

# MALAWI GOLD STANDARD

*Creating Income from Natural Resources*

## FISH FARMING TRAINER'S GUIDE POND AQUACULTURE



**USAID** | **MALAWI**  
FROM THE AMERICAN PEOPLE

**WorldFish**

**giz** Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH







## CONTRIBUTORS

The Malawi Gold Standard Aquaculture Production System was first published with support from the **United States Agency for International Development (USAID)** Malawi country office through the COMPASS II Project in 2006. It was reviewed and revised in 2019 with support from GIZ under the Kutukula Ulimi mMalawi (KULIMA) Project.

The technical content was developed from extensive fieldwork, research, and experience of team of experts from the **Department of Fisheries** under the Ministry of Agriculture, Food Security, Nutrition and Water Development; and the **WorldFish Center**. Specifically the following people are worth mentioning for the first version: **Dr. Daniel M. Jamu**, former WorldFish Center director for East and Southern Africa, serving as team leader and aquaculture production systems analyst; **Dr. Patrick S. Kambewa**, University of Malawi Chancellor College professor of economics, serving as deputy team leader and business model analyst; **Dr. Ben M. Kaluwa**, University of Malawi Chancellor College professor of economics, serving as supervising economist; **Dr Joseph Nagoli**, WorldFish Center Social Scientist, serving as livelihoods analyst and socio-economist; **Sabstone Unyolo**, Dept. of Fisheries former National Aquaculture Center acting head, serving as pond engineering and hydrology analyst; **Winnie Nkhonjera**, Dept. of Fisheries national coordinator for aquaculture extension, serving as fish nutrition specialist; **Brino Chirwa**, Dept. of Fisheries national coordinator for aquaculture strategic planning, serving as technical analyst on fish ecology, environment and species selection; **Friday L. Nikoloma**, commercial fish farmer, serving as business advisor; and **Henry G. Hunga**, independent consultant, serving as data analyst and extension material draftsman.

This version was revised by the following: **Dr Joseph Nagoli**, Country Research Lead for WorldFish Malawi; **Arban Pulaizi** and **Sabstone Unyolo** from the Department of Fisheries Headquarters; **Dr Leston Yoyola Phiri**, **Hopeful Kanthenga** and **Dyna Chemula** from the Malawi Fisheries College; **David Mbamba** and **Innocent Thidza** from Mzuzu Fisheries Research Station; **Hassib Sainani** from the National Aquaculture Center.

The technical material was peer reviewed during its development and refinement by experts that have included **Alexander Bulirani**, former Director Dept. of Fisheries ; **Dr. Moses Banda**, Dept. of Fisheries deputy director for research and head of the Malawi Fisheries Research Institute; **Dr. Alfred Maluwa**, former head of National Aquaculture Center; **Dr. Steve Donda**, Dept. of Fisheries deputy director for planning and evaluation; **Orton Kachinjika**, Dept. of Fisheries deputy director for extension; **Maurice Makuwira**, Dept. of Fisheries planning specialist; **Dr. Jeremiah Kang'ombe**, Bunda College head of aquaculture and fisheries department; **Dr. Emmanuel Kaunda**, Bunda College associate professor of aquaculture and fisheries; **Lars Windmar**, WorldFish Center economics and marketing specialist; **James Magasa**, MALDECO Aquaculture Ltd. operations manager; **Esben Holm**, MALDECO Aquaculture Ltd. technical advisor; and **Hiroshi Omizo**, National Aquaculture Center technical advisor.

Production of the package of extension materials was spearheaded by technical specialists on the COMPASS II team, including the following individuals: **Patrick Mphaka**, Development Alternatives, Inc. media productions officer; **Levi Z. Manda**, DAI public awareness specialist; **Jamil Simon**, Spectrum Media president and media campaign specialist; **Leila Simon**, Spectrum Media graphic artist and digital design specialist; **Eric Neudel**, Spectrum Media video production specialist; **Beyard Namale**, DAI enterprise fund manager; and **Richard Mwale**, illustrator.

Technical guidance and materials review were provided by other members of the COMPASS II team, including **Todd Johnson**, DAI senior natural resource management specialist and chief of party; **John Dickinson**, DAI natural resource decentralization specialist and deputy chief of party; **Priska Munthali**, DAI assistant natural resource decentralization specialist; **Shelix Munthali**, DAI natural resource-based enterprise development specialist; and **John Pratt**, former DAI enterprise development specialist.

A very special acknowledgement and note of appreciation must go to **Dr. Sloans Chimatiro**, NEPAD Regional Fisheries Advisor and Dept. of Fisheries former Director, whose vision and energy launched this year-long effort.



## CONTENTS

1	Introduction	3
2	Preparing for Fish Farming	5
3	Site selection and Pond construction	9
4	Fish Growing	21
5	Fish Breeding and Nursery Management	25
6	Integrated Aquaculture-Agriculture	31
7	Managing Your Pond	33
8	Harvesting	43
9	Marketing	46
10	Benefits of Working with Other Fish Farmers	49
11	The Business of Fish Farming	51
12	Summary	57



# I. Introduction

## Definition of fish farming

Is the raising of fish in an enclosed or controlled environment such as ponds, tanks, raceways, cages etc

## Importance/ Benefits of Fish Farming

Fish contribute to food security and are nutritious because they are high in protein, vitamins and minerals. Eating fish regularly can help improve your family's diet. A good, well-balanced diet makes people strong and healthy. With fishponds near your home, you can harvest fresh fish often.



Fish can provide income and employment. When you harvest fish, there will often be more than you can use yourself. You can sell extra fish to neighbors or take them to markets. You can also sell fingerlings to other fish farmers. Having fishponds on a small scale can supplement your income; on a larger scale, fish farming can be a good business.

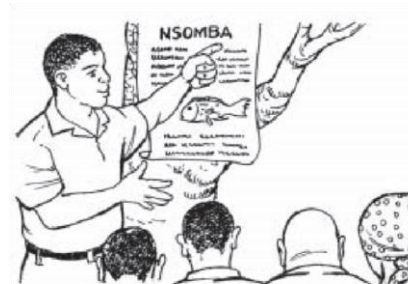


Fishponds are a good use of land. One hectare of water can easily produce 2000 to 4000 kilos of protein-rich fish each year. Ponds can often be built on land that is not good for other types of farming, and puts waste from gardening and animals to productive use.

Fishponds can provide a year-round water reservoir that can be used to irrigate and produce more than one crop in a year. As a reservoir, a fishpond can prevent soil erosion and help to rehabilitate land.

## What does fish farming involve?

Fish farming is not difficult, but like all types of farming it requires knowledge, hard work and daily effort. Before you start to build a pond, ask for help from a fisheries officer or an experienced fish farmer. Their advice can help you avoid mistakes and problems on your way to becoming a successful fish farmer.





The business of fish farming is always changing as researchers develop new ways to improve productivity. So once you start your business, you should plan to keep learning. Find out the latest advice from fisheries officers and also pay attention to your own results and learn as much as you can from them. If something doesn't work or if there are problems, try to figure out why, ask others and work to correct the problem.



## 2. Preparing for Fish Farming

### The Steps In Fish Farming

1. Learn about fish farming from experienced fish farmers, fisheries officers and books
2. Choose a good site for your ponds and think ahead to plan for growth
3. Build your ponds well to avoid future problems
4. Pond preparation
5. Find a good source of fingerlings (young fish) and use them to stock your ponds
6. Maintain and manage your fish and ponds
7. Harvest the fish and drain the ponds
8. Record production, costs and profits
9. Refill ponds, restock fingerlings and begin again
10. Keep on learning!
11. Expand with more ponds

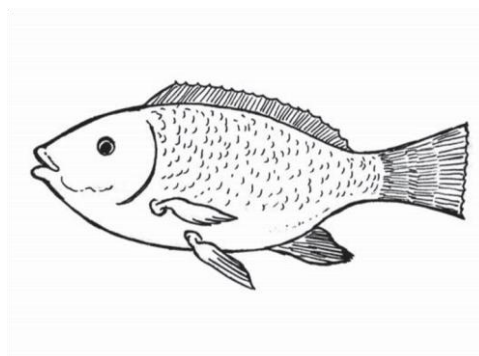
As you read further in this guide, you will learn more about each of these steps.

