



SUSTAINABLE POND AQUACULTURE IN LUAPULA PROVINCE

TRAINING MANUAL

2021

FISH FOR FOOD SECURITY PROJECT IN ZAMBIA(F4F)

GIZ ZAMBIA
0

©Copyright of FAO fish farming training manual, National research foundation, South African Institute for Aquatic Biodiversity, Incubation Programme training manual

Prepared by: Luapula Fish for Food Team

Mwangala Kabika, Carl Huchzermeyer and Chipepo V Phiri

Inhalt

TRAINING PREPARATION	3
DIDACTIC SUMMARIES	5
Module 1: Pond design - The physical environment for fish	5
Module 2: Pond Ecology	7
Module 3: FISH IDENTIFICATION AND POLYCULTURE	8
Module 4: Harvest Cycle- Overbreeding, Partial Harvesting	9
Module 5: Nutritional benefits of fish	9
Module 6: Record Keeping	10
Module 8: Gender in Aquaculture	12
Part 1: Pond Design – the physical environment for fish	13
Part 2: Pond ecology- life in the pond	15
Integrated Aquaculture and Agriculture.....	17
Part 3. FISH IDENTIFICATION AND POLYCULTURE	17
Fish species cultured in Luapula	20
Part 4: Harvest Cycle- Overbreeding, Partial Harvesting and Benefits of Small Fish.....	22
Part 5: Nutritional benefits of fish	25
Part 6: RECORDING KEEPING	26
Part 7. BASIC FINANCIAL LITERACY IN AQUACULTURE	28
Part 8. GENDER AND AQUACULTURE	30
THE DIFFERENCE BETWEEN GENDER ROLES AND SEX ROLES.....	31
IMPORTANCE OF GENDER IN AQUACULTURE	32

TRAINING PREPARATION

- Draw up a plan of training location/Place (Village), Dates
- Find a contact person (DoF (Department of Fisheries) focal person, Lead farmer)
- Communicate the target number of participates
- Write invitation letters for DoF focal persons
- Write a service request and information Admin (lunch for participates, logistics for trainers-vehicle, fuel, allowances)
- Print the training manual, participates list etc.
- Visit place or village where the training is going be held, a day before the training

Pond Aquaculture in Luapula

Most farmers in Luapula are small scale fish farmers with very small pond (as small as 4m²(2m x 2m)) with no drainage pipe, no overflow pipe, thin or low pond walls and shallow ponds, most of the ponds are overcrowded with stunted fish from different fish generation, unfertilized ponds (with clear water), most farmers cannot afford supplementary feeds. When it comes to record keeping, farmers have little to no written records of their fish farming, half of the fish farmers do not involve or work with their children or spouses.

The manual aims to build the capacity of the fish farmers to improve access to sustainable fish products of people facing food insecurity through practicing sustainable pond aquaculture, promote knowledge exchange through trainings and encourage farmers to adopt the recommended fish species in Luapula

The Training Manual

The training manual was developed to assist the small-scale fish farmers in Luapula to increase their fish production, increase knowledge on the nutrition value of fish and income through practicing sustainable aquaculture

The training manual consists of seven (7) modules – 1) pond design – the physical environment for fish 2) pond ecology – life in the pond and integrated aquaculture 3) fish identification and polyculture 4) harvest cycle – overbreeding, partial harvesting, and benefits of small fish 5) nutritional benefits of fish 6) record keeping 7) basic financial literacy in aquaculture 8) gender. The manual material was based on the assessment need of target group (fish farmers) and is tailored to the local condition of Luapula province. It encourages the fish farmers to use the locally and affordable input to improve the management of fishponds.

Each Module has the *context, before and after* scenario of the fish farmers after and before the training, *learning objective* and *information on sustainable pond fish farming*. The manual can be used to improve

production fish, improve knowledge on recording keeping, promote sustainable aquaculture business development of the fish farm and nutrition benefit of fish in human diet.

Please note that this manual is not a definitive manual and contains extracts from various sources.

TRAININGS

pond-side training

This is a training carried out at the pond or near the fish farmers pond or at a demonstration pond. pond side training is practical and demonstrative training, the theory part of the training is done in a classroom or under a tree or at the community hall, this way it is easy for the fish farmers to access the venue since it is in their villages. This also gives a chance for women to attend and actively participate in the training. This is good because there has been a record of low attendance of women in trainings, this is due to various factors like women being the main care takers of homes hence having to attend to daily chores, culturally this puts a limitation on women staying long hours away from their homes to attend trainings, this takes up more of their time to do other home tasks.

METHOD OF INTERACTING: group work, presentations, drama, site visits, games and encouraging farmers to participate in the training by asking question or letting the farmers answer their fellow farmer's questions rather than the trainer giving all the answers this way farmers share their fish farming experiences and utilize their exiting knowledge in fishpond culture.

LEARNING MEDIA: printed training manual, illustration, videos, pictures, flipcharts, fish measuring chart. Other materials required record keeping pack (book, pen, pencil, ruler etc.). The training material is used as the tool for the training. It is important to use a language that the participants/fish farmers understand during training and the training manual must be in translated in a language the trainee understands and able to read.

It is important for the trainer to introduce the training team, the project and the objective of the training, all the participants to introduce themselves. During the training it is important for the trainer to be respectful, the trainer should be able to understand the level of literacy of the trainees, address the participants by name, respect and observe traditions and norms, encourage everyone to participate especially women and be careful about sensitive issues.








It is recommended to have half a day's training with short breaks in between to give room to the fish farmers to do other activities. The training is usually done within 2 to 5 days depending on the trainees' need.

Monitoring- A tablet-based monitoring system has been adopted using Kobo collect toolbox to collect data from fish farmers. The data collected ranges from training content topic adoption to farm records like pond size and number of ponds, stocking data, harvest records, etc.

Evaluation and Assessment – Assessments can be done by observing the trainees, through question and answers, observing how actively the farmers are participating in the training or at the end of the training through a questionnaire. The questionnaire has a section for the trainee to give feedback on the training and the fish farmers demographic.

DIDACTIC SUMMARIES

Module 1: Pond design - The physical environment for fish

Justification and context		The physic environmental conditions of the pond highly affect the growth of fish. The module is mainly to make the already exiting farmers or trainees understand how a bigger and deeper pond can hope to improve fish production, protect the fish from predators and introduce to fish farmers/trainees to a smart fish farming through the bottom drain this will helps to drain cold water from the bottom leaving warm water on top and make harvest easier.
Objectives		To educate participants on the role of the physical environment in regulating fish performance and behavior.
Participants		<ul style="list-style-type: none">• 10-30 Fish Farmers
Trainer		Aquaculture/Fisheries Expert
Mode of delivery		Physical demonstration at the pond, questions and lecturing
Training materials		Printed module, pond design manual illustration
Location		Pond side, Classroom
Content		<ul style="list-style-type: none">• Introduction of participants• Overview of the module series
References		Manual pp. 1

Module 2: Pond Ecology

Justification and context



The application of manure, dry grass and compost increases the abundance of natural food (microorganisms) in the fish pond. Fish feeds on different microscopic (small animal that can't be seen with the naked eyes but through the microscope). In this module different type of microorganisms and how the grow will be discussed.

