

[a]Data represent means ± standard error of three measurements.
[b] Means with the same superscript along rows are not significantly different ($p>0.05$)

We further assessed shelf life of the products using multiple analyses and the results are presented in Figure 2 below. The results show that total viable counts (log cfu/g) for fish that are smoked using traditional methods exceeds the threshold after two and half weeks while the total viable counts for smoked fish products do not exceed the acceptable norm until the ninth week. There were significantly higher spoilage organisms in products from TSK than those from ISK. This shows that fish products from improved smoking kilns as smoked products gain an addition of six and half weeks (6.5 weeks) and is a good implication of longer shelf life than fish products from the traditional smoking kiln. Therefore, using ISK has the potential to address issues of quality and safety of smoked fish products along the fisheries value chain as the method and products comply with codes of ISO-9000 Quality Assurance and ISO-22000 Food Safety.

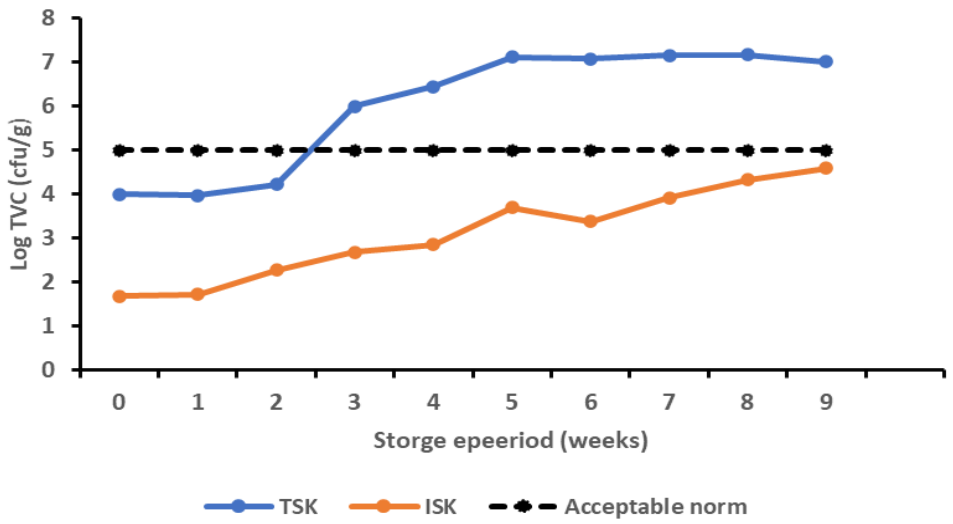


*Figure 2: Levels of Total Viable Counts over storage time*

#### *4.1.4 Comparison of the Nutritional Quality of Open Sun Dried and Solar Tent Dried Usipa (Engraulicypris sardella) of Lake Malawi along the Value Chain*

We also assessed the quality of solar tent dried fish along the value chain. This was achieved through student work. The aim was to examine changes in nutritional quality of open sun dried (OSD) and solar tent dried (STD) Usipa along the fish value chain. The findings show that there was a decrease in fat content in both samples. Further analysis of fats revealed that lipids were degrading. Analysis of peroxides (PV) (one of the by-product of polyunsaturated fatty acids degradation induced by heat, light, and oxygen) increased as the product was kept longer on the market ranging from 6.7 to 8.27 Meq $O_2$/ Kg fat and 5.3 to 6.82 (Meq $O_2$/ Kg fat) in OSD Usipa and STD Usipa, respectively. However, in STD Usipa PV values were significantly lower than in OSD, and only increased more after 3 days on the market. A similar trend was observed in TBARS, a product of further degradation of peroxides that cause rancid taste of the fish. Degradation of fat/lipids not only reduce the nutrient quality but also product quality. These findings suggest that main change in nutrient quality for dried fish was degradation of lipids, and this was higher in open sun-dried fish.

