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Training of Trainers and capacity building workshop for hatchery and feed operators in Kasama, Zambia

Workshop report

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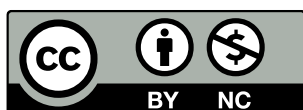
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List of acronyms

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IBEMS	Inclusive Business Entrepreneurial Modela
ToT	Training of Trainers
FCR	Feed Conversion Ratio

1. Executive summary

IBEMS/Aquapreneur under the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) funded 'Piloting inclusive business and entrepreneurial models for smallholder farmers and poor value chain actors in Zambia and Malawi', were trained on Better Management Practices (BMPs) of Aquaculture including business planning. The training workshop took place over 4 days and managed to equip IBEMS with new skills and knowledge on aquaculture and also the skills they needed to train, support and mentor other farmers to grow their business. The participants also validated the training materials and a significant number of farmers preferred the English manual to the Bemba manual and therefore suggested that the project distribute the English language manual in addition to the Bemba language manual so that farmers are able to use the language to use. Farmers were also trained on managing a fish farming business. At the end of the workshop, the trained IBEMS committed to developing business plans for managing their aquaculture business and training plans to offer training and support to other farmers.

2. Introduction

The project 'Piloting inclusive business and entrepreneurial models for smallholder farmers and poor value chain actors in Zambia and Malawi', is funded by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The project aims to establish pro-poor, gender and youth-inclusive business and entrepreneurial models that provide sustained access for smallholder fish farmers in Zambia and Malawi with productivity and profitability enhancing fish seed, feed and knowledge increased access to fish for enhanced nutrition of consumers. Lack of quality seed is one of the main challenges, smallholder aquaculture farmers face (Kakwaasha et al., 2020). Lack of quality seed is coupled with inaccessibility of seed by smallholder farmers in rural areas due to the centralized seed distribution system. Additional farmers lack access to quality feed. To this regard, the project is scaling up decentralized seed and feed distribution models in Northern and Luapula Provinces to make fish seed and feed more available and accessible by smallholder fish farmers.

The outputs the project include: 1) scalable pro-poor, gender and youth-inclusive business and entrepreneurial models (IBEMs) innovation platforms involving private and public actors that facilitate meaningful linkages to and support local entrepreneurs and smallholder farmers; and 3) innovative training materials and approaches utilizing key FISH CRP research innovations on hatchery and best management practices, business skills development, entrepreneurship, and gender, youth, and nutrition integration.

The training workshop responded to output 3 of the project.

2.1 The Workshop Outline

The ToT workshop took place over a period of four days. The first day focused on introducing the project, introducing aquaculture in Zambia, the type of fish species cultivated, site selection for earthen fishponds, better management practices for dambo areas, pond layout and construction, and management of nursery ponds. Day 2 focused on farm operations, including stocking, feeds and feeding, fertilization and supplementary feeds and biosecurity. On day 3, in the morning, the focus was still on farm operations, including water quality and fish health. By mid-morning of day three, the focus shifted to harvesting, post-harvest handling and marketing. In the afternoon, after finishing the marketing session, the training focused on business management. This session focused on business planning, production planning, finances and record keeping. The last day was a day for practicals. The training team organized a field visit to Kasakalabwe Cooperative so that training participants could observe and practice what they had learnt over the first three days of training. Below is a summary of the roadmap

2.2 Objectives and outputs

The training workshop was designed to accomplish the following:

- Train IBEMs Better Management Practices for aquaculture
- Training IBEMs to train other farmers (ToT) and to familiarize them with training materials
- To train IBEMs on the seed and feed business models and to ensure that they understand their role
- To conduct business training for IBEMs
- To engage IBEMs in the validation of training materials (both the English versions and the translated versions)

At the end of the workshop, the trained IBEMS committed to developing business plans for managing their aquaculture business and training plans to offer training and support to other farmers.

3. Day 1

On day one the early morning sessions introduced the project background, the seed and feed models and a discussion of the state of aquaculture in Zambia, including species that are legally allowed in the various districts of Northern and Luapula provinces.

Dr Mudege welcomed the participants to the workshop and gave a background of the project, mainly focusing on its aims and objectives. In addition to the objective, she also explained the role of IBEMS in the project. She highlighted the expectation that the trained IBEMS will train between 42-50 other farmers in their community to ensure aquaculture farmers are knowledgeable and create business opportunities for themselves. While the project will provide training and equipment to IBEMS, IBEMS will bring quality inputs (such as good quality fingerlings and commercial feeds) closer to farmers and provide training. She highlighted that after the training, with IBEMS would develop training plans and business plans for their aquaculture business with support from project staff. Dr Lundeba introduced and explained how the feed models would work and emphasized the roles and responsibilities of IBEMS.

After introducing the IBEMS models, she moved to discuss what aquaculture is and the constraints and benefits of smallholder fish farming in Zambia. The session was participatory. Working in six groups, training participants listed the constraints, opportunities and benefits of aquaculture farming.



Figure 1: Training participants participating in group work

The groups listed the following opportunities or advantages of fish farming:

- Source of income
- Source of employment
- Source of protein
- Plays a role in reducing malnutrition at the household level
- A means of diversifying farming and spreading the risk

The groups listed the following constraints to fish farming:

- Lack of feed availability and accessibility due to long distances travelled to get it.
- Lack of quality seed in the communities as well as limited sources of quality seed
- Lack of information on better management practises of fish farming which leads to poor management of fish.
- Little or no extension support and lack of training
- Security issues such as human theft, frog infestations, predation
- Lack of labour
- Lack of family integration for example husbands not allowing their wives to be involved in fish farming or the wives feeling that they are not benefitting from the farm
- Marketing issues, for example, low prices of farmed fish for those near lake and rivers.
- Lack of fish farming complementary equipment such as scales and seine nets.

During the plenary discussion session of these constraints, DoF officers responded that they face challenges in providing extension and facilitating aquaculture development. The major challenge they face is the lack of resources to reach out to all farmers, especially logistical support.

Participants were also asked to list the fish species cultivated in Zambia. After the discussion, Dr Mary referred participants to the training manual to look at the description of the various fish species focusing on their origin, local name, growth, reproduction, production temperature, natural occurrence and whether or not they are allowed to be cultivated in Zambia and in Luapula and Northern provinces specifically. The group discussed the relevant sections of the manual and asked why some species are not allowed in the Northern and Luapula provinces. Dr Mary took the participants through the manual sections that discuss the following issues:

- If I want to culture Nile Bream (Nile tilapia) or other exotic species, why am I not allowed?
- I can manage the exotic strains in my aquaculture farm, so there is no danger of mixing these with indigenous fish populations.
- In my community, it is hard to find the fish seed. If I want to purchase seed from another district, what should I do?
- How do I know whether the fish I want is the right species for my area?
- What other things do I need to take into account when selecting a fish species for culturing?