### Suitable Species for Fish Farming

There are thousands of different types of fish in the world, but only a few types grow well in ponds. Availability, pond conditions, markets and other factors will determine the best choice of species for your pond.

#### Tilapia

Tilapia is one type of fish that thrives in small ponds, and is now being raised in warm countries of Africa, Asia and the Americas. There are more than 100 different types of tilapia found in Africa. Each type looks and behaves slightly differently.





### **Chambo** (*Oreochromis karongae*)

Chambo is grey in color and has vertical lines on its body. Ripe males show white margin on the dorsal and tail fins. It matures at the range of 15 cm to 38cm total length (28.9cm on average). It is endemic to Lake Malawi. Its optimum temperatures are between 20-35°C. Chambo breed successfully in ponds. Chambo usually reaches sexual maturity at around 70 g., which means that they spend a lot of energy on growing rather than breeding. That makes chambo ideal for fish farming, where large fish are needed at harvest. Chambo mainly feed on plants that naturally grow in fertilized pond water (phyto-planktons), protein-based feeds including soya (formulated feeds).



Chambo

### **Makumba** (*Oreochromis shiranus*)

The makumba is well distributed across the country and is recommended for fish farming because it has the capacity to feed efficiently on phytoplankton in fishponds. Makumba has four anal spines, lacks a genital tassel, and ripe males have a bright red margin on the dorsal fin.



Makumba

Makumba breed easily under pond conditions and reach sexual maturity at an early stage (around 20 g). Because they use more energy for breeding than growing, they must be well fed or their growth rate will be reduced. Makumba has high fecundity and the size of its eggs is smaller. It can produce 150 to 1000 eggs per spawn. Makumba grow well in fertilized ponds but the size of harvest depends on the quality and quantity of the feeds used and or grown as males only. High production is attained if they are fed formulated feeds and apart from this they also respond well to other external feeds such as maize bran and rice bran. They grow better when only males are raised.





### **Chilinguni** (*Tilapia rendalli*)

The chilinguni is indigenous to Malawi and is well adapted to all water bodies of Malawi. This fish is commonly described as a red-breasted tilapia and is known by several local names, including chilinguni, nyungusale, katakuzi, nyakalua, mgoma mbungu, and many others. The chilinguni is brightly colored with 5-7 olive vertical bars, a bright red spot on the throat and breast, and a distinct black spot on soft dorsal rays called “the Tilapia spot.” It has 15 to 17 dorsal spines and 3 anal spines. Its length at maturity is 17.7cm and its maximum length is 45cm. Chilinguni is a relatively cold area species. It specifically lives well between 24-28°C.



Chilinguni

Young and adult chilunguni are plant feeders that live in areas with plenty of vegetation. Its ability to digest aquatic plants makes this fish especially important in combination with other tilapia species. Some of the vegetation on which the chilunguni feeds include sweet potato, cassava and papaya leaves, black jack/chisoso, elephant/napier grass, and others. It has a high reproduction rate and produces about 5,000 – 7,000 fry per brooder and breeds about 8 times each year. However, since its eggs are laid in shallow areas, the number that hatch and survive is low because many eggs and hatchlings die from high temperatures and predators.

### **Mlamba (Catfish)**

The mlamba is characterized by a large flat armored head, with no spine in the dorsal fin. It has a long base with no scales. The fish attains a maximum length of 170 cm but its length at maturity is 30.8cm. One of the most unique features of mlamba is their ability to breathe air (atmospheric oxygen), which enables them to live in extremely high population density and greater yields in various culture systems. The above outlined feature make catfish a suitable candidate in times of inadequate rains because they can survive in ponds with low water levels and grows remarkably fast which is an advantage to attain marketable size within a short period of time. Its temperature tolerance ranges from 8 to 35°C.



Mlamba

The growth rate of the mlamba is better than the tilapia; however, it does not spawn easily in ponds and tanks. It has low fry survival rates due to cannibalism if the pond is not well managed. Mlamba can be grown successfully in combination with makumba. Combining these 7



two species can improve the growth of both species because the cannibalistic nature of the mlamba controls the makumba population. However, the mlamba is not widely accepted in Malawi for cultural and religious reasons.



### 3. Site selection and Pond construction

#### Site selection

Once you have decided to raise fish, you should make sure your land is suitable for building a fishpond. It is important to look for these factors:

#### *Water*

A year-round source of water must be available for the fish pond; however, this does not mean that water should run into the pond continually (This will be explained later.) You will need enough water to fill the pond when you begin and to top it up whenever the level drops from evaporation or seepage. Make sure that water will be available for the pond throughout the dry season.

Springs, streams, and groundwater are good water sources for a fishpond. However, you should be sure that the water source does not contain chemicals that are sprayed on crops. Do not use tap water as this may contain chemicals such as chlorine. Chemicals can kill your fish.

Rainwater and runoff are also good water sources for fishponds. However, ponds that rely on rainwater alone often dry up during the dry season. In these ponds, you must harvest the fish before the water level drops too low. Then, when the rains begin to fill the pond, you can restock the pond and start again.

#### *Soil*

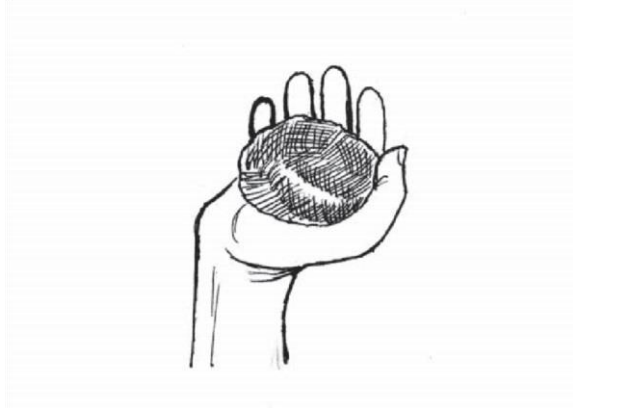
Soil containing clay is the best type for fishponds because it holds water well. Sandy soil is not good for fishponds because it will seep. To check your soil type, don't just examine the top layer. Dig at least one meter down into the soil, and take a sample from the bottom of the hole.

Do the following:

1. Squeeze a handful of moist soil into a ball
2. Throw the ball about 50 cm up into the air, and then catch it
3. If the ball holds together, it probably has enough clay to support a fishpond



4. If the ball falls apart in your hand, this means the soil is not good for building ponds



Good soil

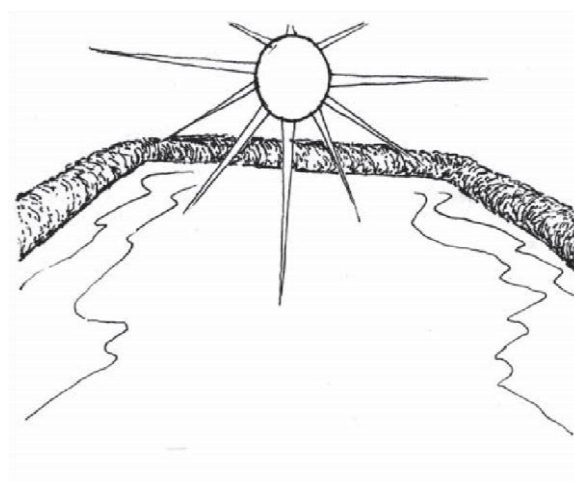


Bad soil

### *Climate*

Pond water temperature is very important when raising fish. The climate and elevation affect the water temperature. Tilapia grow best in warm water (25-30°C), which is usually found at low elevations. Tilapia can live in cooler water at higher elevations, but they grow and reproduce more slowly.