### 4.2 Increase production and marketing of quality processed fish products by increasing participation of women and the youth in the fish value chain

One of the ways of improving production of processed fish along the value chain is through the reduction of post-harvest losses. However, the effect of IFPT on fish post-harvest losses was not established in the first phase of the project. Under this objective, we assessed the effect of IFPTs on fish post-harvest losses by using the load tracking method that is illustrated in Figure 3.

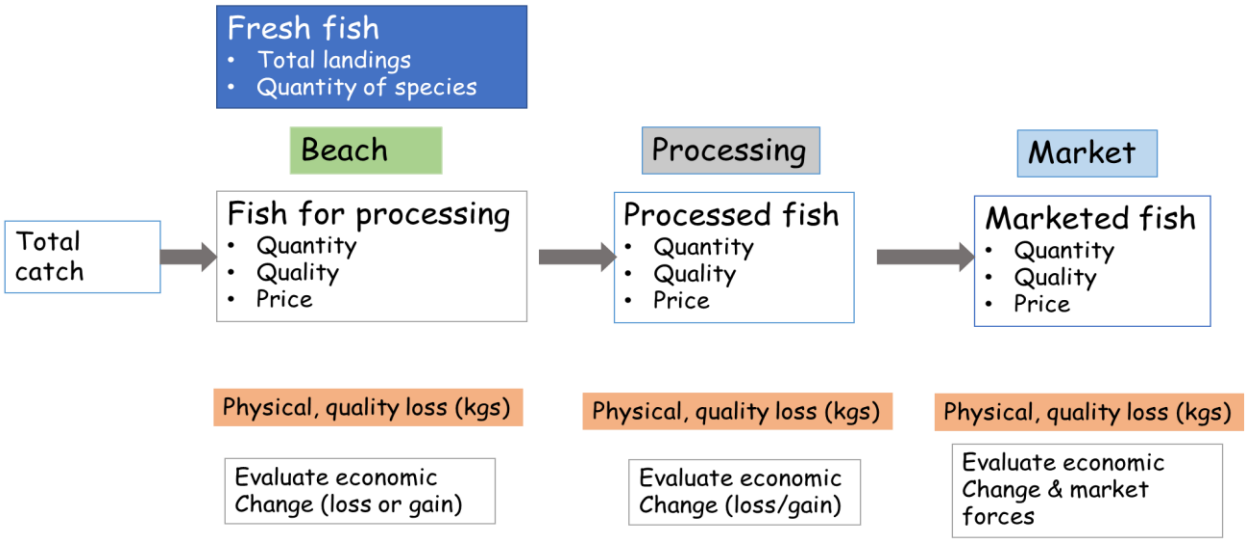


Figure 3: Flow diagram for post-harvest loss assessment using Load Tracking (LT) method

The losses were categorised into physical losses, quality losses, and economic losses and data were collected in three seasons (cold, rainy, and hot). Summary of the results is presented in Table 4 below.

*Table 4: Estimated quality, physical, and economic losses in fish across three seasons*

| | Quality (%) | | Physical (%) | |
|---|---|---|---|---|
| Season | Open sun drying | Solar tent drying | Open sun drying | Solar tent drying |
| Cold | 8.6 | 3.9 | 13 | 5.4 |
| Rainy | 10.3 | 4.6 | 16.9 | 4.3 |
| Hot | 8.4 | 3.7 | 7.1 | 3.1 |
| Total (%) | 27.3 | 11.9 | 37 | 12.8 |

Results show that physical and quality fish losses occur along the value chain and differ significantly ($P<0.05$) between seasons. Total physical losses were found to be 37% in open sun drying and 12.8% in solar tent drying, respectively. The total quality loss in open sun drying and solar tent drying were 26.3% and 11.9% in open sun drying and solar tent drying, respectively. In this regard, the solar tent drying reduces physical and quality losses by 24.2% and 15.1%, respectively. The major causes of the losses were insect infestation 39% and 5%, breakages 25% and 4%, and spoilage 19.6% and 3% for open sun dried and solar tent dried fish products, respectively. There were significant differences ($P<0.0003$) between the three causes of fish loss in open sun drying and solar tent drying. Improving post-harvest losses of small pelagics through adoption of modern technologies and best practices therefore can increase the livelihood and nutritional benefits of small pelagics fish products by increasing the economic and nutritional value of traded fish products.