At the end of the morning session, participants asked the following questions:

Question 1: How can one maintain the temperature in a pond being continuously fed by underground water?

Response: Dr Mary Lundeba responded that it is not ideal to have a pond being continuously fed by underground water. Such a site is not recommended for locating a pond. Underground water is often colder than the surface water, and if it is let in continuously, the temperature will always be on the lower side. She advised that those interested in profitable fish farming should look for an ideal site following the recommended Better Management Practices (BMPs) for locating a fish pond.

Question 2: How can you determine/check the water temperature?

Response: Fish farmers can check water temperature using a water quality meter or a thermometer. Suppose a farmer does not have these instruments and would like to release fish into the pond for stocking. In that case, they can el the difference in water temperature by placing their palm between the container or plastic containing fish and the water where you are introducing that fish to feel if the water has a different temperature or the same before releasing your fish.

Question 3: Does the scenario in oceans of having tides in the night also happen in ponds?

Response: No, the tides are influenced by nature which is a result of gravitational pull. This gravitational pull is usually associated with large water bodies such as oceans and seas.

The mid-morning sessions on day 1 focused onsite Selection for earthen fishponds, Better

3.1 Site Selection

During the site selection discussion for fish ponds, Dr Mary Lundeba asked participants to discuss what they do and consider when siting a fishpond. After the discussion, Dr Mary Lundeba focused on the official position and focused on the following issues:

- What to consider when selecting the site for your pond and why
- What to avoid when citing a pond and why
- How to keep the pond warm
- Similarities and differences for ponds for grow-out fish, pond- based hatchery systems and hapa based hatcher systems
- How to check if the soil type is suitable for pond construction

At the end of this session, she referred participants to the relevant sections of the training manual to read and get this information. She also emphasized that farmers should not site their ponds in ecologically sensitive areas because they might disrupt biodiversity around those areas and that farmers should not construct a pond on top of a water spring. After all, there could be too much water, especially during the rainy season, which can lead to flooding of the pond and fish loss. Excess water could be difficult to control. It will also be difficult to maintain pond fertility in terms of bloom development by fertilization because of too much water.



Figure 2: Training participant from Kasakalabwe illustrating a point on site selection

3.2 Better Management Practises for dambolands

She proceeded to discuss with the farmers about the best management practices for dambo areas. During this session, she highlighted the disadvantages of constructing ponds in dambo lands and the dos and donts of constructing fishponds in dambolands. Disadvantages include losing fish stocks, especially during the rainy season; difficult to construct ponds because of too much water and dambo ponds are undrainable, making accounting for fish stocks, especially during harvest difficult. However, she stated that if a dambo area is the only alternative a farmer has they need to increase the height and width of pond dykes and, use large overflow pipes to facilitate the quick exit of excess water. She recommended that farmers needed to select areas with limited flood risk. She ended by refereeing training participants to the appropriate sections of the training manual.

At the end of this session, a participant asked the following question:

Question 1: Can one keep fish on a site/land with a lot of iron?

Response: Dr Lundeba responded that farmers could locate a pond in an area with a high iron content; however, the pond will be difficult to manage. If this is the only site a farmer has, then he/she must lime her ponds regularly using agricultural lime or wood ash to help regulate water pH.

After lunch, on day one we had two sessions. The first session focused on nursery ponds and the last session of the day was a practical session on pond layout and construction.

3.3 Nursery ponds

Participants were split into four groups to discuss how they stock nursery ponds, manage nursery ponds whether they grade fry or not and what stocking density they used. They came back to the plenary to present the results of the group discussion. It emerged that many of those attending the training were not hatchery operators until the project selected them. As a result, they did not have nursery ponds, did not grade fry and did not consider stocking densities. The exception was members of cooperatives such as Kasakalabwe who observed strict protocols regarding the management of fry and nursery ponds. Dr Mary summed up the discussion by emphasizing on the following:

- Explaining what nursery ponds are
- Why it is crucial to raise fry in fertilized ponds
- Alternatives to nurse fish if a farmer does not have nursery ponds before releasing them to grow-out ponds.
- She also explained how often fry should be graded and why
- She explained about the recommended stocking densities for tilapia and why.
- She also explained how often farmers should feed fry in the nursery.

After the session on the nursery management participants asked the following questions:
;

Question 1: On what do fry feed?

Response: Plankton mostly and also starter feed/fry mash.

Question 2: What is the best size for fish that can give the best fingerlings?

Response: A good size of tilapias, for example, *Oreochromis macrochir* (locally known as pale or inkamba) is between 150-300g. It is vital to maintain broodstock on good nutrition because tilapias like *Coptodon rendalli* (locally called impende) easily get stunted on poor nutrition and start spawning even at 30g, which might affect the growth trait of fingerlings. Species like catfish take longer to spawn. They start spawning when they are around 1kg.

Question 3: Is it appropriate to be counting fry/fingerlings each time you are collecting?

Response: Yes. This practice allows a farmer to know your fry/fingerling production in terms of numbers or weight.

3.1 Practical session on pond construction

The day ended with a practical on pond construction. Mr Henry Kanyembo facilitated this session at Musenga primary school. Mr Kanyembo started by asking participants to decide where to site the pond and give reasons for that. Discussions ensued, but eventually, participants decided to site the pond close to the water source. After selecting the site, participants demonstrated how they site ponds. Some errors were observed in the following:

- Training participants incorrectly did the first step of siting the pond. Participants did not follow the 3-4-5 rule required for squaring a corner at the start of setting the pond. The consequence of this error was the compromise on the uniformity of the fishpond.
- Participants had less understanding of when and how to use the line level.



Figure 3: Mr Kanyembo demonstrating 3-4-5 squaring rule of setting up a pond at Kasenda primary school

Mr Kanyembo and extension officers such as Ms Mfuno Mwendalubi eventually explained

the correct way to site. Participants started measuring, putting pegs and ensuring that the corners of the ponds had appropriate angles. Using line levels (Spirit level), ropes, stakes/pegs and measuring tap X 2 [between 5m & 10 m and a 100m measuring tap) participants eventually pegged the pond correctly according to specified standards. They pegged a 15 by 10 pond.



Figure 4: Workshop participants attentively listening to Mr Sichilima a feed operator from Luapula province

Participants fully participated and freely engaged with each other on various components of the pond pegging process. Women were given a chance to lead the laying out of the pond to encourage their participation.