The trainer must show the participates or fish farmer how the microorganisms looks like through the microscope, pictures or videos.

Objectives



For Participates to know;
the importance of fertilizing the pond.
Factors to consider when applying fertilizers.

Participants



10-30 Fish Farmers

Trainer



Aquaculture/Fisheries Expert

Mode of delivery

Teaching, watch a video, show pictures of micro organisms

Training materials



Microscope, video and pictures of micro-organisms, water

Location










Classroom, under a tree

References

Manual pp.

Module 3: FISH IDENTIFICATION AND POLYCULTURE

Justification and context		<p>Fish species are diverse and requires different conditions to survive and reproduce. Meaning that, their management is will also vary and the degree variation usually depends on their genetic makeup. The module will help fish farmers in Luapula to understand the different type of species that can be cultured in fish pond.</p> <p>The trainer must help the participants to appreciate the culturing of different species in the same pond because of different feeding habits of fish.</p> <p>To educate the participants the importance of fishpond fertilization in aquaculture.</p>
Objectives		<p>For participates to know;</p> <p>The background on the biology of fish species that are cultured in Luapula.</p>
Participants		10-30 fish farmers
Trainer		Aquaculture/ Fisheries Expert
Mode of delivery		Teaching, question on the type of species that participates culture and identification of fish species.
Training materials		fish posters, manual
Location		Classroom
Content		<ul style="list-style-type: none"> • The need to know the biology of fish species • Fish species commonly cultured in Luapula
References		Manual

Module 4: Harvest Cycle- Overbreeding, Partial Harvesting

Justification and context



The module highlights why it is important for fish farmer with mixed sex fish to partially harvest some fish from their pond. It is important to for farmer to partially harvest some small fish to sell as fingerlings and for consumption this improve nutrition in the human diet, create space for the fish to grow to table size fish and improve cash flow.

Objectives



For participates to know;
what partial harvest and the importance of partial harvest.

Participants



- 10-30 Fish Farmers

Trainer



Aquaculture/Fisheries Expert

Mode of delivery

Teaching

Training materials



Partial harvest video

Location



Pond side, Classroom

References

Manual pp.






Module 5: Nutritional benefits of fish

Justification and context









The module aims to provide the fish farmers with information of the importance of fish in human diet, it covers the nutritional content of fish and their function in the human body and encourages the consumption of small fish.


For participates to know;






Objectives		The nutritional value of fish Importance of eating fish
Participants		10-30 Fish Farmers
Trainer		Aquaculture/Fisheries Expert
Mode of delivery		Teaching and open discussion
Training materials		Printed module and let me tell you comic/video
Location		Pond side, Classroom
References		Manual pp.

Module 6: Record Keeping





Justification and context		<p>Record keeping allows tracking of fish farming activities, the level of fish farming management and expenses. comprehensive record keeping will improve the business efficiency and management and provide a basis for future plans. Without proper records of the fish farming it would be very difficult to access loans from financial institutions or finding a good investor. This module covers the importance record keeping, types of record to keep and how to start keeping records.</p> <p>To describe the importance of record-keeping in aquaculture to the participants</p> <p>For participates to know;</p>
----------------------------------	---	---



Objectives		The importance of recording keeping How good your farm is – promote fish farming as a business
Participants		<ul style="list-style-type: none"> • 10-30 Fish Farmers
Trainer		Aquaculture/Fisheries Expert
Mode of delivery		Teaching and question
Training materials		Record Keeping pack (Notebooks, pens, pencils, paper, markers, fish measuring chart)
Location		Classroom
References		Manual pp.

Module 7: BASIC FINANCIAL LITERACY IN AQUACULTURE		
Justification and context		<p>Most small-scale fish farmers lack financial literacy and skill. This makes it difficult for them to better manage their business. In this module, the training will help build financial literacy of the fish farmers so that they can improve the farming on the business part. The module is focused on the definition of financial literacy, financial plans, budgeting, marketing and market analysis. To educate the participants on basic financial literacy skills to better manage their fish farming business.</p> <p>For participants to know;</p>

Objectives		To acquire financial literacy What marketing is and its role in aquaculture Costs identification prepare budgets and calculate profits/ losses
Participants		<ul style="list-style-type: none"> • 10-30 Fish Farmers
Trainer		Aquaculture/ Fisheries Expert
Mode of delivery		Open discussion, question and teaching
Training materials		Notebooks, pens, pencils, writing board, flip paper, markers
Location		Classroom
References		Manual pp.

Module 8: Gender in Aquaculture

Justification and context		Gender is an increasingly relevant topic globally due to the need to ensure equity and equality in food production systems. This module covers concepts on gender equality, the statement of equal ease of access to resources and opportunities regardless of gender, including economic participation and decision making in fish farming, and the state of valuing different behaviors, aspirations and needs equally.
Objectives		The participants to know; Definition of gender, concepts and gender equity The difference between gender roles and sex roles
Participants		<ul style="list-style-type: none"> • 10-30 Fish Farmers
Trainer		Aquaculture/ Fisheries Expert

Mode of delivery		Group work – divide the trainees in 2 or 3 group to discuss sex and gender role, presentation and teaching
Training materials		writing board, flip paper, markers
Location		Classroom
References		Manual pp.

Part 1: Pond Design – the physical environment for fish

Context

The module is mainly to make the already exiting farmers or participates how a bigger and deeper can enhance fish production in a pond, protect the fish from predators and introduce fish farmers or participates to a smart fish farming through the bottom drain which helps to drain cold water from the bottom and make harvest easier.

Learning Outcome

1. Be able to explain why it is important to have a bigger and deeper pond
2. Be able to explain why it is important to have a bottom drain

Before

- Most farmers have very small pond with low water volume.
- Fish farmers didn't understand the importance of having a big pond.

After

- After the training most farmers understood the importance of having bigger pond for stable temperatures and good water quality.
- Most farmer are adopting to the bottom drainage which removes cold water and makes it easy to drain.