Try to find the warmest area you can for building fishponds and keep the area free from trees and shrubs, which shade the water and lower its temperature. Tilapia thrives in open, sunny locations where the water temperature remains warm.



### *Topography*

Gently sloping land is ideal for fish farming. Ponds can also be built in flat or hilly areas, but construction and management are more difficult in these locations.

Areas to avoid for fishponds are:

- Flat or swampy low areas, which cannot be drained
- Steep areas where building would be difficult
- Areas that flood such as valleys and gullies

These conditions can present problems all the way through the process, during construction, maintenance and harvesting.



### *Location*

A good location for your fishpond is very important for success. It should be near your house so it is easy for you to feed and check on the fish. Keeping the pond close to home will help you protect your fish from thieves and predators.

## **Pond construction Guidelines**

A fishpond is a shallow body of water built for raising and harvesting fish. Not just any pond will do. Fishponds should be built so they can be filled easily and drained completely. Following these guidelines will help make your pond easier to build and manage.

### ***Pond Design***

The design of the ponds affects the success of fish farming. It is related to location, slope of land as well as other purposes the pond will fulfill such as acting as a reservoir for storing water for crop irrigation and watering animals. The design should permit maximum retention of water during drought as well as withstand flooding during heavy rains.

### ***Size and Shape***

Rectangular ponds are easier to build and harvest than round or square ponds. The size of the pond is an important and somewhat complex issue because it relates to land suitability, the availability of financial and labor resources and other factors. The optimal size for a fishpond that can provide a viable income for the fish farmers is a total of 1,000 sq m. One can reach that level in a variety of ways; one can build two ponds of 500 sq m each, or build five ponds of 200 sq m each.

### Choice I: Large ponds

Fewer, larger ponds are more profitable than small ponds. You can get better prices at harvest time with larger catches and there are fewer losses to predators. The costs of building and operating a large pond are higher; however, a fish farm of at least 1,000 sq m is more profitable because there are savings in transportation and other costs that come from buying and selling in large quantities. However, it is not always possible to begin operation at this level.

While many Malawian farmers may have suitable land for developing a fish farm, they may not have adequate financial or labor resources to start out with a 1,000 sq m fishpond. The costs of digging the pond, buying the fingerlings and purchasing adequate feed and other supplies for a pond of this size can be overwhelming obstacles. As we have pointed out in the Fish Farmer's Handbook and elsewhere in this Trainer's Guide, it is possible to overcome these obstacles in a variety of ways, such as working in groups or borrowing the start-up costs from a bank.



### Choice 2: Small ponds

Farmers can also begin with a small pond. If this is the only way a farmer can begin fish farming, it is better to start small than not start at all. Even with a small pond, a farmer will at least provide food for his family and neighbors and earn additional income from the sale of excess fish. The farmer will also gain some experience in all aspects of operating fishponds and will begin building a local market for his catch. If a farmer does start small, it is best if the ponds are sited in such a way that it will be possible to enlarge them when the resources and markets become available.

Building several small ponds also has technical and business advantages. Each pond can be used for a specific purpose: one pond can become a hatchery and other ponds can be devoted to growing either single-sex or monoculture fish. Having several ponds also allows you to stagger the cycle of growth so that you can harvest and drain one pond while another is already part way through the cycle. This allows you to even out the income stream by having smaller, but more frequent harvests. It also makes it easier to get through the four-month cycle between draining and starting a pond and harvesting and selling the fish.

### Groups of ponds

There is another way to look at this issue of pond size and scale of operation. If there are several fish farmers operating close to each other, each with a relatively small pond, they can overcome the disadvantages of having small ponds by timing their growth cycles so they can harvest together. By combining their harvests and selling the fish at the same time, they can get a higher market price and reduce their costs by sharing the transport expenses. Another way for small fish farmers to work together is for one fish farmer to specialize in raising fingerlings to supply other fish farms in the area. Also, several fish farmers operating close to each other can share tools. They can also buy feed and fertilizer in bulk together and thereby purchase these supplies at lower prices.

The recommended size for small fishponds is between 200 and 500 sq m. To achieve optimal profitability for a smallholder fish farmer or group of fish farmers, we recommend at least two 500 sq m fishponds, equal to 1,000 sq m. This size allows for high production and helps control problems with predators by giving fish enough space to escape.

The key is to make the pond size appropriate to what one can handle in terms of available financial and labor resources, producing harvests that are equal to readily available markets.

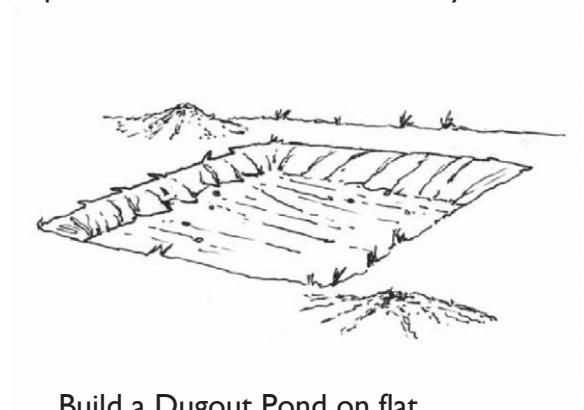
### **Depth**

The water depth should be 1 m in the shallow end (about knee high) and 1.5 m in the deep end (about waist high). The shallower end will allow you to skim fry easily into the nursery hapa (explained later). Your pond can be deeper than this if you need to use your pond as a water reservoir in the dry season. Just be sure that all the water can be completely drained for harvest.

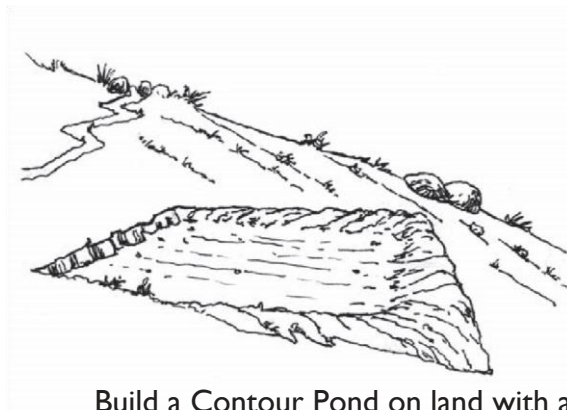


## Types

The type of pond you build depends on your land and where it will be built. Different types of ponds are built for flat and hilly areas.



Build a Dugout Pond on flat land



Build a Contour Pond on land with a slight slope

Dugout ponds are built in flat areas by digging out the soil in all parts of the pond. The water level will be below the original ground level.

Contour ponds are built in areas with sloping hills. The soil on the upper side of the pond is dug out and used to build up a dam on the lower side. In these ponds the dam must be strong because the water level in the pond will be above the original ground level.

## Pond Layout

Depending on the number of ponds to be constructed, it is very important to consider the layout in relation to water source, shape of land and drainage channel. Ensure that water from one pond does not drain in another pond as this may spread diseases. Ponds should therefore be laid out to allow for expansion in such a way that additional ponds that will share the same source of water should all drain into a drainage channel.

## Building Your Fish Pond

Building your pond can be the hardest and most expensive part of fish farming. Just remember that a well-built pond is a good investment that can be used for many years. Build your pond well so it will be strong and last for a long period of time.