Figure 5: Woman participant taking part in the pond construction practical session

Questions asked during this session included the following:

Question 1: Where should digging of a pond begin?

Response: After laying out the pond and properly defining all the parts of the pond, the next step is digging of the pond. You should dig from the pond bottom

Question 2: How do you determine how much to dig and how high the dikes should be?

Response: There is a need first to decide the depths of both the shallow and the pond's deeper ends. Using the line-level and the set pegs on each corner, one needs to go round all the pegs for the four corners and determine how much soil should be dug to reach the specified target height for a particular corner. The recommended depths for a pond are 0.8m to 1m on the shallow end and 1.2m to 1.5m on the deeper end. Together with the site's topography, these measurements can guide in determining how much to dig on a particular corner of a pond. The measurements and topography also assist in determining the cut and fill line for the entire pond.

4. Day 2

On day two, the first session focused on stocking, and the mid-morning session focused on feeds and feeding. After lunch, the focus was on fertilization, supplementary feeding, and the last session focused on biosecurity.

4.1 Stocking

Dr Lundeba facilitated the session on stocking. She explained what stocking is. She explained about stocking densities and why it is important not to overstock fish. She focused on the following topics:

- Considerations for looking for seed and assessing fry and fingerlings quality
- Measures to take when transporting fingerlings to reduce stress and mortality
- Ideal stocking rates during transportation of fingerlings (she referred to the table in reading materials)
- Best practices when transportation times are longer than 30min
- The best steps to take when stocking a fishpond?
- Acclimatizing fish to new conditions
- The stocking density for fingerlings
- The best time and place to stock seed?
- Dos and Don'ts of Handling and Stocking Fingerlings
- Why it is important to keep stocking records

Dr Lundeba took the participants through the stocking session of the manual. She also introduced the IBEMS to stocking records. She also talked about the importance of using aerators when transporting fingerlings from the hatchery to the client. There was a practical demonstration of how aerators work.

Some participants expressed interest in purchasing the aerators and wanted to know how much they cost and how they could get them.

Using details from an imaginary farm, participants in groups filled in the stocking record.



Figure 6 Group representatives making presentations on stocking records.

At the end of the stocking session, the IBEMS asked the following questions:

Question 1: How can one know that the fish is sick?

Response: By, first of all, knowing the expected behaviour of fish, for example as they feed and also knowing the normal colour, shape, fins, eyes etc. of fish. Any deviation from the normal signals that something is wrong with fish

Question 2: What is the quickest mode of transport to use when transporting fingerlings?

Response: By air and car. However, this does not apply to most smallholder farmers. The easiest would be the use of bicycles or motorbikes

Question 3: What is the best time for fry collection?

Response: Mornings and late afternoons when temperatures are low. Time for fry collection is also dependent on the season of the year.

Question 4: How many days are required for conditioning fish?

Response: This is dependent on the final destination. The longer the distance, the more conditioning days required. As a guideline fish can be conditioned for between 1-4 days.

Question 5: Do we have to wait for 48Hrs conditioning period even when the distance is close?

Response: No, you can condition fish for 24hrs and transport to shorter distances

Question 6: What kills fish during transportation?

Response: Fish excreta, which fouls water in the container and depletes dissolved oxygen in the transporting container

Question 7: What happens when the fish is gasping for oxygen?

Response: It means that dissolved oxygen is not enough in the water for fish to breathe adequately. Open the outlet to let the water out and let in freshwater, which contains more dissolved oxygen. Overfertilization can deplete oxygen. Stop fertilization immediately if you see fish gasping.

Question 8: During transportation, what happens when you come across serious potholes?

Response: Reduce speed to avoid stress and shock

Question 9: Are aerators 100% oxygen suppliers?

Response: No, aerators only aid in capturing atmospheric oxygen and mixing it into water.

Question 10: How much do aerators cost?

Response: Over K300.00

Question 11: Where and how can I get an aerator?

Response: Aerators are only found in Lusaka currently. Whoever wants to acquire one can consult us.

Question 12: How many fish can I put in a transportation bag for transporting?

Response: The number of fish to be put in transporting containers depends on the size of fish, size of the transporting container, distance, mode of transportation and whether or not oxygen gas is available to be used. For example, broodstock can be as low as 5 in a plastic bag. Fry can be as many as 2000 in a 20L container.

4.2 Feeds and Feeding

Facilitated by Dr Lundeba, the session of fish feeds and feeding was divided into three:

- Importance of quality feed
- Feed Conversion Ratio (FCR)
- Better management practices for feed and feeding

The first session focused on the importance of high-quality feed, compared the feed conversion ratio of commercial feeds and other types of feeds, and the cost efficiency calculations of using different feed types. There was a discussion on making feed effective, especially ensuring that you use quality fingerlings on your farm and follow other BMPs in managing your farm. If you give commercial feeds to already stunted fish, you will not get returns from your investment. Also discussed were good feeding practices related to when and how to feed your fish and calculate the amount of feed given to fish. There was also a discussion about other feed alternatives that a farmer can use if the feed is not available in the areas. However, the training team emphasized the value of commercial feeds and quality fingerlings if farmers wanted value money.

After the theoretical session, IBEMS were separated into groups to calculate cost efficiency as well as well as to calculate the amount of fish to give to the fish

The second session on feed focused on the Feed Conversion Ratio. The session facilitator discussed the following issues:

- What is FCR?

- Why is it important to know FCR?
- How do I calculate FCR?
- What are the optimal FCR?

After the explanations, IBEMS were given an example to calculate the FCR for their fish.



Figure 7: Mrs Precious Nyirenda a DoF officer taking notes during FCR calculation presentation

The third feed sub-session focused on Better Management Practices for feed and feeding which included

- Where to get quality feed
- How to maintain quality feed
- Size of feed
- When to feed your fish (Guide for feeding tilapia at 24-30 °C using a quality formulated feed)
- Reducing stress and environmental impact of feeding
- Introducing feeding rings – the advantages of using feeding rings
- How to determine what quantity of feed is the right amount
- Best feeding times
- How to store feed
- Keeping a feeding record

After the theoretical component, farmers were introduced to the feeding record and taken through completing the feeding record. The facilitator also explained why it was important to keep a feeding record.



Figure 8: Farmers completing the feeding records

Questions

Question 1: Is it okay to grow fish just for making fish feed?

Response: There was no response to this question.

Question 2: Are there domestic machines just for making fish feed?

Response: Yes, there are hand mixers, which can be used to make pellets. There are also domestic pelleters that can be obtained from CAMCO. The only setback is that feed produced by these domestic pelleters do not float.