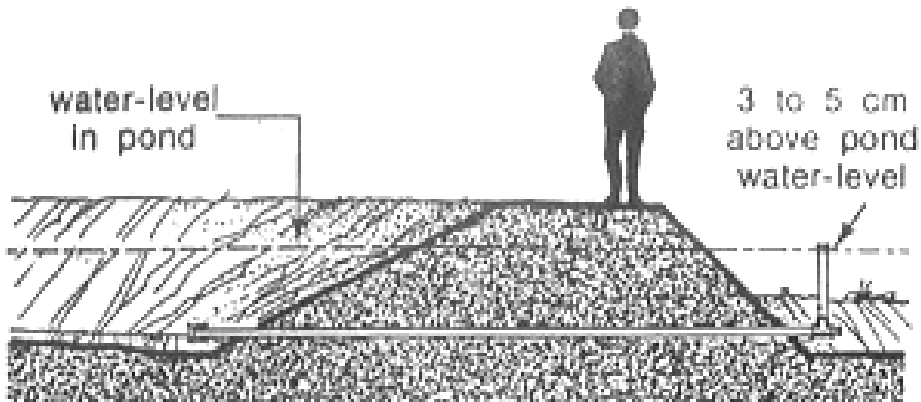
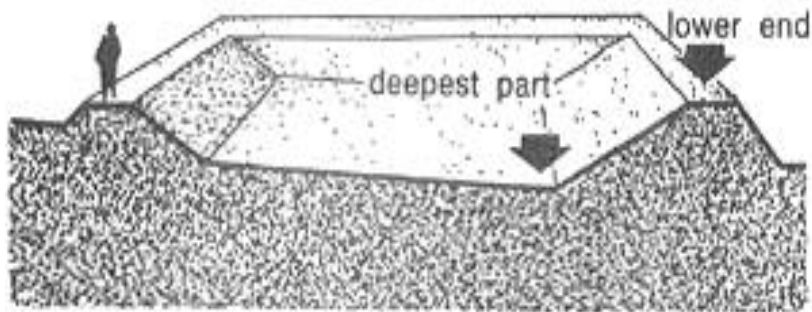
Why should we build a bigger fishpond?

The recommended size of a fish pond is 20m x30m (600m²)

- 1) More stable temperature (water stays warmer at night)
- 2) More stable water quality
- 3) Fish feel safer and grow to larger sizes

What to remember?

- 1) Water is very heavy: walls must be thick to stop leaking
- 2) Foundation trench filled with compacted anthill clay helps prevent the wall from moving and water from leaking
- 3) Soil is heavy... dig more soil from the deep end: this helps make your pond deeper, you save labour, and you have more soil for building a thick wall.
- 4) Soil texture and structure affects the durability and size of the dikes
- 5) A pond usually has a deeper end and a shallow end for easier draining during harvest, 0.8 – 1.0m at the shallow end and 1.0 to 1.5m at the deep end is usually the recommended **height.**
- 6) Bottom drain helps remove cold water from the bottom, and makes harvesting easier



(From FAO manual)

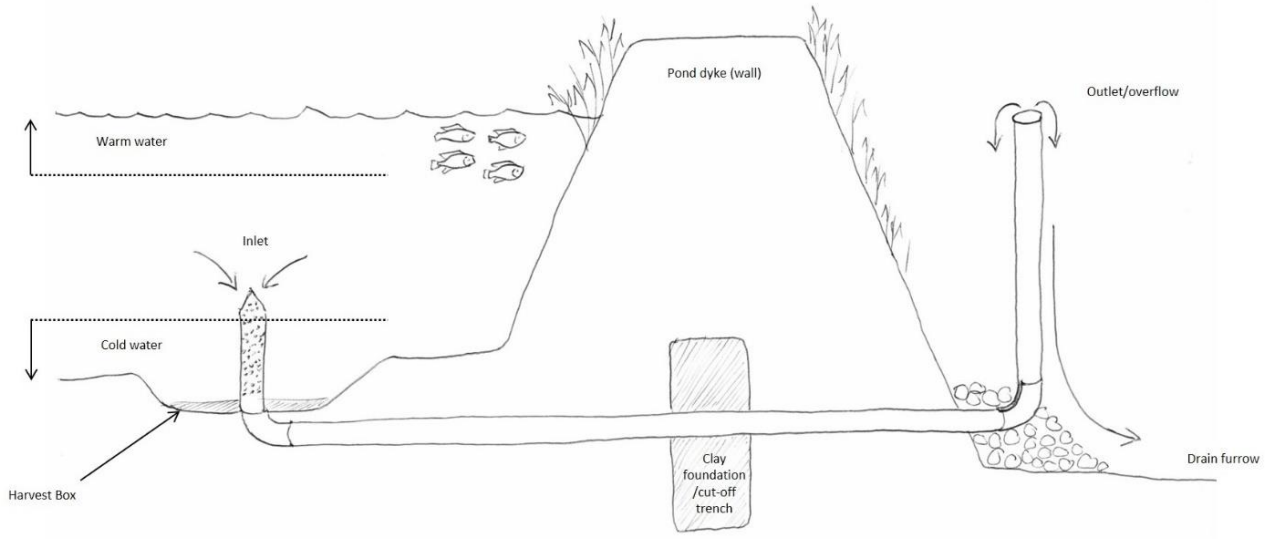
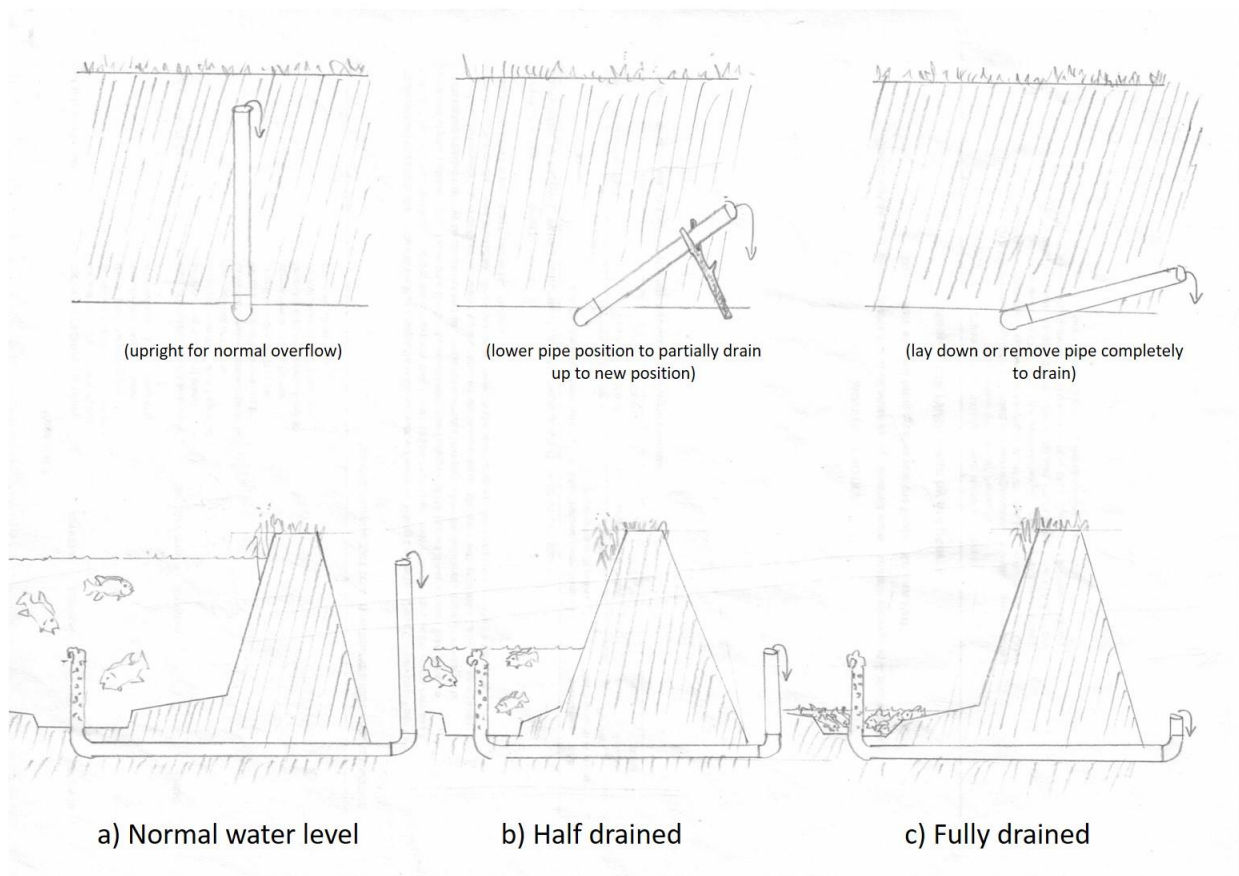