### 4.3 Evaluating the impact of scaling strategies on economic empowerment of men, women, and the youth

In evaluating the impact of scaling strategies, we measured the level of women empowerment before and after the implementation women empowerment activities in the form of gender transformative approaches. This was done by comparing the level of women empowerment between fishing and non-fishing communities (done through a student) and assessing the impact of implementing gender transformative approaches on women empowerment. We used the project-level Women's Empowerment in Agriculture Index (pro-WEAI) to measure women economic empowerment. In Table 5, we compare the Pro-WEAI results for fishing and non-fishing households.

*Table 5: Comparison of levels of women empowerment for fishing and non-fishing communities*

| INDICATOR | FISHING | NON-FISHING |
|---|---|---|
| Number of observations | 148 | 133 |
| **3DE score** | 0.68 | 0.78 |
| Disempowerment score (1 – 3DE) | 0.32 | 0.22 |
| % Achieving empowerment | 0.30 | 0.45 |
| % Not achieving empowerment | 0.70 | 0.55 |
| Mean 3DE score for not yet empowered | 0.55 | 0.59 |
| Mean disempowerment score (1 – 3DE) | 0.45 | 0.41 |
| **Gender Parity Index (GPI)** | 0.85 | 0.89 |
| Number of dual-adult households | 57 | 34 |
| % Achieving gender parity | 0.50 | 0.44 |
| % Not achieving gender parity | 0.50 | 0.56 |
| Average empowerment gap | 0.30 | 0.19 |
| **PRO-WEAI SCORE** | **0.70** | **0.79** |

The findings show that the aggregate pro-WEAI score for women in fishing households is 0.70 and non-fishing households 0.79. This means that women in non-fishing communities are more empowered than women in fishing communities. This calls for intensification of the implementation of women empowerment activities in these communities. In assessing the impact of GTA we designated one of the districts (Nkhatabay) as a control, and the remaining three (Mangochi, Salima and Nkhotakota) as treatment districts. However, at implementation stage, three sites in Mangochi were not exposed to the treatment and we defined them as control sites during the analysis. In Table 6, we compare the baseline and endline levels of women empowerment levels for the treatment and control sites.

*Table 6: Baseline level of women empowerment in the project site*

| | BASELINE | | | | ENDLINE | | | |
|---|---|---|---|---|---|---|---|---|
| | Control | | Treatment | | Control | | Treatment | |
| | Women | Men | Women | Men | Women | Men | Women | Men |
| Number of observations | 342 | 123 | 137 | 66 | 199 | 62 | 96 | 30 |
| 3DE score (or 5DE score) | 0.73 | 0.76 | 0.71 | 0.79 | 0.70 | 0.75 | 0.80 | 0.71 |
| % Achieving empowerment | 37% | 43% | 35% | 48% | 33% | 44% | 53% | 40% |
| Mean adequacy score for not yet empowered | 0.57 | 0.58 | 0.55 | 0.59 | 0.55 | 0.55 | 0.57 | 0.52 |
| | | | | | | | | |
| Number of dual-adult households | 123 | | 66 | | 62 | | 30 | |
| GPI score | 0.88 | | 0.81 | | 0.93 | | 0.9 | |
| % Achieving gender parity | 56% | | 34% | | 68% | | 50% | |
| Average empowerment gap | 0.26 | | 0.29 | | 0.22 | | 0.2 | |
| | | | | | | | | |
| **pro-WEAI score** | 0.74 | | 0.72 | | 0.72 | | 0.81 | |

The findings show that the pro-WEAI score for the treatment districts was higher (0.81) than it was for the control districts (0.72). This suggests that the gender transformative activities we implemented raised the level of women empowerment. An application of the ANCOVA regression showed that GTA activities increased women empowerment by 3.15 percentage points, and this is statistically significant.