Question 3: What quantities can one use when mixing soybean meal with other feed ingredients?

Response: When formulating home-made feed, a farmer needs to know the crude protein content of a protein source to guide other ingredients' calculations. If a farmer wants to formulate a simple feed using two ingredients, say soybean and maize a mixture of 37.5 kg soybeans and 62.5 kg maize can help.

Question 4: How can I tell that fish is actively feeding?

Response: You can tell by observing fish once you administer feed. Small fish will come to the surface and feed. Big fish will usually grab the feed from the surface and feed from the water column. When you throw fish on the pond fish grab feed actively.

Question 5: Where can one get ingredients when formulating their feed?

Response: One can grow ingredients such as soybeans, maize, sunflower, millet, cassava etc. A person can also buy these ingredients, including maize and rice bran from other sources.

Question 6: Is it not too stressing for fish when sampling?

Response: No, this is a management practice, which should be implemented. Sampling helps you know if your fish are growing well, free of disease, and, most importantly, adjust your feeding rate using the average weight. When sampling, you do not catch all the fish from your pond but get just a sample of, for example, 30 fish, weigh them quickly, and check on the health status.

4.3 Fertilization and supplementary feeding

Fertilization and supplementary feeding

Mr Mutakela Mutakela facilitated the session on fertilization and supplementary feeding. He focused on the following issues:

- What is the purpose of fertilization?
- How to tell whether the pond is adequately fertilized
- Dos and Don'ts of pond fertilization
- What to use to fertilize ponds
- How do I apply organic manure?
- How to apply inorganic (chemical) fertilizer?
- BMPs on fertilization & supplementary feeds

After this session, one participant asked the following question:

Question 1: What is the measurement of using inorganic fertilizer in the pond?

Response: Per 200 m² pond apply 200g of inorganic fertilizer per week until the water turns green.

4.4 Biosecurity

Mr Mutakela Mutakela facilitated the biosecurity session. He divided the biosecurity session into four areas: 1) Animal Management; 2) Good husbandry; 3) Pond management; 4) People management.

Animal management: he defined biosecurity, and, discussed why biosecurity measures are important on a farm. He also talked about biosecurity measures that can be taken, including ensuring you always use healthy seed on your farm. He also introduced quarantine, why quarantine is important, what to do when fish are quarantined, and the length of quarantine.

Under Good husbandry, Mr Mutakela discussed good husbandry measures. He asked training participants to discuss how they can implement good husbandry measures on their farm and their constraints in implementing these.

Training participants discussed the following constraints:

- Ensure that fish are not stressed.
- Daily observation of fish at feeding time.
- When using commercial feeds, do not use them past the expiry date.

- You may need to vaccinate your fish against disease - farmer to contact the fisheries officer for more information on vaccinations.

Constraints mentioned by farmers:

- Maintain a good quality of water.
- Always follow feeding schedules as advised.

Under pond management Mr Mutakela discussed the following issues:

- Use of clean equipment and, how to clean your equipment. He took the participants through the table with concentrations of cleaning solutions in the manual.
- Pond liming between batches – quantities of lime to be used (He took training participants through the relevant sections of the manual)
- Alternatives to agriculture lime
- Waste disposal including disposal of dead fish
- Controlling of weeds and dense vegetation near ponds
- Predators and pest control measured
- Preventing livestock from entering the pond

He asked participants to discuss how they can implement these measures on their farm.

Training participants made the following suggestions: Providing total farm security against predation, regular farm visits, and consulting the Department of Fisheries officer whenever there is a technical problem

He talked about liming, lime application measurements, and what kind of lime should be used under pond management. He highlighted that ponds should be limed before fertilizer is applied since this contributes to phytoplankton bloom. He introduced the liming record and explained why it was vital to keep the record.

Regarding people management, Mr Mutakela discussed the following:

- Limiting the number of people entering the farm if they have no purpose being there
- Following bio-security protocols such as all people coming to the farm stepping into the footbath and washing hands.
- Not allowing visitors from farms that have diseases or mortality problems.

Training participants identified trespassing on the farm by community members as a potential constraint to biosecurity measures targeting people management. Fencing the pond area to prevent trespassing was mentioned as a potential solution.

At the end of the session participants asked the following:

Question 1: What is the purpose of quarantining fish?

Response:

- It protects the fish on your farm from potential exposure to exogenous diseases and pathogens.
- Allows the new fish enough time to acclimatize to their new water environment, feeding and management regime.
- Give fish time to recover from handling and transportation stress.

Question 2: What type of disinfectant can one use on a foot bath?

Response: Virkill is the disinfectant used.

4. Day 3

On day three, the morning session focused on water quality, fish health, fish harvesting, handling, and transport. The afternoon session focused on business training and management. The main focus themes included marketing, fish farming business and business planning, production planning, finance and cash journal.

4.1 Water Quality

Mr Henry Kanyembo facilitated this session. Referring to the manual, he focused on why water quality is important, water quality parameters, Dissolved oxygen (DO) concentration, temperature, pH, transparency, water colour, Ammonia (NH₃) and how farmers can measure these parameters. He talked about why it is important to measure these parameters. He also discussed Better Management Practices of water quality, how often a farmer should check water quality and possible measures that a farmer can take to mitigate water quality problems. He also introduced water quality determination equipment such as a Secchi disk used to measure the level of fertilization in the pond, thermometers required for temperature determination, and pH testers used to determine the acidity and alkalinity of water in the pond. He further showed the participants an example of a water test kit that can determine several water parameters at once.

At the end of the water quality session, a participant asked the following question:

Question 1: For mouthbrooders, if the fish is gasping, does it contribute to eggs spoilage?

Response: If the eggs are being incubated, yes because the brooder will spill the eggs. The most important thing is to maintain good water quality in the spawning ponds/hapas

4.2 Fish Health

Dr Mary Lundeba facilitated the fish health session. She took the participants through issues raised in the manual. She referred them to the appropriate pages, particularly the fish health poster with clear pictures on how some diseases manifest in fish. She focused on the following issues:

- What the most common clinical signs of stress are
- Common clinical signs of diseases and parasite infections in tilapia:
- What to do when disease occurs
- Viral diseases
- Parasitic, bacterial and fungal diseases
- How can I tell if fish deaths should be regarded as abnormal?
- Tilapia major clinical signs (link to poster)
- BMPs on fish health
- Estimating biomass in the pond

At the end of the session, she also introduced fish mortality records and explained why it is important for farmers to keep these and how they should be completed.

There were no questions at the end of this session.