### The Steps in Building a Fish Pond Are:

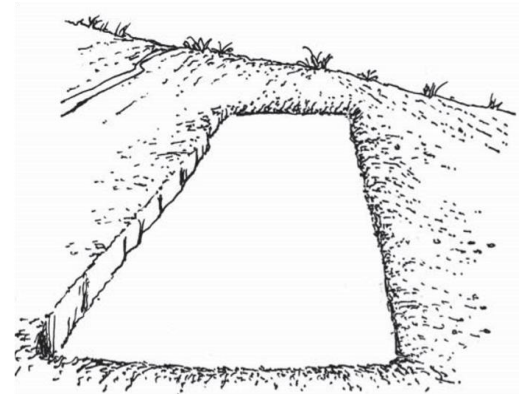
Constructing a pond can be the hardest and most expensive part of fish farming. A well-built pond is a good investment that can be used for many years. Construct a pond well, so it will be strong and last for a long period of time. The following are the steps to be considered in pond construction:



1. Prepare the site
2. Build a clay core (for Contour ponds only )
3. Dig the pond and build the walls
4. Build the inlet and the outlet
5. Protect the banks
6. Build compost fences and add fertilizer
7. Fence the pond
8. Fill the pond with water
9. Check for problems before stocking fish

### Prepare the Site

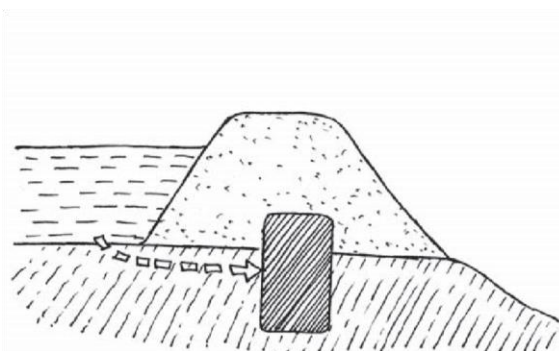
First remove trees, brush and rocks and cut the grass in the area planned for the pond. Then measure and stake out the pond. Pond pegging involves measuring the dimensions of the pond and fixing pegs into the ground to mark the most important parts of the pond. Pegs should act as guide to show the farmer where to place soil for marking the pond walls. Remember the pond banks will extend several meters beyond the water area.



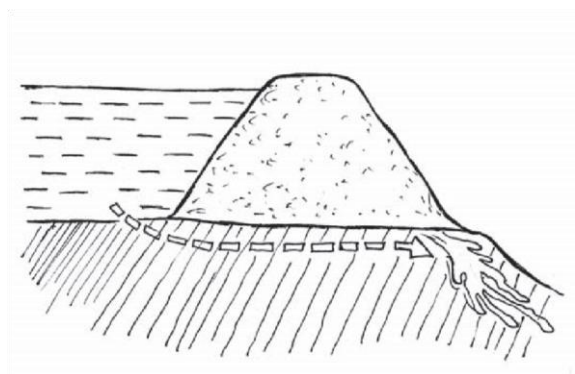
In sloping areas, build a Contour pond with the long side of the pond running along the low end of the slope of the land.

Then remove the top layer of soil containing roots, leaves, etc. Put it well outside of the pond area. Save this topsoil because you will use it later when you plant grass on the finished pond walls.

### Build a Clay Core (In Contour Ponds)



Contour Pond WITH clay core prevents water from leaking out



Contour Pond WITHOUT clay core can leak and walls can fail





A clay core is the foundation for the pond wall when the pond is built on a slope. The clay core makes the wall strong and prevents leaks. A clay core is needed in Contour ponds, and is built under the wall where the water is higher than the surrounding ground level.

First remove all the topsoil from the area for the pond walls. Then dig a “core trench” like a foundation for a house. This trench should be about 50 cm wide and 30 to 60 cm deep or until you hit a strong clay subsoil layer. The trench should be dug along the lower side of the pond, and half way along each side of the pond. Fill in the trench with good clay soil. Compact this soil each time you add several inches of new clay.

It takes effort to build a strong clay core but it provides a foundation for the walls and prevents water from seeping out of the pond. Where there is no clay core, the water seeps under the pond wall and can eventually break down the entire wall; the clay core stops the water from seeping under the newly built wall.

### **Digging the Pond and Building the Walls**

As you dig out the pond, use the clay soil to begin building up the wall known as a “dyke” on the top of the clay core. If you hit poor sandy soil, throw this outside of the pond area. *Sandy or rocky soil, or soil that contains roots, grass, sticks, leaves, etc. should not go into the wall.* These will decay later and leave weak spots where the water can leak out.

Compact the soil often as you build the wall. After adding 30 cm of loose soil, trample on it by foot or use a rammer. You can pound it with your hoe, a heavy log, or a piece of wood attached to the end of a pole. This will make the dam strong. If you don't do this, the soil will remain loose and the wall will not hold water.

The pond walls should be about 30 cm above the water level in the pond. Once you have reached this height, add a little more soil to allow for more settling. Then do not add any more soil on top of the walls.

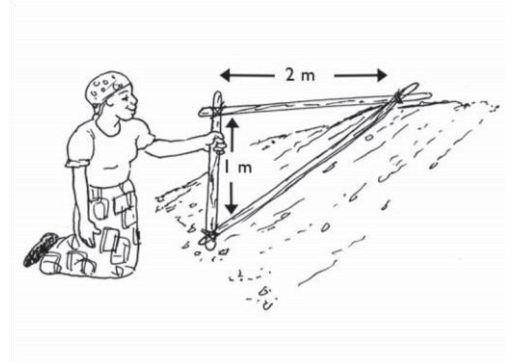




If the walls reach this height and you are still digging the pond, throw the soil outside the pond area. If the pond walls become too high, they become unstable and high walls make it hard to work around the pond.

The pond walls should have a gentle slope similar to the slant of a house roof. This makes them strong and prevents them from undercutting and collapsing into the pond. It is easier to slope the walls *after* digging out the main part of the pond.

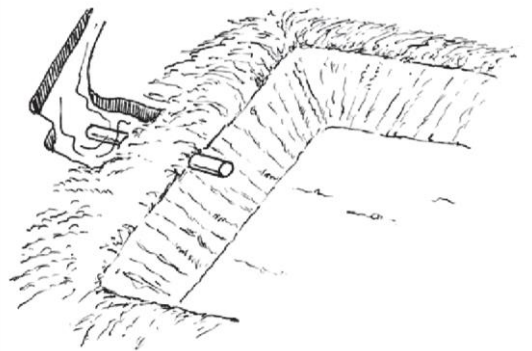
The best slope for the pond walls is to rise only 1 m in height for every 2 m in length. You can easily make a triangle to help build the slope at this angle.



The pond bottom should also slope gently or be stepped, so that the water will vary in depth from 50 cm to 1 m. It is important to smooth out the pond bottom after reaching the proper depth. This will make it easier to use nets for harvesting fish; they will slide easily over the pond bottom.

### Installing the Inlet, Outlet and Overflow pipes

The inlet consists of a canal to bring in the water, a silt catchment basin, and a pipe to carry water into the pond. The water coming into the pond often contains a lot of soil and silt. This will make the pond very muddy. A silt catchment basin will stop this soil from entering the pond. Widen and deepen the inlet canal just outside of the pond bank. The soil will settle into this hole, instead of entering the pond.