Figure 1: Cross-section of the pond dyke showing external upstand bottom drain system.



Part 2: Pond ecology- life in the pond

Context

The application of manure, dry grass and compost increases the abundance of natural food (microorganisms) in the fish pond. Fish feeds on different microscopic (small animal that can't be seen with the naked eyes but through the microscope) plants and animals. In this module different type of microorganisms and how they grow will be discussed.

The trainer must show the participates or fish farmer how the microorganisms looks like through the microscope, pictures or videos.

Learning Outcome

1. Be able to know the importance of fertilizing the pond.
2. Be able to explain how different pond micro-organisms grows

Before

- Before the training Farmers used the fertilize the pond without a full understanding of pond ecology: micro-organisms.
- They used to fertilize their pond so that they can protect their fish from predators (birds, human being etc.)

After

- Farmers now understanding the importance of adding manure to the pond because manure supply nutrients for the algae and some bacteria.
- The farmers were able to see the micro- organisms the fish feeds on, through the microscope.
- They now understand that introducing extra organic matter will provide enough start up food for the fish in the pond.

What do fish eat?

What lives in your pond?

Remember: Tilapia eat microscopic (very small) animals and plants that grow in the pond that we can't see with our eyes.

These animals and plants are called micro-organisms. Pond microorganisms grow in different ways:

- Some grow by photosynthesis from sunlight and nutrients/fertilisers in the water. These make the water green and are called algae.
- Some are bacteria that grow by decomposing/rotting old leaves, grass and manure.
- Some are small animals that grow by eating bacteria and algae.
- Others grow by breaking down hard plant matter such as dry grass which is lying on the pond bottom.
- Some are Large plants that may be have roots in the bottom or may be floating.

Tilapia feed on these unseen things by eating mud, feeding along grass and the pond sides, and also by skimming them off the pond surface when it is hot.

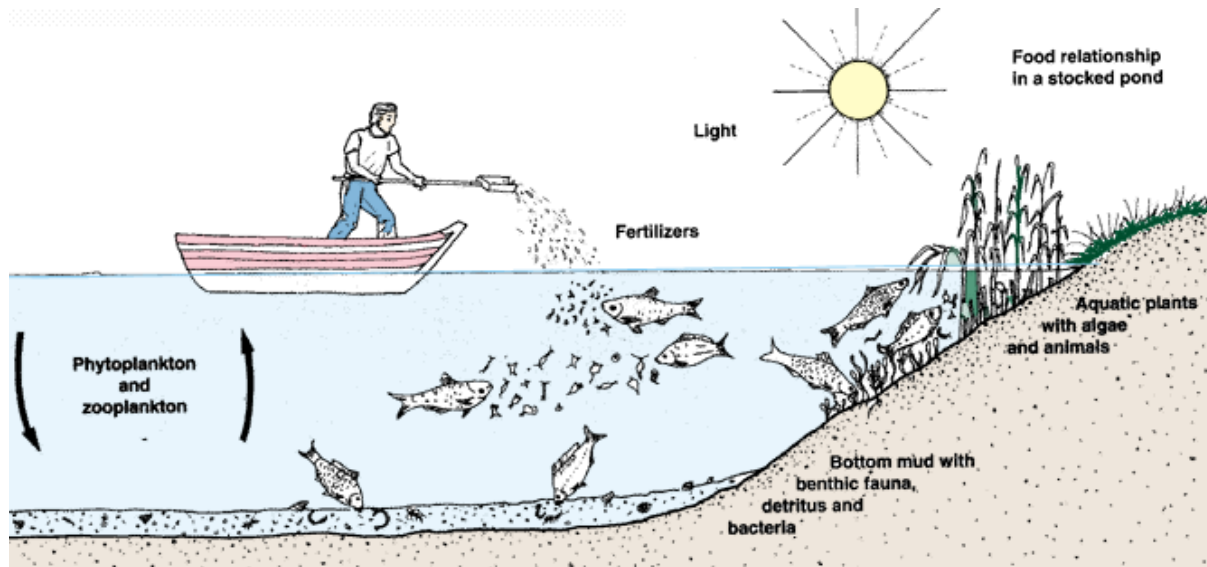
It is VERY important that you add these things to your pond:

- Manure to supply nutrients for algae and some bacteria.

- Compost and dry grass to provide cellulose (hard plant matter) for some microorganisms.
- These should be applied by scattering it evenly across the whole pond.

Soil fertility and soil chemistry affects water quality

In a new pond, EXTRA organic matter (dry grass, leaves, manure) is needed to help form dark mud, helping to seal the pond from leaking and provide enough start-up food for your pond microorganisms as you prepare to stock fish.



Integrated Aquaculture and Agriculture

Integrated aquaculture means linking two or more farming activities, where at least one is a fish farming activity. The integration of aquaculture and agriculture is good for smallholder farmers to improve their farming system economically and ecologically. It is sustainable, resilient solution to increase food security.

Integrating farming system involves managing existing household resource to support multiple farming activities for example fish farming maybe integrated with crops like cabbage.....by planting them on top of the dikes or near the pond and using the fertilized pond water to water the crops. Farmers should remember not to carelessly spray pesticide or fungicide, this may cause fish mortality if the pesticides are accidentally sprayed in the pond.