## 5. Synthesis towards AFS themes

### 5.1 Increasing agricultural productivity (Availability)

In the past one year, our project has increased agricultural productivity in a number of ways. Firstly, the promotion of Solar Tent Dryers among the fish processors made the project to make more healthy fish available through the reduction of postharvest losses. The study on the effects of solar tent dryers on fish postharvest losses has assisted in showing the magnitude of losses that are being prevented by using this technology. This means that the adoption of new technologies through the innovative gender financing mechanism will increase fish availability. Further to this, the project has introduced the improved smoking kiln to the Lake Malawi fishery whose fish production is much higher than the production levels at Lake Chilwa where this technology has been adopted for many years. Lake Chilwa also experiences significant seasonal and annual fluctuations in fish production because the lake dries in some years. As such, introducing the improved smoking kiln at Lake Malawi ensures continued supply of quality smoked fish in Malawi.

### 5.2 Improving access to resources, and/or markets and income (Accessibility)

The project is contributing to the AFS theme on improving access to resources, and/or markets and income through the development and promotion of the gender-sensitive financing mechanism.

The gender sensitive financing mechanism that has been developed and is being promoted is significantly improving access to financial capital to fish processors who ordinarily could not be given bank loans by commercial banks. All the 18 loan applicants could not be given a commercial bank loan using the standard commercial bank facilities. More importantly, women who are normally financially excluded are actively accessing the loan facility.

The project has also built the capacity of the fisherfolk to manage their business. The beneficiaries in the project are more confident in applying for other opportunities. For example, the award of a MK 36,740,000 (CAD 48,609/AUD 51,886/) grant to one of our beneficiaries by the Malawi Government's Agricultural Commercialisation Project attests to the fact that the project has built significant capacity in the beneficiaries. Since the beneficiary who has been awarded this grant would like to operate as a bulk buyer, this is improving access to markets by most of the fish processors who are using the technologies. Fish processors face serious challenges when they are accessing supermarkets because of low working capital as well as the requirements for certification. The bulk buyer will however have adequate working capital to pay the fish processors on spot and wait for the supermarkets for the payment. This is significantly improving access to markets of fish products.

### 5.3 Informing policy

As of now, three areas of policy relevance have emerged. Directly, the project has assisted the country in coming up with two standards for fish products: the dried small freshwater pelagics – DMS 1435:2018; and the smoked, smoke-flavoured, and smoke-dried fish – MS 117:2018. The approved standards will help to transform the fisheries value chain into more commercially viable, as fish products are becoming more consumer and commercially oriented. The improved fish processing technologies that are being promoted in the project also act as a focal point in meeting the Fisheries Departmental priority area No3, its strategies are focusing on reducing post-harvest fish losses. Evidence from this project is crucial in meeting this policy objective.

The other window of opportunity is that findings from this project will contribute to the revision of the National Export Promotion Strategy and formulation of food safety policy. This is an opportunity for the country to raise awareness of the fisheries value chain in advancing food safety and facilitating trade of processed fish products. This will help improve the national fish value chain system and legal frameworks and implement adequate infrastructure to manage the value chain. Fish products processed from IFPTs meet international standards for export and coincidentally the results of this project will come out when the Department of Fisheries in the Ministry of Agriculture, Irrigation and Water Development and the Ministry of Trade and Industries have planned for the revision of the policy by including local and international fish trade where quality is of paramount importance. This will increasingly become important in regional trade because processed fish products from improved fish processing technologies have good quality, high market value and long shelf-life.

## 6. Project outputs

Outputs from the project include manuscripts that are to be submitted for publication, the standards for dry fish and smoked fish, and three MSc theses.

The following are the titles of the theses:

1. Eliphaz Kuseni. Assessment of Women Economic Empowerment Gap Between Fishing and Non-Fishing Households in Mangochi, Malawi: Application of Decomposition Analysis. MA in Economics, University of Malawi.
2. Dorothy Banda. Assessing the effectiveness of solar tent drier on drying time, microbial, and fat quality of fresh usipa (*Engraulicypris Sardella*) and fresh utaka (*Copadichromis Inornatis*) fishes of Lake Malawi. MSc in Food Science, Lilongwe University of Agriculture and Natural Resources (LUANAR).
3. Zione Wataya Mwila. Assessing financial inclusion of the fishing sector and its determinants along Lake Malawi. Master of Business Administration. University of Malawi.