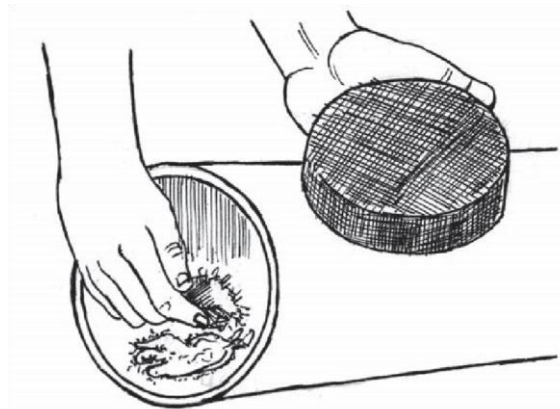
The inlet pipe runs from the catchment basin through the pond wall into the pond. It should be about 15 cm above the water level so that the incoming water splashes down into the pond. This will prevent fish from escaping by swimming into the inlet pipe. It will also help mix air into the water.

The overflow pipe is used only in emergencies. Water should *not* flow out of the ponds on a daily basis. During heavy rains, the overflow pipe helps remove excess rainwater and runoff from the pond.



The overflow pipe can be installed at an angle. It is best to install the overflow pipe with the intake below the water level; this prevents the screen from clogging with debris that may be floating on the pond surface.

The inlet and outlet pipes can be made of metal, plastic, bamboo, wood or other materials. All pipes used in fish farms should have screens to stop fish from entering or leaving the pond. Screens can be made from many types of materials. Anything will do that allows water but not small fish to pass through:



- Screen or wire mesh
- A clay pot with holes punched in it
- A piece of metal with holes punched in it
- A loosely woven grass mat
- A basket

The screens must be cleaned daily.

### **Protect the Pond Dykes**

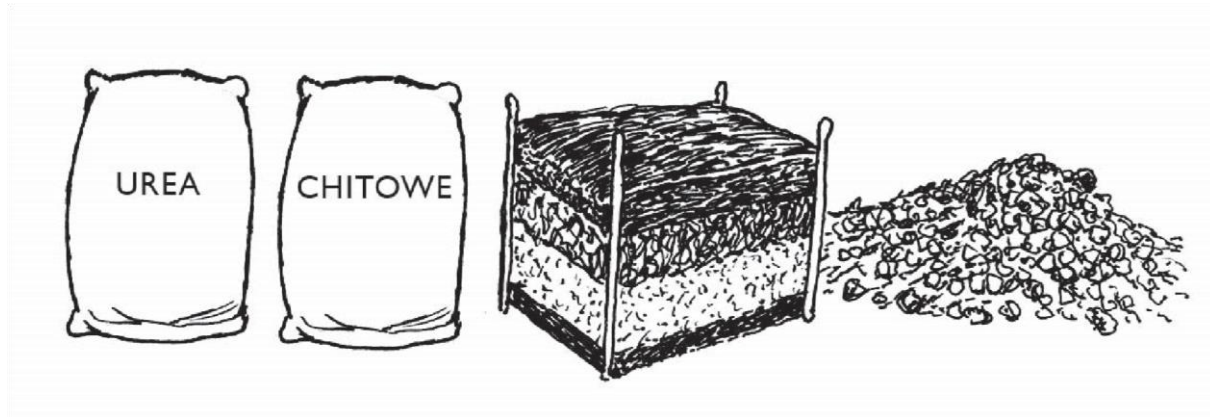
When you finish building the pond banks, cover them with the topsoil that you saved when you started digging the pond. Then plant grass on the banks. The fertile topsoil will help the new grass get started quickly. Once the grass begins to grow, it will help to protect the walls from erosion.

Heavy rains, flooding and too much runoff going directly into the pond can destroy the pond banks. This problem is most common in Contour ponds built on hillsides. To prevent this, divert the runoff water around the sides of the pond. Dig a ditch along the upper side of the pond. Using the soil from this ditch, build a small ridge below it. The ditch will carry runoff water away from the pond. This will prevent flooding and protect the pond walls.



## Preparing the pond for stocking

### ***Build Compost Fences and Add Fertilizer***



Build compost fences when the pond is dry. Don't wait until after filling the pond to build them. Each fence should be about 1 m long by 1 m wide. Build it with sticks that will not rot. Dig the sticks into the bottom about 8-10 cm apart. Then attach other sticks as cross pieces. Build the fences on the long sides of the pond.

The next step is to apply fertilizers. You can use chemical fertilizers, compost, or animal manure. Chemical fertilizers are recommended for high production. Compost and animal manure are easier to obtain and less expensive, but they may not produce as many plants (plankton) to feed your fish. Before the pond is filled with water, put organic fertilizer on the dry pond bottom and fill the compost fences with a mixture of animal manure and dried grasses, until the pile is as high as the expected water level. After you fill the pond, stir the compost once or twice a week. Add more compost when the level drops down. Two compost fences are enough for a 200 sq m pond for one growing cycle.

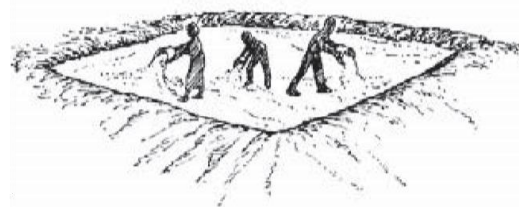
Animal manure should be spread on the pond bottom before filling the pond with water. Spread a layer of manure evenly. For each 10 by 10 m (100 sq m) you will need two gunnysacks of cattle, sheep, goat or pig manure. Chicken manure is more effective as it has a high nitrogen content. Adding manure into the top 10-15 cm of soil will help stop the soil from leaking when the pond is filled with water. For easy collection of animal manure, follow recommendations from the Ministry of Agriculture by putting your animals in standard raised kraals.

Chemical fertilizers should only be applied *after* filling your pond with water. 200 g of chemical fertilizers per week are enough for a 200 sq m pond until the water turns green. Do not add too much chemical fertilizers at once as this may kill your fish.



## Liming

Liming is done to reduce acidic conditions, to make fertilizer work effectively and to disinfect the pond from parasites. In general, red soil and areas with high rainfall will have higher acidity than dark soils and areas with low rainfall. Lime ( $\text{CaCO}_3$ ) should be applied at a rate of 2000kg per hectare to the new dry pond before filling water, two weeks before the application of manure. Ask your Fisheries or Agriculture Officer for advice or follow these general recommendations:

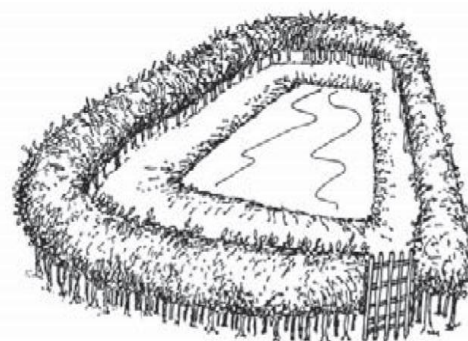


Fish farming area	Lime application rates (per 200 sq m)
High alkalinity areas (Low acidity): Chitipa, Rumphu, Mzimba, Namwera, Lilongwe, Zomba West	Lime = 4 buckets (1 liter size) Wood ash = 5 buckets (1 liter size)
Low alkalinity areas (High acidity): Nkhata Bay, Mulanje, Thyolo, Chiradzulu, Zomba east, other parts of Dedza	Lime = 25 buckets (1 liter size) Wood ash = 30 buckets (1 liter size)

Add lime or wood ash on the pond bottom in addition to manure *before* filling the pond.

## Fence the Pond

Putting a fence around the pond will help in several ways. It will protect young children from falling into the pond, and it can help keep out thieves and predatory animals. To make a low cost and sturdy fence, plant a thick hedge around the edge of the pond. Using a thorny bush like Mtete can make this kind of fence even more effective. Or you can build a fence using poles and thorn branches.