- Irrigation
- Livestock and poultry
- Agroforestry

Part 3. FISH IDENTIFICATION AND POLYCULTURE

Context

Fish species are diverse and requires different conditions (water quality, temperature, food, habitat, etc.) to survive and reproduce. Meaning that, their management is will also vary and the degree variation usually depends on their genetic makeup. The module will help fish farmers in Luapula to understand the different type of species that can be cultured in fish pond.

The trainer must help the participants to appreciate the culturing of different species in the same pond because of different feeding habits of fish.

Learning Outcome

1. Be able to identify the three-tilapia species found in Luapula, know the local names and describe the distinguishing features of each species.
2. Be able to know what polyculture is and its importance

Before

- Most farmers can't identify the fish species stocked in their ponds.
- The fish farmers don't know the importance of polyculture

After

- Farmers have been equipped with handy ways and methods of identifying their fish and they now know the fish in their ponds.
- Farmers now know fish behaviors and how to manage their fish.

The main characteristics used to identify fish are the shape of the body, the head, the mouth, and the size of the fin and scale types

The main fish species cultured in Luapula include; the red-breast tilapia (EN) *Coptodon Rendalli* (Mpende, cituku, akachenje), Greenhead (EN) *Oreochromis macrochor* or *Oreochromis mweruensis*, Banded tilapia (EN) *Tilapia Sparmanii* and Giraffe catfish (EN) *Auchenoglanis accidentals*. (Imbowa)

Red-breast (EN) *Coptodon Rendalli* (SN), Mpende (LN)



- Important fish for farming in Luapula.
- Redbreast tilapia has a reddish belly although other species develop red breast during mating season
- They are monogamous substrate spawners – parent fish make a nest and carefully guard their eggs and newly hatched fry.
- Highly vegetarian, feeds on algae and able to feed on grass and leaves

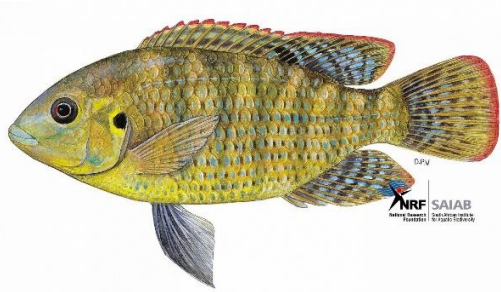
- Grows well in small ponds and can be cultured with other species like greenhead (pale) and banded tilapia (matuku)
- Caudal fin is emarginate shaped
- It is considered the most taste fish in Zambia and has a wide market acceptance

Greenhead (EN) *OREOCHROMIS MACROCHOR(SN)*, *Pale (LN)*



- The greenhead bream has a bright green color with black fleck on the face and body
- It has red eyes with a seemingly black ring around the eyes
- Silvery on the side of the body in young fish (sometimes called white pale)
- It is a mouthbrooder.
- The male fish make a volcano shaped nest where the female lay eggs
- The eggs, embryos and fry are brooded in the mouth of the female fish.
- The baby fish (fry) swim back in the mouth of the female fish in the night or in case of danger for protection
- Can be cultured in fertilized pond on natural microorganism foods (feeds on detritus and phytoplankton)
- Crossbreeds with Nile tilapia

Banded tilapia (EN)TILAPIA SPARMANII (SN), *Matuku (LN)*



- This is a small species common in small streams and wetlands, and they thrive in small scale fishponds
- Banded tilapia has an indistinct (not so clear) color, its bluish green, dark olive


- They are substrate spawners, the parent fish guard the young with great energy and feed on algae, soft plants, and insects
- They are often viewed negatively by farmers because they do not grow to large size as the other cultured tilapia: however, they are extremely prolific, easily sold and are one of the most widely eaten species in communities across Zambia
- They reproduce quickly and at a small size
- Matuku are nutrition champions: they are very high in iron and calcium, both important micronutrients especially in areas without livestock
- Tilapia is one of the only fish genera where an African name has been used in their scientific name from the Setswana word tlapi – meaning fish.


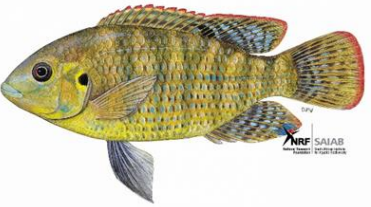

Giraffe catfish (EN) *AUCHENOGLANIS OCCIDENTALIS* (SN), Imbowa (LN)



- The most famous of Luapula’s fishes, it is renowned for its rich, tasty flesh which is very fatty and smokes well
- Juvenile fish show a mottled giraffe-like pattern, which becomes uniform grey-brown as they grow
- Eggs are scattered in a nest and guarded by the male fish.
- It can grow up to a maximum length of 80cm (31.5’)
- Insect eater and scavenger, but will readily accept most sinking foods
- Generally peaceful when culture with other species but smaller fish may be at risk of being eaten

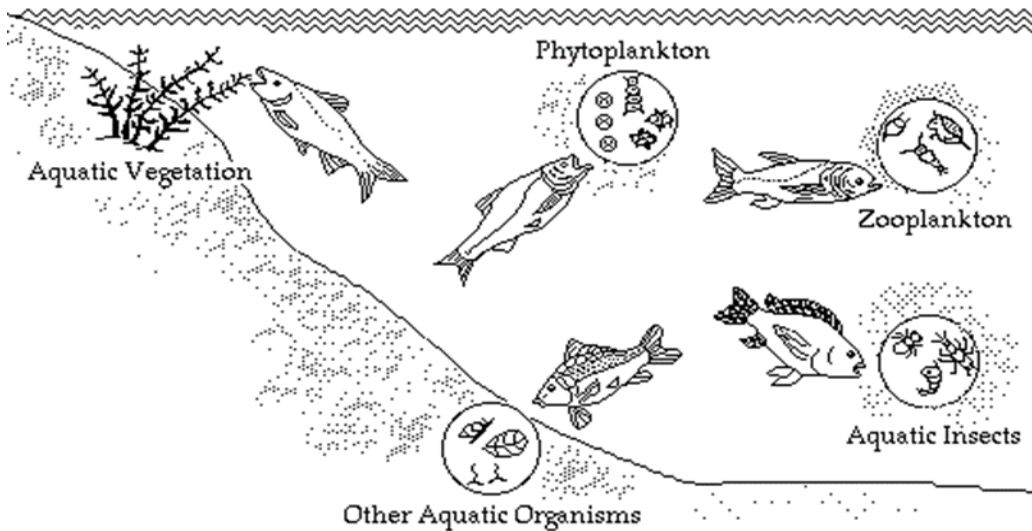
Fish species cultured in Luapula

Species	Common names	Origin	Feeding behavior	Size when sexual mature [cm]	Breeding season [month]	Optimum Temp
 <i>Coptodon Rendalli</i>	Red-breast Mpende	Indigenous	Juveniles feed on plankton adults feeds aquatic plants, algae, vegetative detritus insects and crustaceans	20.5-21.8 cm	December - March	24 – 32 °C