4.3 Fish Harvesting

Mr Mutakela facilitated this session. He focused on the following:

- How to choose which equipment to be used for harvesting.
- Pros and cons of using each method of harvesting: Seine nets, Gill-nets, Breaking of the pond dike (wall):
- BMPs for fish harvesting

He then introduced a pond record sheet for recording consumed and harvested fish.

At the end of the session, a participant asked the following question:

Question 1: Is it okay to use a hook in the pond?

Response: No. It is not okay because the hook usually requires considerable labour to obtain adequate samples of fish.

4.4 Fish Handling and Transport

Dr Lundeba facilitated this session. She focused on the following issues:

- Why is proper handling important?
- Measures to maintain the fish quality during harvesting and post-harvest handling
- Importance of hygiene measures when handling fish
- Signs of spoiling post-harvest
- Storage mechanisms and time it takes for fish to spoil
- Methods of preserving fish
- BMPs for handling and transport

There were no questions at the end of this session.

4.5 Marketing

Mr Henry Kanyembo facilitated this session. The session focused on identifying potential fish markets where farmers can sell. Training participants started by listing all the markets they could sell their fish. These included neighbours, district and local markets. However, participants/IBEMs were concerned that if they sold input to farmers and farmers do not have a market for their fish; it would kill their business. A Triple Blessings representative (private sector) who attended the meeting mentioned that Triple Blessings was available to purchase fish from farmers. Triple Blessings mentioned that it was failing to get the quantities of fish it needs from farmers. He asked IBEMS to encourage farmers to produce fish in batches and coordinate production with other farmers so that Triple Blessings can always get the quantities of farmers it needs to buy. The facilitator and participants also discussed BMPs for marketing. These BMPs included ensuring food safety, advertising fish and harvest dates in advance, harvesting fish. Participants were also encouraged to keep harvested fish in hapas in the ponds so that if they did not sell all the fish on the same day, the fish would still be alive and not spoil.

4.6 Business Management

Focusing on Business Management the day Mr Henry Kanyembo facilitated 3 afternoon sessions. The sessions focused on the following 1) Fish Farming Business Planning; 2) Production Planning; 3) Finance and; 4) cash journal. All sessions were a mixture of theory and practices.

Business Planning

The first session on *Business Planning* sought to answer questions such as what a business plan is, why it is important to develop a business plan, and who needs a business plan. Most IBEMS except cooperatives mentioned that they had a business plan in their heads, but it was not written down. Mr Kanyembo emphasized that IBEMS needed a business plan that is written down so that they can monitor whether the business is making progress and is profitable. An action point mentioned at the training was that the project would work closely with the IBEMS to mentor them to develop business plans relevant for their businesses. A key question from IBEMS was how they would start implementing the training before they were making any profits. They did not have travel funds or funds to buy additional equipment needed for training. Mr Kanyembo encouraged them to develop training plans and share these with the WorldFish team. The team would help to assist with resources for some of the initial training before the businesses could finance the training. The finance needed for training should also be part of the business plan since the business model focuses on providing training to farmers to purchase inputs to improve their farms' productivity and profitability.

Production Planning

This session started by defining what a production plan was and why it is important. Also discussed were BMPs on business planning such as securing enough funds to buy inputs and making the necessary calculations and analysis beforehand. Participants also discussed why it is important to keep records and the BMPs for record-keeping. Farmers were given some figures from a farm and asked to use the production planning document in the manual to plan the productivity of their farm and the projected profits. IBEMS enjoyed this exercise.

Questions were related to how to do some of the calculations.

Question 1: How do you calculate the cost of production from construction through to harvesting? How can you determine the profits expected?

Response: First of all, you will need to determine the pond's specifications and how much it will cost to construct if you do not have the pond and d like to construct it. After construction is done, the next step is to understand the number of fish to stock which will eventually lead you to determine the required amount of feed for the entire growing period. At this stage, it is worth noting/assuming the size of fish to be stocked and the expected FCR of fish, which will help determine the amount of feed required. At this stage, you will need to have a working figure of the anticipated size of fish at harvest, which will help you assume the profits for your stock.

Finance and cash journal

Mr Kanyembo facilitated this session. He combined the finance and cash journal sessions. The session asked and addressed some of the following questions:

- What are expenses?
- What is income?
- What are earnings?
- What is a cash journal?
- When should you update your cash journal?

After this discussion, Mr Kanyembo discussed the BMPs for finance such as keeping receipts for expenses and sales and keeping a cash journal. At the end of the session,

there was a practical exercise of filling in the cash journal. Training participants were split into groups to fill in the cash journal. After group work, participants came back to plenary. Two groups presented their cash journals. After the presentations, participants asked the following questions:

Question 1: What category are bank charges in a cash journal?

Response: Bank charges should be treated as expenses for the farmer.

Question 2: How do you describe the money in the bank in a cash journal?

Response: This should be entered into the cash journal as cash at bank.

Question 3: Do you record the detailed transactions inclusive of quantities involved?

Response: Yes. A transaction of this nature would require quantities involved recorded.

At the end of day three, IBEMS stated they had learnt a lot and could train others. However, they recommended that the Department of Fisheries have more extension officers on the ground at the same levels as agriculture extension officers so that fish farmers and IBEMS could get the support they needed for fish farming and their training duties.

5. Day 4

Day 4 focused on practical sessions which were implemented at Kasakalabwe Multi-Purpose Cooperative. Kasakalabwe Multi-Purpose Cooperative is based in Kasama District. This cooperative is a hatchery operator for tilapia seed under GIZ project and catfish seed production under WorldFish/Musika project. Kasakalabwe is a cooperative that is positioning itself to become a hub of fish production in the Northern Province of Zambia. Kasakalabwe organized the field visit program in response to requests by the organizing team regarding what needed to be demonstrated.

5.1 Biosecurity demonstrations

On arrival at the training, participants observed biosecurity protocols. They washed their hands with soap and water and stepped their feet in a foot bath with water and powdered chlorine solution. See pictures below:



Figure 9: Training participants washing their hands with soap and water before stepping onto the Kasakalabwe Multipurpose Cooperative pond area



Figure 10: Training participants going through the foot bath for disinfection as a biosecurity measure before getting into the fish farm at Kasakalabwe

5.2 Feed Demonstrations

Mr Mutakela demonstrated about the feed. He gave an explanation about floating feeds how much feed can be given to fish.

After that, they demonstrated how to feed fish using a feeding ring. Training participants were able to appreciate that a feeding ring can be cost-effective. The feeding ring used was made of thick PVC plastic and a total length of 6 meters and 1.5 meters in diameter. Training participants/IBEMS expressed concern that local farmers may not afford the feeding rings or purchase materials to make them locally. Some discussions about local materials can be used to make feedings rings that could be affordable to farmers. Some IBEMS suggested that they would try local materials such as bamboo and then give feedback to the project.