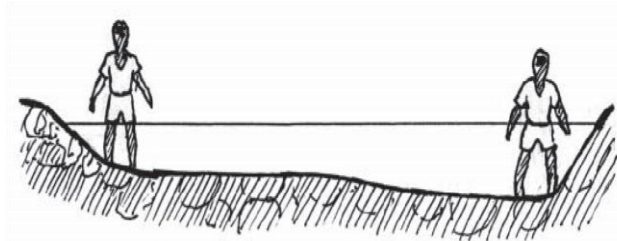


## Fill the Pond with Water

Before you start filling the pond, put rocks on the pond bottom where the water will splash in from the inlet pipe. This will keep the water from digging a hole and eroding the pond bottom. Make sure a screen is placed on the inlet pipe to keep wild fish from entering the pond. Then open the inlet canal and bring the water into the pond.



While the water is filling, measure the water depth with a stick. The deep end should be at least 1 m deep (water should reach your waist), and the shallow end 50 cm deep (water should reach just below your knees). Stop filling the pond when you reach this depth. *Do not overfill the pond.* Water in tilapia ponds should be stagnant.



The overflow pipe is used only in emergencies when too much rain and run off flow into the pond. Water flowing through your pond slows down fish growth. The incoming water is cool and infertile. Add fresh water only when the pond level drops down 15 cm or more from evaporation or seepage.

## Check for Problems before Stocking Fish

It is best to fill the pond at least two weeks *before* you stock it with fish. In this way the pond water will become warm and fertile before the fish are stocked. Also, if you find a problem, you can take care of it before the fish arrive.

For example, if after you stop adding fresh water, you discover that the water level drops quickly, this indicates that you have a leak. If this happens, you should try to locate the leak and repair the pond before stocking the fish.

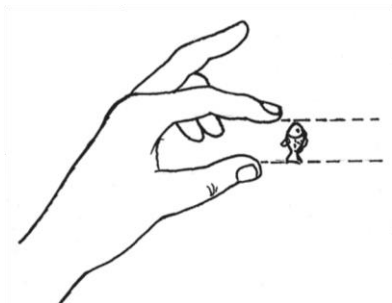
What can you do if your pond doesn't fill up? Often new ponds will seep when they are filled with water for the first time, as the soil absorbs the water. Keep adding new water for several weeks, and slowly the pond will start to hold water.

In areas with poor soil, ponds may seep for several months. However, ponds that seep can seal up eventually as mud and fertilizers build up on the pond bottom. If the rate of seepage does not slow down after several weeks, take care of this problem. You may need to drain the pond to find the leak, so make sure your pond is holding water before you stock your fish. Obviously, you can't drain the pond to repair a leak after the pond has been stocked.

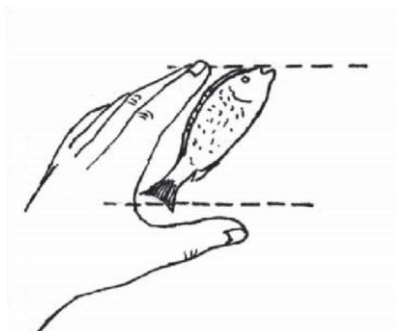


## 4. Fish Growing

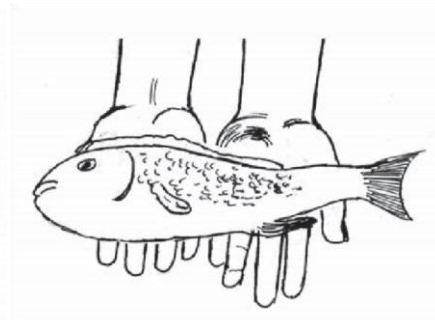
### Stocking Fish



Fry



Fingerling



Full grown fish

### Number and Type of Fish to Stock

Stock your pond with small fish called fingerlings, which are about 20-30 g. Small fish grow well before they begin to reproduce. If you stock larger fish they can reproduce immediately. When this happens the pond can quickly become overcrowded with too many fish. Overcrowding slows the growth of the fish.

It is best to buy pure tilapia fingerlings to grow in warm areas. Other types of fish may be easier and cheaper to obtain, but remember that they will not grow as well as tilapia. Talk with other fish farmers and fisheries officers to find out where you can get tilapia fingerlings.

Stocking the right number of fish in the pond helps your fish grow well. If you stock too many fish they will be crowded without enough food or space to grow well. They will stay small and thin, called “stunted.” On the other hand, if you stock too few fish they will grow well, but there will be wasted pond space and low production.

The number of fish to stock depends on the size of the pond, measured by the surface area, not by the depth. The rate that allows for good fish growth is five tilapia fingerlings for each square meter of pond area.

First you must measure your pond size in square meters:

1. Measure length and width of the pond water surface
2. Multiply length (m) by width (m) to get the area (sq)
3. Multiply the area (sq m) times 5. This equals the number of tilapia fingerlings to stock.

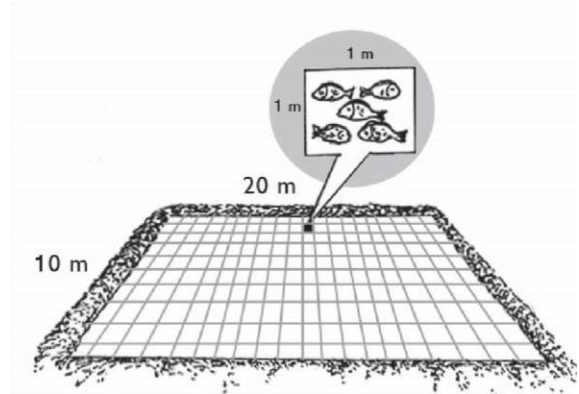


**Example:**

In the figure to the right, the pond is 20 m long and 10 m wide.

The area is  $20 \times 10 = 200$  sq m.

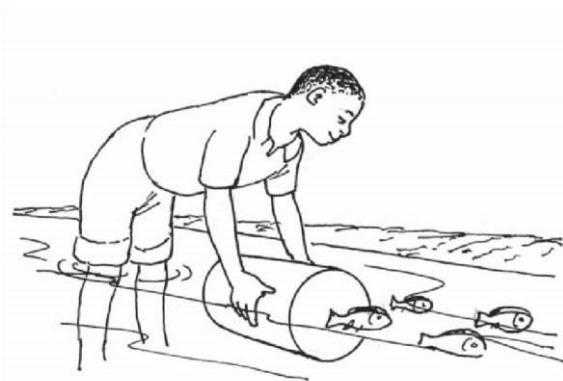
The number of fish to stock is  $200 \times 5 = 1000$  tilapia fingerlings.



**Tempering and Stocking Fish**

Fish are very sensitive to rapid changes in water temperature. When you bring fish to stock your pond, let the fish get used to the pond water slowly before you put them in. This is called “tempering.” It is one of the most important steps in stocking fish. If you don’t temper the fish, many can die.

When you arrive, check the difference in temperature between the water in the pond and the container. Put your hand into the container and then into the pond. If the pond water feels warmer or colder than the container, immerse over half of the container with fingerlings in the pond for about 5 minutes or until the water temperatures in the container and pond are almost the same. Slowly tilt the whole bucket under the surface of the water, and allow the fingerlings to swim out by themselves. Don’t throw or dump the fish from the bucket into the pond.



**DO** submerge the bucket when releasing fish into the pond



**DON'T** pour fingerlings on top of water

Later that day, and for several days afterwards, you should check the pond for dead fish. Count them as you remove them and try to replace the losses immediately. Replace twice the number of observed dead fish.





## Factors Affecting Fish Growth

Many things can affect the way fish grow. When you understand these things, you will be able to manage your pond so that the fish grow quickly.