The project has developed the following fish standards:

1. Dried small freshwater pelagics – DMS 1435:2018. *Dried fish standard Approved by the Malawi Bureau of Standards and sent to WTO for gazetting*
2. Smoked, smoke-flavoured and smoke-dried fish – MS 117:2018. *Smoked fish standard Approved by the Malawi Bureau of Standards and sent to WTO for gazetting*

The titles for the manuscripts include:

1. Socioeconomic inequalities in household resilience in the context of COVID-19 in the fisheries sector in Malawi, *Under review*
2. The resilience of the fish value chain actors in the context of COVID-19 shocks in Malawi. *Submitted to a Journal*
3. Comparison of the Nutritional Quality of Open Sun Dried and Solar Tent Dried Usipa (Engraulicypris sardella) of Lake Malawi along the Value Chain. *Completed manuscript, undergoing internal review*
4. Reducing postharvest losses through solar tent drying in Malawi's fish value chain. *Completed manuscript, undergoing internal review*
5. Using gender transformative approaches to empower women: impact evaluation study in Malawi's fisheries sector. *Completed manuscript, undergoing internal review*
6. Quality and safety of Lake Malawi Diplotaxodon species using traditional and Improved smoking kiln. *Completed manuscript, undergoing internal review*
7. Financing adoption of improved fish processing technologies: Lessons from Malawi. *Incomplete manuscript*
8. Does the same fate await them both? A tale of two fish processing technologies among small scale fisher folk along Lake Malawi. *Draft manuscript, undergoing internal review*

9. Assessment of Women Economic Empowerment Gap Between Fishing and Non-Fishing Households in Malawi, *undergoing internal review*
10. Assessing the effectiveness of solar tent drier on drying time, microbial, and fat quality of fresh usipa (*Engraulicypris Sardella*) and fresh utaka(*Copadichromis Inornatis*) fishes of Lake Malawi, *undergoing internal review*.

## 7. Problems and challenges

Key problems and challenges of the project are highlighted below.

- Delay in the agreement of the components of the gender inclusive financing mechanism. Part of the source of the problem was time constraints on the side of officers the bank assigned to the project. The first officers were senior and had little time to concentrate on the negotiations. The delay in the agreement delayed the implementation of the project activities that hinged on the financing mechanisms. The bank resolved this by assigning another officer from their Agribusiness section to make sure that rolling out of the mechanism should be fast-tracked.
- High staff turnover was another challenge we faced. The project has lost three key members one due to death, and two due to professional development in form of promotion and getting another job. This significantly affected components of the project that were led by these staff. We have resolved this by assigning some members to their responsibilities and beefing up of the team with new members.
- The emergence of COVID-19 pandemic affected us as meetings of many individuals were not possible and researchers were required to operate from home. When restrictions on movements and meetings were still in force, we resorted to the use of telephone calls. Additionally, internal project meetings were conducted virtually.
- As a response to COVID-19 pandemic, the project organized COVID-19 awareness meetings and it also distributed personal protective equipment in the form of hand washing equipment, face masks, and soap. This was conducted in all project sites to ensure safety of project participants as they continued with their day-to-day activities as well as project activities where possible

## 8. Overall assessment and recommendations

Overall, we think that the project was successful despite the challenges we faced. However, we would have been more successful if we had not lost time repeatedly. We experienced time constraints that affected the project in two main ways. First, the negotiations with the bank took longer than anticipated as explained earlier. Secondly, we lost over six months of field work due to the restrictions on travel and public gathering instituted by the government to control the COVID-19 pandemic. While the project received a no-cost extension, the short planning horizon still constrained levels of achievement.

Since the beneficiaries of the loan package have not completed paying back the loans, we will continue to monitor them and get more lessons from their experiences.