See photos of the feed demonstrations below:



Figure 11: Demonstrating the feeding ring at Kasakalabwe



Figure 12 Dr Mary demonstrating fish feeding using feeding rings to IBEMS

A representative of Kasakalabwe also fed the catfish in a different pond. Training participants/IBEMS had the opportunity to observe this feeding session. He explained that he had to be careful not to overfeed the fish.



Figure 13: Training participants listening to Mr Felix Mulenga a representative for Kasakalabwe explaining about other activities at the fish farm

5.3 Water Quality checks

Both Mr Mutakela and Mr Kanyembo facilitated the water quality demonstrations. Mr Mutakela illustrated the use of the Secchi Disk. Some farmers volunteered to go into the water to try the Secchi disk. The water at Kasakalabwe had the appropriate amount of phytoplankton because participants could observe the Secchi disk up to 30 cm depth. IBEMS expressed surprise at how easy it was to use a Secchi disk.

See picture of an IBEM using a Secchi Disk below:



Figure 14: An IBEM / training participant demonstrating how to use a secchi disk

Mr Kanyembo demonstrated water quality testing using probes to check for temperature, dissolved oxygen, and pH.

Please see pictures below:



Figure 15: Mr Kanyembo demonstrates how to use a water quality meter as training participants look on

5.4 Demonstration of harvesting using seine nets

Kasakalabwe Multi-Purpose Cooperative members demonstrated harvesting using seine nets. Please see the pictures below.



Figure 16: Training participants and Kasakalabwe Multipurpose Cooperative members participating in fish harvesting using seine nets

5.5 Tour of the Kasakalabwe catfish hatchery

This tour was facilitated by Mr Francis Bwalya Banda, an intern working with Kasakalabwe Multi-Purpose Cooperative. First, he showed the quarantine ponds and explained why the cooperative has quarantine ponds. He explained that all catfish in the quarantine ponds were recently recruited broodstock. The broodstock needed to be quarantined until Kasalabwe Multi-Purpose Cooperative was sure that it did not have any diseases before being released into the ponds.



Figure 17 Training participants listening to Mr. Francis Banda an intern at Kasakalabwe as he explains on the quarantine concrete ponds for catfish

Some participants wanted to know the age of the catfish in the ponds. Mr Francis Banda explained that the catfish was one year old. He also explained that in aquaculture to start breeding, catfish need to be induced by a hormone called Gonadotropin-releasing hormone (GRH). They had not started collecting eggs for the hatchery because they were waiting for the hormone to be delivered to them.

However, he took participants through the hatchery and explained how the eggs would be collected from the catfish and put in hatching tanks on a mesh slightly submerged in water. He explained that once the eggs hatched, the hatchling would fall into the water where it would be collected in the hatchling tank. Operating a catfish hatchery was a 24-hour operation every day to ensure that if any hatchlings died, they are quickly removed so that they do not produce ammonia which kill otherwise healthy fry.

5.6 Other technologies demonstrated

Grading baskets. See picture below Dr Mary Lundeba showing what grading baskets look like and explaining how they work.



Figure 18: Dr. Mary showing the grading baskets to the workshop participants

Frynet. See pictures below.



Figure 19: Members of Kasakalabwe co-operative demonstrating how to catch fry from the pond using a fry net

It was not possible to demonstrate the process of stocking since it started raining and participants had to depart. There was no place to shelter from the rain.

After arriving back at the hotel where training was happening, training participants had their lunch. After lunch Dr Mudege addressed the participants and discussed with them how they could integrate gender into the training they were going to offer as well as how they could prepare for training to ensure that the training was able to benefit the farmers. (See Annex 2 for more details of the session). After the session, Dr Mudege gave a vote of thanks thanking the farmers for attending the training. She also thanked DoFs, SMEs and other NGOs present for being part of the training. After the vote of thanks participants were given feedback forms which they filled and submitted to the facilitating team.

6. Feedback from workshop participants

All training participants responded to the evaluation questionnaire (46/46). 6 of the respondents were women. The mean age of respondents was 42.83, and a median age of 43 and mode of 36.

Participants were asked to rank the usefulness of the topic they were trained on using the categories 1) very useful, 2) useful and, 3) not useful at all. Below is a tabular representation of their answers:

Table 1: Usefulness of topics covered

Topic	Very Useful	Useful	Not useful at all
Farm Preparation			
Species selection	42	6	
Site selection	44	2	
Pond construction and preparation	37	9	
Biosecurity	39	4	1
Farm Operations			
stocking	34	6	
Nursery	34	7	
Fertilization and Supplementary feeds	37	3	
Water Quality	36	4	
Fish Health	30	7	
Post - Harvest Management			
Harvest	29	12	
Handling and Transportation	34	7	
Marketing	34	7	
Business Management			
Business planning	32	7	
Production Planning	34	7	
Finances	30	11	
Record Keeping	34	7	

Overall, all participants found all topics presented at the training workshop as either useful or very useful. The majority of the participants felt that all the topics discussed at the training were very useful.

Participants were asked if there was any topic that was not covered that they would want to be covered in future. 44 out of 46 respondents answered this question. Twenty-five participants responded that the facilitators had covered all.

Table 2: topics that training participants want covered in future sessions

Suggested Topics	Frequency	Comments
Species identification	11	
Feed formulation	6	
Sex reversal fingerlings	5	
FCR	2	
Sexing	1	
Pond management	1	
Finances	1	
Feed storage	1	

Workshop participants were asked the following question, ‘Do you feel confident that you will be able to train other farmers from the training that you have received?’ All 46 training participants responded that they feel confident that they can train other farmers.

Training participants were asked if they had any comments and suggestions about the training materials. Participants gave the following comments and suggestions:

- Consider printing the BMP manual in coloured.
- Consider printing the BMP manual in English.
- Consider providing training materials that the IBEMS need for practical sessions when training other farmers.
- Harmonize the language in the translated manuals to ensure that the manuals make sense

Participants were asked to rate the assistance that had been provided to them during training. 36 stated that the support was well done, and nine stated that it was average

Training participants were asked to rate facilitators concerning attitudes and responsiveness in handling the training and related requests. Forty-four participants answered this question. Thirty-eight rated facilitators attitude as excellent and five rated facilitators attitudes and responsiveness as average.

Participants were asked to rate the logistic support, especially **the quality** of services received in preparation for the training and assistance provided during the training (e.g. food, toilets, venue etc.). All participants answered this question. Thirty-nine felt that the services were excellent, five rated the services provided as average, and two stated that WorldFish could improve the quality of services it offered.