### Fingerling Source and Quality

One major constraint to aquaculture is access to good quality fingerlings for initial stocking. For subsequent growing cycles you can use the fingerlings from your own nursery hapas (as will be explained in the next chapter). We suggest that farmers in a given area identify producers of high quality fingerlings who can become reliable suppliers for the local fish farmers.

Small young tilapia grow more quickly than other older larger fish. Therefore to get the highest yields from your pond:

- Stock small fast-growing fish (20-30 g) rather than larger fish
- Avoid stocking stunted young fish by getting your initial fingerlings from specialized fingerling producers. A 20 g fingerling will on average be 1 month (30 days) old.

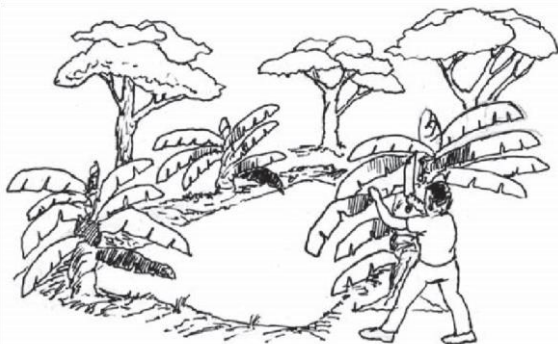
### Fish Density

Fish must have enough space in a pond to grow well. If there are too many fish, they become overcrowded and stunted. To avoid this problem:

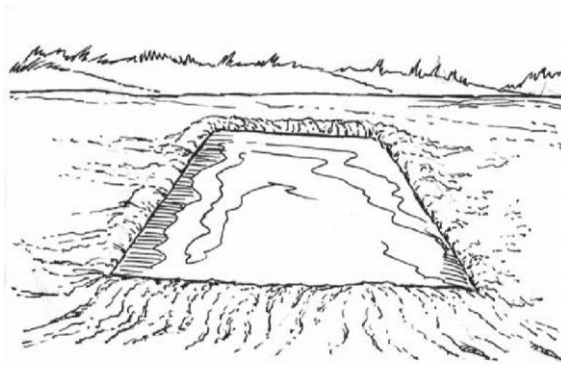
- Stock only five fingerlings per square meter
- Skim young fish regularly and grow them in hapas
- Harvest regularly every 4 months during hot months, and every 5 months in cold months

### Water Temperature

Tilapia eat best and grow most quickly when the water is warm. There are some ways you can help keep your pond water warm:



Reduce shade



Pond area should be clear

- Let sunlight enter the pond by removing trees and vegetation that shade the water.



- Keep the pond water stagnant. Add fresh water only when the level drops by 15 cm or more.
- Keep the water depth 1 meter at the deep end and 50 cm at the shallow end.

### **Food Supply**

The way fish grow in ponds is different from the way they grow in lakes and streams. In the wild, many types of natural foods are available. Fish in ponds grow close together in a small area, therefore ponds do not have enough natural foods to support the fish. Fish in ponds must rely on you, the owner, to supply their food. Fertilize the water to increase natural foods

- Add supplemental feed

### **Reproduction**

It is important to understand how a fishpond can quickly become overcrowded with small tilapia. Overcrowded fish will not grow well, and will stay small or stunted.

Chambo matures when they are about 60-70 g. They usually reach this weight at 2-3 months of age. When breeding begins, the male makes a round nest on the pond bottom by waving his tail back and forth. Then he attracts a female to lay eggs in the nest. The male fertilizes the eggs, and then the female picks them up and keeps them in her mouth to protect them.

After several weeks the eggs develop into tiny fish called “fry.” The young begin to swim around but stay in a group near their mother. When they sense danger they swim back into their mother’s mouth. They leave the mother after 2 more weeks. When you start seeing this, remove the fry using a scoop net and put them in nursery hapas erected in the pond. You can also construct a nursery pond if resources allow. For best results, don’t leave your fry in the main ponds.



## 5. Fish Breeding and Nursery Management

Fish breeding is the process of raising fish in enclosed facilities to produce young ones. The fish that produce young ones are referred to as brooders and the young ones that are produced are referred to as fingerlings/seeds. There are three major fingerling production systems such as:

- Ponds system
- In door hatchery system
- Hapa based system
- Breeding methods

### Natural breeding

- Spawning, fertilization and hatching all occurs in the rearing facility e.g. pond
- Continuous skimming and breeding occurs

### Artificial breeding

- Spawning and fertilization occurs in the confinement
- Eggs are harvested for artificial incubation in the hatchery
- Harvested eggs are classified into groups bases on stage of development and species or strain of the fish

### Brood stock Recruitment

Brood stock should be collected from natural water bodies such as rivers, lakes. They can also be collected from selective breeding programs. Brood stock should be selected by skilled personnel using the following selection criteria.

- Both males and females should range from 100 to 250g (above 15cm)
- Should be in good health, without diseases, deformities and physical injuries or wounds.
- Bright in body colour, strong, swimming vigorously, and have clear side stripes.

### Brood stock conditioning before transporting

- Keep brood stock in concrete tanks or hapas placed in pond, river or lake from where the fish is collected for 24 – 48hrs.
- Stop feeding the fish to reduce metabolic activities. This reduces water contamination during transit.
- Remove weak and dead fish from conditioning hapa or tank.



## Brood stock management

In term of pond conditions:

- Water source should be stable with water flowing all year round of good quality.
- Pond water level should be maintained at a depth of 1.2m.
- Pond area should be between 400 and 1000m<sup>2</sup>.
- Pond dike should be solid, without leakage, and if possible, be reinforced with cement.
- The dike should be at least 30cm above the ground, with draining ditches all around to prevent rainwater pouring into the pond which may ruin the dike and cause changes in water quality.

## Selecting Brood stock for Breeding

Select the fast growers with no injuries, free of diseases, bright in body colour, healthy and strong in appearance.

Separate the males and females into different ponds for conditioning. The number of males and females reserved should be 1.5 times the amount needed for breeding.

- Avoid selecting deformed and aging brooders
- Select round belly brooders.
- Pairing and breeding
- Set-up Breeding hapas/ponds

Set hapas in the pond parallel to each other, east-west direction to maximize utilization of sunlight. The hapas should be 2m away from the pond edge. Hapas should be 20m×6m×1m in size with 250µm mesh size. The total area of hapas should not be more than 50% of the pond area. When setting up more than one hapas, make sure the space between every two hapas is more than 1.5m.

## Pairing

Only one species of tilapia should be bred in one pond to avoid cross breeding.

During the peak breeding season (September to December every year, brood stock should be:

- Stocked at 3 fish/m<sup>2</sup>
- Stocked at a sex ratio of 1: 2 or 1: 3 (males to females) per 5 m<sup>2</sup>

Before stocking, bath the brood stock in 3~5% salt solution (5g of salt in 1 litre of water) for 10 ~ 15 min to remove parasites.



## Feeding

Brood stock should be fed twice a day at 8:00 - 9:00 am and 3:00 - 4:00 pm. The feed should contain between 25 -28% of crude protein, and the daily feeding rate should be 5-3% of the total body weight.