 <p>Oreochromis Macrochor</p>	<p>Greenhead Pale</p>	<p>Indigenous</p>	<p>Feeds on algae and diatoms in detritus and phytoplankton</p>	<p>18-22 cm</p>	<p>September - February</p>	<p>24 – 32 °C</p>
 <p>TILAPIA SPARMANII</p>	<p>Banded tilapia Matuku</p>	<p>Indigenous</p>	<p>algae, aquatic vegetable, and Juveniles feed on small crustaceans.</p>	<p>8 - 10 cm</p>	<p>It undertakes seasonal upstream migration and breeds before and during these migrations</p>	<p>22 - 25°C</p>
 <p>AUCHENOGLANIS OCCIDENTALIS</p>	<p>Giraffe catfish Imbowa</p>	<p>Indigenous</p>	<p>feeds mainly on fish (mormyrids, cyprinids and cichlids) and eggs but does consume zooplankton, aquatic insects, aquatic crustaceans (crabs and shrimps).</p>	<p>33 – 34 cm</p>	<p>September - April</p>	<p>21-25°C</p>

POLYCULTURE

- Polyculture is culturing of more than one species of fish in a pond at the same time.
- Culturing of more than one species can be advantageous because of the different feeding habits of fish (fish feed on different trophic levels). Meaning that the fish can improve the utilization of food resources in a pond.
- In Luapula macrochor(pale) and Rendalli (mpende) can be cultured together to take advantage of the different feeding habits (mpende is more of a vegetation feeder and pale is more of a plankton feeder).
- Farmers can enjoy the consume of different species
- There is less rick of price fluctuation on the market. If the price of one species is low, the price of another species may still be high.



Part 4: Harvest Cycle- Overbreeding, Partial Harvesting and Benefits of Small Fish

Context

Learning Objective

1. Be able to explain what partial harvest is
2. Be able to know and explain the importance of harvesting from time to time

before

- partial harvesting was never practiced by farmer and the pond were usually overcrowded causing slow growth rates for the fish because of competition of food in fishpond.
- Farmers have stunted fish in the pond.

after

- Farmers are now practicing partial harvest, mostly after training.
- Farmers see the benefits of thinning out the fish.
- The fish that is thinned out is used for home consumption, cash flow and there is more food and space for the fish to grow

3. Overbreeding

All tilapias (e.g., mpende, pale, amatuku) start breeding at small sizes (at 100 g) in fishponds and produce many fingerlings. When the fish become too many, they stop growing because of competition for food, space, and oxygen. This leads to stunting of the fish in the fishpond. It also increases size variability

Stress also makes the fish grow slowly and susceptible to diseases infections because their immune system is weakened. Things that cause stress on the fish are rapid changes in temperature and water conditions, and starvation. Big, deep, and fertile ponds minimizes fish stress and improve growth.

The fish farmer needs a good harvest plan (when, type of harvest, tools). A good harvest plan will help the farmer find good marketing opportunities and good cash flow.

Partial Harvesting

It is important to harvest some fish from time to time, especially the small sizes. Partial harvesting can also be called 'thinning'. Removing some small fish has the following benefits:

- Leaves more food and space for the other fish to grow faster and bigger
- Provides nutritious fish for home consumption and sale to neighbours
- Improves cash flow by bringing in a bit of money while you wait for your main harvest
- You can sell small fish when people have less money (e.g., during the rainy season) and save your big fish to sell when the price is good, and buyers have money (like after selling their crops)

Remember after harvesting to keep some medium and big fish as breeders, so that you quickly get some more small fish again on the next pond cycle (see example)



Small fish for sale using 'Mbale Mbale' measuring dish

Example Pond 1) No partial harvest

Month	1	2	3	4	5	6	7	8	9	10
Details of fish	Stocking with 1000 fingerlings	Growing fast	Fish start breeding	Breeding and growing	Breeding and growing	Growing slows, breeding continues	Breeding and stunting	Breeding and stunting	Breeding and stunting	Total Harvest. Many small fish, big fish are <u>thin</u>
Total weight of fish in pond	1 kg	5 kg	15 kg	25 kg	40 kg	50 kg	60 kg	65 kg	70 kg	75 kg (40 kg small fish, 35 kg big fish)
Income (kwacha)	0	0	0	0	0	0	0	0	0	K2200 (K800 for small fish (K20/kg) and K1400 for big fish at K40 per kg because they are thin)

Example Pond 2) With partial harvest every 3 months

Month	1	2	3	4	5	6	7	8	9	10
Details of fish	Stocking 1000 fingerlings <u>and</u> 10 breeders	Growing and breeding	<i>Partial harvest</i>	Breeding and growing	Breeding and growing	<i>Partial harvest</i>	Breeding and growing	Breeding and growing	<i>Partial harvest</i>	Total Harvest. Big fish are <u>fat</u>
Fish biomass (weight of fish in pond)	2 kg	7 kg	18 kg (3 kg harvested) 15 kg remaining	20 kg	25 kg	40 kg (10 kg harvested) 30 kg remaining	40 kg	55 kg	75 kg (15 kg harvested) 60 kg remaining	75 kg (10 kg small fish, 65 kg big fish)
Income in kwacha	0	0	K60 at K20/kg	0	0	K200 at K20/kg	0	0	K300 at K20/kg	K3450 (K200 for small fish (K20/kg) and K3250 for big fish at K50 per kg because they are <u>fat</u> Total for 10 months: K4010)

Part 5: Nutritional benefits of fish

Context

Fish is known to be one of the cheapest sources of animal protein in most parts of Zambia. For most households, it is often the only source of animal protein. This module will help farmers to understand the importance of eating fish (nutritional benefits) and this in-turn will also help them market their fish products/fish?

Learning Outcome

- Be able to know the nutritional value of fish
- Be able to know that fish is a valuable source of proteins and nutrients
- To explain the nutritional benefits of fish in the context of food and nutrition security.
- Be able to know the importance of increase in consumption of nutritious fish in the first 1000 days

Before

- Farmers do not know the nutrition benefit of fish consumption
- Most farmers consume fish just because it is relish
- Farmers do not know the nutrients found in fish and their importance to a human body

After

- Farmers know that fish is the cheapest source of protein in Luapula
- Now farmers consume fish knowing the nutrients content in fish and how they help their health
- Know the importance of fish diet to expecting mothers and children

Fish is a valuable source of protein and nutrients in our diets and can largely contribute to food security. It accounts for a healthy and affordable source of animal protein.