Participants were asked to give an overall score for the training using the following categories 1=Very poor, 2=poor, 3=good, 4=Very good, 5=Excellent. 43 participants responded with the following assessment:

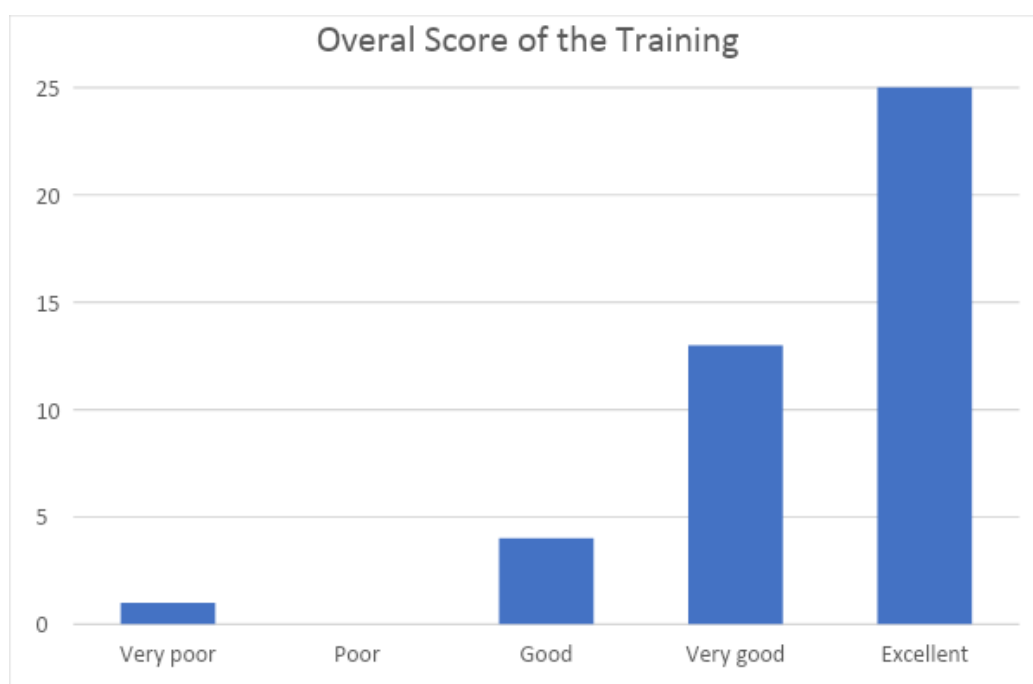


Figure 20: Overall rating score for the training

Training participants gave the following recommendation to improve training in future:

- Increase training days
- Call for another training.
- Next time choose two farm training sites of different standards to learn from both.
- Time for practical's should be improved.
- Training should be done on-site for the effectiveness of practicals.
- BMPs should be printed in English and also provide soft copies of the manual.
- Improve on timekeeping.

Conclusion

In total 40 IBEMS and 6 Department of Fisheries Extension officers were trained on BMPs for aquaculture including business management.

Annex 1: Training Agenda

Day 1 – 30 November 2020

Table 3: Training agenda

Time	Program	Facilitator
8:30 - 9:00	Arrival and registration	Mutakela
9:00-9:30	Introductions	Henry
09:30-9:40	Project introduction and background	Netsayi
09:40 – 10:00	Background to hatchery Operators and feed Operators	Mary Lundeba
10:00-10:40	Introduction to aquaculture Tilapia species cultured in Zambia Distribution of Species allowed in various Districts of Northern & Luapula Provinces	Mary Lundeba
10:40 – 11:00	TEA BREAK	
11:00-11:45	Site selection for earthen fishpond	
11:45 – 12:15	Better Management Practices for Dambo areas	Mary Lundeba
12:15- 13:15	Pond Layout and construction	Henry Kanyembo
13:15 – 14:15	Lunch	
14:15-15:45	Nursery Ponds	Mary Lundeba Henry
15:45 – 17:00	Pond Layout and construction demonstration	Henry
16:00	Evaluation of day 1	

Day 2- 1 December 2020

Time	Program	Responsibility
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8:30 - 9:00	Arrival and registration	Mutakela
9:00-10:00	Stocking	Mary Lundeba
10:00-10:30	Feeds and feeding	
10:30-11:00	TEA BREAKS	
11:00 – 13:00	Feed and Feeding	Mary Lundeba
13:00- 14:00	Lunch	
14:00 – 14:30	Fertilization and supplementary feeding	Mutakela
14:30 – 15:30	Biosecurity	Mary Mutakela
15:00- 16:30		
16:30	END OF DAY	

Day 3: 2 December

Time	Program	Responsibility
8:30 - 9:00	Arrival and registration	Mutakela
9:00- 10:00	Water quality	Henry
10:00-10:30	Fish Health	Mary Lundeba
10:30- 11:00	TEA BREAK	
11:00 – 12:00	Fish Health	Mary Lundeba
12:00-12:30	Fish harvesting	Mutakela
12:30- 13:00	Handling and transport	Mary Lundeba
13:00- 14:00	Lunch	
14:00-14:30	Marketing	Henry Kanyembo
14:30-15:00	Fish Farming Business: Business planning	Henry Kanyembo
15:00 – 16:00	Production Planning	Henry Kanyembo
16:00-16:30	Finance	Mercy
16:30- 17:00	Cash journal	Mercy
17:00	END OF DAY	

Day 4 2 December

Time	Program	Responsibility
8:30 - 9:00	Arrival and registration	
9:00-9:30	Departure to Kasakalabwe Multi-Purpose Cooperative for Practicals	Kanyembo/Mutakela
9:30	Biosecurity protocols at Kasakalabwe Multi-Purpose Cooperative	Henry Kanyembo
10:15 – 11:15	Feed Demonstrations	Mutakela
11:15-12:15	Water quality testing demonstration	Henry Kanyembo
12:15- 13:15	Demonstration of harvesting Using Seine nets	Kasakalabwe Multipurpose Cooperative
13:15 – 14:15	Tour of the Kasakalabwe Catfish Hatchery	Kasakalabwe Multipurpose Cooperative
14:15	Departure back to Kasama	
1430:15:30	Lunch	
15:30-16:00	Evaluation	Mutakela
16:00	END OF DAY	

Annex 2: Preparing for training

Preparation for training

- Prepare a training plan, on the topics that you would like to cover
- Decide whether you will invite training participants to a central location to implement the training or whether you are visiting individual farmers
- Ensure you have all the resources that you need to have a successful training.
- Prepare a register so that participants who attend the training session/ demonstration you are hosting are registered. Registration details should capture Name of the participant their age, sex and location.
- If you visit farmers at their home also, please keep a record.
- Understand what the expectations and learning objectives of training participants
- Training should include a means of trained to practice skills and techniques
- Mix theory and practice. Farmers learn better when they observe and practice

Training methods

- Invite both men and women farmers. If it is difficult to get women to attend, you may use women lead farmers and other traditional leaders to help you invite as many women as you can.
- Choose a training venue/ demonstration site that is accessible to farmers
- Carefully select a time when you are likely to get both men and women to attend.
- Encourage participants, especially women and young people to share their experiences and to participate actively in the training
- You can invite not more than 25 farmers at a time to ensure interaction between you and the training participants.
- Facilitate the training in a language that is easily understood by your training participants.
- To finish all the sections in this booklet you may need 3 to 5 days with a group of participants. If training is taking place in the community these days can be split over a number of weeks.

Training plan

- Define topics that you want to cover
- Decide how much time you will need to cover these topics.
- Define the learning objectives: What should the trainee be able to do after the topic has been discussed?
- Find out what the trainees already know about the topics.
- Determine what the trainees should know and what skills they need.
- Build on the trainees' knowledge and skills.

Teaching skills

- Be well prepared before each training
- You need good communication skills
- You need to know the local language
- Be respectful to others
- Listen well and acknowledge participant's contributions
- Encourage discussion
- Encourage participation from all participants (especially women and young people) by asking them for their opinions, or encouraging them to demonstrate certain things

- Be honest when you do not know something
- **Evaluation of progress of trainees**
- Assess the progress of trainees
- If trainees are not making progress you may need to adjust your training methods
- Provide feedback to trainees

Annex 3: Participants list

Table 4: List of participants

SN	Name	Organization	Sex	District	Remarks
1	Chisanga Bwalya	Farmer	M	Mungwi	Hatchery Operator (HO)
2	Chomba Chileshe	Farmer	M	Luwingu	HO
3	Barnabas Chota	Farmer	M	Luwingu	HO
4	Morris Mwape	Farmer	M	Luwingu	HO
5	Seggie Nsombo	Farmer	M	Luwingu	HO
6	Charles Kunda	Farmer	M	Luwingu	HO
7	George Given Mwila	Farmer	M	Mbala	HO/Feed Operator (FO)
8	Davy Sichula	Farmer	M	Mbala	HO
9	Leontina Kabwe	Farmer	F	Mbala	HO
10	Levy Sinyangwe	Farmer	M	Mbala	HO
11	Chisha Sylvester Sikazwe	Farmer	M	Mpulungu	HO
12	Joseph Chisanga	Farmer	M	Kasama	HO
13	Judith Chola	Farmer	F	Luwingu	HO
14	Simon Chitundu	Farmer	M	Mporokoso	HO
15	Lameck Lombe	Farmer	M	Mporokoso	HO
16	James Nsama	Farmer	M	Mporokoso	HO
17	Mary Namutowe	Womens Cooperative		Mbala	HO
18	Felix Mulenga	Kasakalabwe Cooperative	M	Kasama	HO
19	Jackson Mwenya	Farmer	M	Chipili	HO
20	Chola Oswald	Farmer	M	Mansa	HO
21	Matilda Luapula	Farmer	F	Mansa	HO
22	John Nyese	Farmer	M	Mansa	HO
23	Jonnah Mubanga	Farmer	M	Mansa	HO
24	Jackson Chola	Farmer	M	Mansa	HO
25	Wiza Sindazi	Farmer	M	Kawambwa	HO
26	Joseph Mumbi	Farmer	M	Kawambwa	HO
27	Eunice Namuchimba	Farmer	F	Kawambwa	HO
28	Micheal Chisha	Farmer	M	Kawambwa	HO
29	Steven Pule	Farmer	M	Kawambwa	HO
30	Flywell Zulu	Farmer	M	Samfya	HO
31	Wilbroad Musanshi	Farmer	M	Mansa	HO
32	Cosmas Chachi	Triple Blessings	M	Luwingu	SME/FO
33	Evans Mutale	Evamuta Enterprises	M	Mungwi	SME/FO

34	Mubanga Seketani	ADSEK Enterprises	M	Mansa	SME/FO
35	Joseph Mulenga	Pibelibe Cooperative	M	Kasama	SME/FO
36	David Ng'andu	Dangs General Dealers	M	Mungwi	SME/FO
37	Mwendalubi Mfunne	SAKUZ Fish Center	F	Mporokoso	SME/FO
38	Mulenga Sichilima	Mule-Stus	M	Mansa	SME/FO
39	Darlington Besa	DoF	F	Mansa	PFO- Luapula
40	Mary Nyirenda	DoF	F	Mbala	District Officer
41	Precious Daka	DoF	F	Mungwi	District Officer
42	Nelson Siwale	DoF	M	Mungwi	District Officer
43	Savior Shimashela	DoF	M	Kasama	District Officer
44	Kaungo Mukuni	DoF	M	Luwingu	District Officer
45	Kazule Siame	DoF	F	Mansa	District Officer
46	Aldridge Mushili	DoF	M	Kawambwa	District Officer
47	Mudege Netsayi	WorldFish	F	Lusaka	Project Lead
48	Mary Lundeba	WorldFish	F	Kasama	Aquaculture Scientist
49	Mercy Sichone	WorldFish	F	Kasama	Research Assistant
50	Mutakekela Guydon	WorldFish	M	Kasama	Research Assistant
51	William Nonde	WorldFish	M	Kasama	Driver
52	Chrispin Chikani	WorldFish	M	Lusaka	Driver
53	Phyllis Kabamba	WorldFish	F	Lusaka	Project Accountant
54	Henry K. Kanyembo	WorldFish	M	Kasama	Research Assistant-Geospatial
55	Malton Moyo	DoF	M	Kasama	DFO

References

Kakwasha K, Mudege NN, Sichilima T, Sebele M and Lundeba M. 2020. Smallholder fish farmers population census report 2020: Northern and Luapula provinces, Zambia. Penang, Malaysia: WorldFish. Program Report: 2020-40

About WorldFish

WorldFish is an international, not-for-profit research organization that works to reduce hunger and poverty by improving fisheries and aquaculture. It collaborates with numerous international, regional and national partners to deliver transformational impacts to millions of people who depend on fish for food, nutrition and income in the developing world. Headquartered in Penang, Malaysia and with regional offices across Africa, Asia and the Pacific, WorldFish is a member of CGIAR, the world's largest global partnership on agriculture research and innovation for a food secure future.

For more information, please visit www.worldfishcenter.org