It is important to increase consumption of nutritious fish in the first 1,000 days (about 2 and a half years) of life; therefore, women and children need to have access to fish (especially small fish) to meet nutrient needs. Increasing consumption of fish products could in many cases be an excellent food-based approach to combat malnutrition and, particularly, micronutrient deficiencies.

Fish (especially oily fish) is essential for the optimal development of the brain system of children, Omega-3 fatty acids are needed for brain development.

Fish is a rich source of vitamins and minerals in many local diets. Small fish are highly nutritious as they can be eaten whole including the heads, skin and bones, hence retaining the nutritional value of fish. When consumed whole, fish is an excellent source of essential minerals such as zinc, iron, calcium and vitamin A & D.

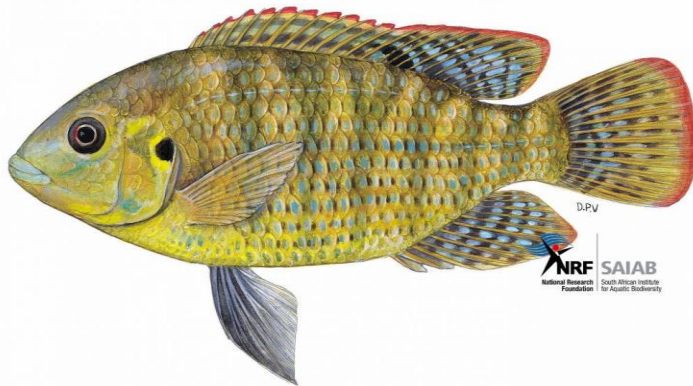
Small fish are rich in:

- Calcium and zinc: for strong healthy bones and teeth. Adults and especially growing children need calcium.

- Iron: for healthy blood, prevention of anemia in pregnant women and contributes to healthy new red blood cells after loss of blood.
- Different types of fats: important for body and mind, especially for learning

Iron and zinc are found in significant amounts, particularly in fish species eaten with bones, such as small indigenous fish species.

Tilapia sparmanii = banded tilapia (amatuku) is a small species, it does well in fishponds and grows fast to its small size. It is rich in calcium and iron. People also like the taste.



Part 6: RECORDING KEEPING

Context

Record keeping allows tracking of fish farming activities, the level of fish farming management and expenses. comprehensive record keeping will improve the business efficiency and management and provide a basis for future plans. Without proper records of the fish farming, it would be very difficult to access loans from financial institutions or finding a good investor. This module covers the importance record keeping, types of record to keep and how to start keeping records.

Learning Outcome

1. Be able to know the importance of record keeping
2. Be able to know when to start keeping records
3. Be to know how good your farm is – promote fish farming as a business

Before

- A very few fish farmers keep records, most fish farmers do not have any records of when they started fish farming, the species stocked, if fish farming as a business is profitable.
- It is difficult for the fish farmers know if the fish production has increased.

After

- If farmer have learnt the importance of keeping recording on the time, labor, stocking date, species stocked, everything spent on the fishpond and money (profit or loss) you get from the pond.

Importance of record keeping: it gives an overview and evidence-based data of the amounts of money spent and the time involved to complete a particular task on the farm. It helps in saving time and money as it allows a farmer to identify where to cut costs and how to maximise labour.

How to start keeping records: Start with having a place to write (notebook) and tools to use (pen, pencil, marker, ruler, etc), from there, one can basically record dates for all activities, feeding time, etc

Types of records to keep:

Inputs

- date of stocking the fish
- date of harvest
- amount of feed given to the fish
- sources of fingerlings, feed, water, etc.
- date when fish mortality occurs
- time spent working
- money spent buying feed
- money spent fingerlings
- number of fingerlings
- Maintenance of the pond and surrounding

Farmers should note that it is important to know how much they would have spent on a piece work if they hired to do the work by asking someone how much they would have charged for the piece work.

Outputs

- harvest data like quantity of fish
- revenue (profit or loss)

What decisions to make based on records:

- increase or decrease input
- partitioning jobs/work
- calculating profits and losses
- identifying where to apply changes

It is important to keep records of your time and labour, as well as what you buy for your fishponds, and the money (profit) you get from the ponds.

Keeping these records helps you build a picture of how good your farm is, and how it compares to other activities (like growing vegetables).

Here are some examples. You can keep your records in your book.

Recording your inputs (things you buy for the pond):

INPUTS RECORD				
Date	Input	Quantity	Price	Time
01 Jan 2021	Fingerlings	1000	K 1500	4 hours
05 Jan 2021	Piecework slashing	6 ponds	K 30	8 hours
10 Jan 2021	Buying Manure	1 bag	K10	1 hours
20 Jan 2021	Buying Feed	1 bag	K 250	1 hour

30 March 2021	Piecework harvest	1 pond, 3 workers	K 45 (K15 each)	4 hours

Weekly hours/timesheet:

Work type	Who?	Quantity	Hours
Feeding fish	Wife	3 times a week	3 hours
Applying manure	Husband	1 time a week	1 hour
Slashing	Son	1 time a week	0.5 hour
Checking ponds	Wife	7 times a week	1.5 hours
Maintaining pond	Husband	2 times a week	2 hours
Adding dry grass	Children	1 time a week	1 hour
Cleaning furrow	Daughter	1 time a week	3 hours
		Weekly total:	12 hours

Income/harvest record:

HARVEST RECORD				
Date	Item	Measurement	Home use or selling	Price
01 Jan 2021	Partial harvest of small fish	3 mbale dish	Home use	-
05 Feb 2021	Fingerlings	200 fish	Selling	K 200
28 March 2021	Big fish from total harvest	50 heaps at 5 fish per heap going at K30 per heap	Selling	K 1500
28 March 2021	Small fish from total harvest	20 mbale at K10 per mbale	Selling	K 200
28 March 2021	Big fish from total harvest	2 heaps of five fish	Gift to family and home consumption	-

Part 7. BASIC FINANCIAL LITERACY IN AQUACULTURE

Context

There is lack of financial literacy amongst fish farmers. The training will help build financial literacy of the fish farmers so that they can improve the farming on a business part. The module is focused on the definition of financial literacy, financial plans, budgeting, marketing and market analysis.

Learning objective

- to be able to acquire financial literacy
- be able to know the importance of saving for their farm and make a budget
- be able to define what marketing is and its role in aquaculture

Before

Most farmers lacked basic understanding of finances in aquaculture

After

Farmers now understand the importance of financial literacy, saving, budgeting and marketing

Farmer are able to identify costs, prepare budgets and calculate profits/loses

Financial literacy is the set of skills and knowledge that allows an individual/ co-operative/ company to make informed and effective decisions with their financial resource.

Finances – it is important to keep track of the money in a business both money that is spent and the money that comes in. farmers can track money in their fish farming business by keeping records, this can be write in a small notebook and make sure these records are well kept and simple for the farmer to understand. Farm financial management involves aspects of goals setting, planning and record keeping tracking the progress of the farm. It is important for the farmers to set goals for themselves at the beginning of their plans of starting fish farming.

Saving – this is a process of setting aside an amount of money for future use or an income not spent.

People save money for several reasons. For fish farmers it is important to save for the following reasons:

- To expand or improve their fish farming business
- Manage production risks
- Savings can act as collateral when acquiring a loan from the microfinance institution.
- To use for unexpected emergencies on the farm

There are various options for saving, in rural settings saving Groups like village banking are usually preferred and commercial banks.

Budgeting

A budget is a plan to coordinate the flow of resources in and out of the business to achieve a given set of goals, it helps you make decisions about spending and saving, helps you to plan for the future and meet your financial goals, helps you organize and manage money more effectively and encourages cautious and disciplined spending.

A budget can help you determine what can be produced, the number of ponds you want to build, size and number of fingerlings you would like to stock, it helps you estimate the selling size of fish and selling price, estimate the cost of labor and estimate the total yield at the end of the growing season.

Budgeting doesn't only apply to big sums of money. It is important that farmers account for the monies that they spend or earn in their fish farming business whether the amount is big or small. Participants must remember that small monies accumulate.

Marketing and Marketing analysis

Marketing is the action or business pf promoting and selling products or services including market research and advertising. Marketing involves the process of finding out what your customers need and wants, when they need them and then working out a way to profitably meeting those needs and wants (Malcon,2000)

Importance of marketing in aquaculture

- Identify buyers of fish and customer needs according to size and species preferences as well as value addition preferences

- Understanding the market demand will enable a fish farmer to plan production processes such as partial harvest, full harvest, storage and transportation e.g. a farmer whose market requires smaller fish will plan their partial harvest or reduce their production cycle to meet the customers need.

Market analysis – looks at several characteristics of the target market and provides information about demand, consumer needs, competitors, government policies, economy and other market variables. It helps you determine the relationship between supply and demand for a specific product.

A farmer should ask themselves the following questions during market analysis

1. What kind of customers am I targeting and
2. What prices are my targets willing to pay (will my price be similar, below or above)
3. Where are my customers located and what means will I use for my product to reach them?
4. What is the best time or period to sell my products
5. What factors influences my pricing strategy

Part 8. GENDER AND AQUACULTURE

Context

This module covers concepts on gender equality, the statement of equal ease of access to resources and opportunities regardless of gender, including economic participation and decision making in fish farming, and the state of valuing different behaviors, aspirations and needs equally. Different types of games should be played to encourage active participation from both men and women

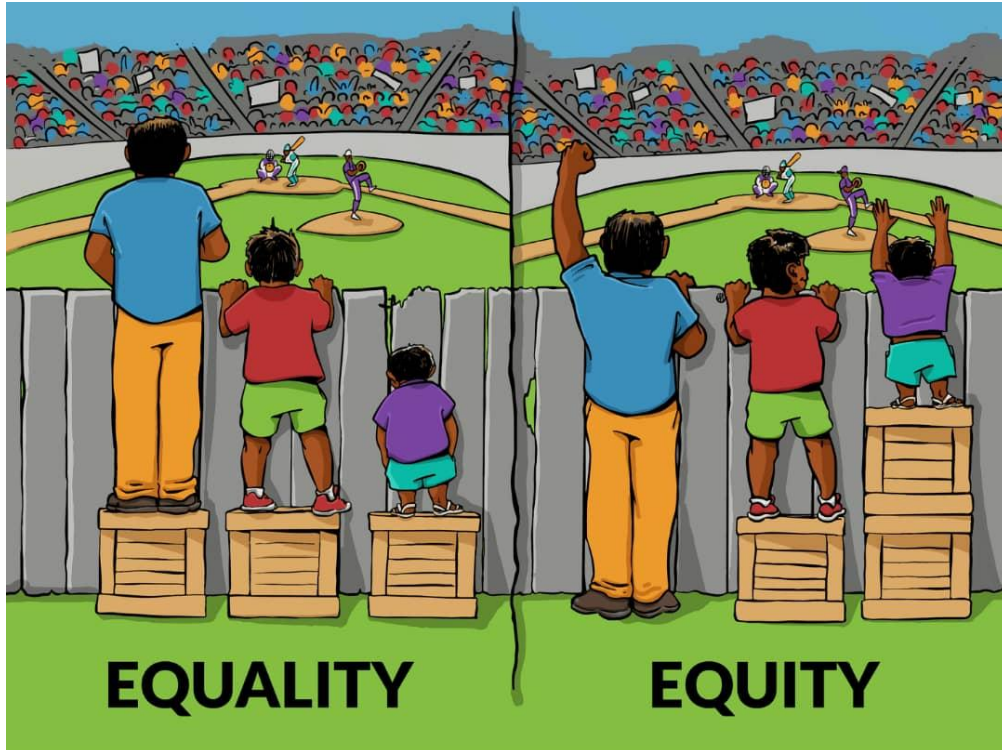
Learning Objective

1. To understand gender definition, concepts and gender equity
2. To understand and learn the difference between gender roles and sex roles
3. To describe the importance of gender in aquaculture production

Gender - These are the different roles done, by women, men, boys and girls in each and every community according the tradition and culture. However, these roles are not fixed and change with time depending on the social and economic environment.

Gender equality - Means that the different behavior's, aspirations and needs of women and men are considered, valued and favored equally. It does not mean that women and men have to become the same, but that their rights, responsibilities will not depend on whether they are born male or female

Gender equity - means fairness of treatment of women and men, according to their respective needs.



THE DIFFERENCE BETWEEN GENDER ROLES AND SEX ROLES

Gender Roles	Sex Roles
<p>Gender roles are however, learnt through socializing in the community i.e., how a boy or girl is to behave, attitudes and activities they are supposed to be involved in as they grow into a woman and a man. This is what determines gender identity, gender roles and responsibility in society.</p>	<p>Determined at birth when a boy or a girl is born</p>
<p>Change with time according to varied social, economic, political and cultural factors</p>	<p>They do not change and are the same in all societies</p>
<ul style="list-style-type: none"> - Women are expected to give childcare and take care of the house chores. - The man is expected to work and provide for the family. 	<p>Sex roles involve childbearing, which are the productive biological roles of a woman and a man.</p>

IMPORTANCE OF GENDER IN AQUACULTURE

Understanding the roles and responsibilities of the men and women is necessary for sustainable development. Gender and Development (GAD) should be promoted in aquaculture since, the men and women's roles are to complement each other.

The general situation of fish farming in Zambia is mainly at a small scale. The fish is cultured in rural areas for food security and excess sold to generate some extra income. The women are equally involved in fish farming activities however, there are rare exceptions of women owning and running their own fish farming business. The fish farm is either for the family or owned by a women group and is likely to be associated with the limitation to, access and ownership of land.