### *Fry collecting time and methods*

- Collect fry after first appearance. Thereafter, collect fry everyday
- Drive the brood stock and fry to one end if hapas are used
  - Leave them for 3 minutes,
- Use a 250 $\mu$ m mesh size net, to collect the fry on the water surface,



Collecting fry from hapa

## Fry handling

- Put all the collected fry into a smaller hapa of 250 $\mu$ m,
- Remove the debris from the hapa,
- Grade them using small net to rear different sizes separately.
- Disinfect fry with copper sulphate solution at 8 mg/litre for 20 – 30 minutes 3~5% or salt solution (5g of salt in 1 litre of water) for 10 ~ 15 min to mainly to prevent and treat trichodiniasis.
- Count number of fry using a beaker/cup as follows;
- Collect fry using a beaker three times
- Count fry at each time of collection
- Find the average number of fry per beaker/cup
- Count number of beakers/cup



- Calculate the total number of fry by multiplying total number of beakers with average number of fry per beaker/cup.
- After counting, stock fry into ponds/hapas/tanks for rearing

## Keeping Fingerlings for Restocking

1. Use of nursery hapa. You can erect a hapa with a 3/8" mesh size net. The hapa size should be 3 m in length and 3 m in width. The hapa should stick out about 15 cm above the water. Remember to cover the top with crosses of strings to protect your fingerlings from predators. Feed the fingerlings with the same feed but at slightly higher rate (10% body weight) and in fine granules.



2. Nursery pond. Build a small holding pond of at least 10 by 5 m in size, and about 60 cm deep. Be sure you have a good supply of fresh water, and screen the inlet and outlet pipes of the pond. *Do not* build a compost fence, but put fertilizer or food into the pond. Fill it with water at least one week before starting to skim your fry. Build a fence or thorn hedge around the pond to keep out animals and children who can harm the small fish.

## Handling and Transporting Fingerlings

Be careful when capturing and handling small fish for stocking. They are fragile and can be easily injured. It is best to handle and transport fish during the cool part of the day — early morning is best. Avoid the hot part of the day.

Use nets or traps to take fingerlings out of ponds. Be careful while seining since muddy water can stress the fish. Wet your hands before handling the fish because dry hands can remove their protective covering that helps prevent disease. Keep the fish in water while sorting and counting.

You can use any clean container for transporting fish — a bucket, gourd, 20 liter tin, drum, etc. Be sure it is clean and does not have any traces of soap, oil, or chemicals in it.

Fill the container only with pond water when you begin. Do not put them directly into water from a spring, a well, or a stream. These water sources are usually either cooler or warmer than pond water. Putting fish directly into water that is a different temperature than where they are coming from can kill them. You can add small amounts of water from these other sources as you transport the fish.



Keep the containers in a shaded area while you work. Count the fish as you gently place them into the containers. You can carry 75 to 100 fingerlings in each 20 litres of water for trips up to one hour long in cool weather. Don't try to put too many fish in each container or they will be overcrowded and die. If the weather is hot or the trip is longer than one hour, reduce the number of fish in each container.

While travelling, check the fish every 15 to 20 minutes to see if they are gulping for air at the surface. If this happens, add some fresh water. If you cannot get fresh water, splash the water with your hands or add air with a bicycle pump.

If you are travelling on foot, cover the container only with leaves or a cloth so the fish can get air. If you are travelling by bicycle or car, you will need to put on a tight cover to prevent the water from spilling. If travelling by car or bicycle, don't fill the containers to the top. Leave about 15 cm at the top for air.

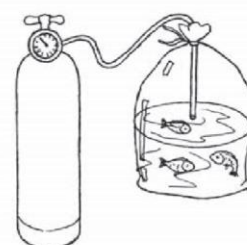
The table below shows ideal stocking rates and transportation time when using containers.

Fish size (g)	Fish density (fish per litre)	Transportation time (minutes)	Temperature (°C)
1-5	8	30	25
5-10	5	30	25
10-20	3	30	25
20-50	1	30	25

If transportation time is longer than 30 minutes and the temperature is greater than 25 °C, then change the water every 30 minutes.

When transporting for longer distances and in large quantities, the following should be used.

**Oxygenated bags:** The bags should be plastic and should not have any holes. Water is poured into the bags and fish are added. The stocking rate is the same as when buckets are used. The bags are pressed above the water to remove atmospheric air, and oxygen is added and the bags are tied with rubber bands. The bag is then placed inside another bag or in wooden box for ease of carrying. You can also use a bicycle pump to add air to the plastic bag if oxygen is difficult to get.



**Tanks:** Tanks are ideal for transporting higher densities of up to 8 fingerlings per litre. The tanks are made of metal or fiber glass. The containers have an open side facing upwards. The open side is covered with Hessian sack and tied around with a rope. The sack protects the tank from direct exposure to the sun. A truck can transport the tanks; as a result more



oxygen dissolves in the water as the vehicle moves. However, the driver should minimize quick forward and backward movements when the vehicle is in motion, as too much movement of water can kill the fish. Travel slowly and avoid using the brakes abruptly to reduce damage to the fish.

### **Important Reminders for Handling and Stocking Fingerlings**

- DO: Transport fish when temperature is cool
- DO: Always use wet hands
- DO: Keep the fish in water while counting
- DO: Handle the fish gently
- DO: Fill containers for transporting with pond water
- DO: Cover containers with leaves or cloth
- DO: Work fast and travel quickly
- DO: Always check temperatures and temper fish
  
- DON'T: Muddy the pond while seining
- DON'T: Squeeze, drop or throw fish
- DON'T: Use dirty containers
- DON'T: Leave fish in containers for a long time
- DON'T: Let fish stand in the sunlight
- DON'T: Overcrowd the fish in the containers
- DON'T Change the water temperature too quickly





## 6. Integrated Aquaculture-Agriculture

### Fish-Crop-Livestock integrated systems

Integrating fish with crops, vegetables and livestock is one way of increasing diversification and resilience of farming households from climate change impacts. Farms may combine fish farming activities with crops and livestock production.



Cabbage grown around fish pond i.e. fish/vegetable integration

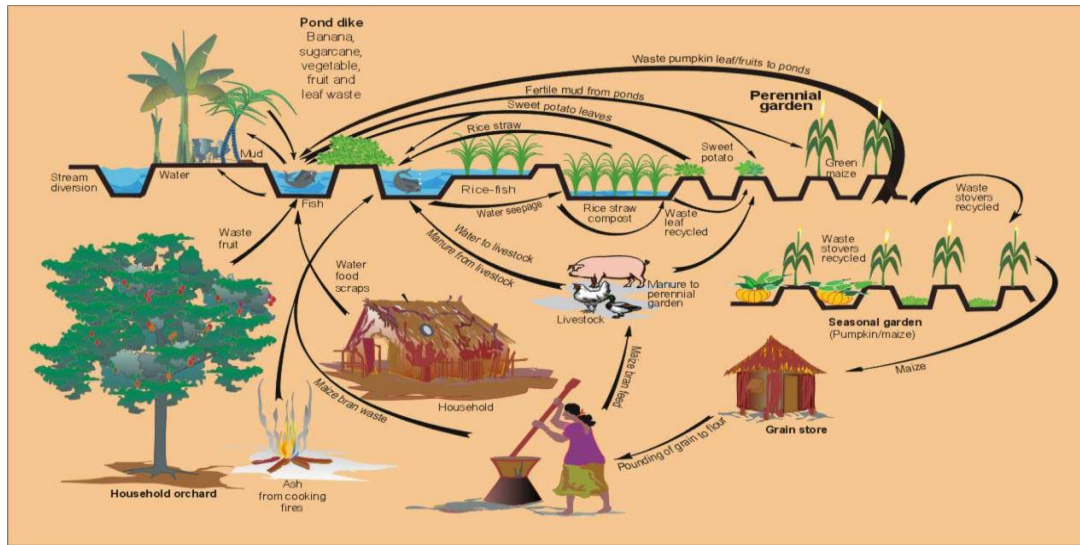


A healthy banana plant grown around a fish pond



Rice/fish culture integration

Farmers who practice integrated fish farming are able to diversify sources of income by selling crops and fish. They also have additional food from irrigated crops and fish making them to be more food secure than farmers who are not practicing integrated fish farming because they make up for yield losses using pond-irrigated maize. The figure below summarizes integrated fish farming practice.



Fish Farming Integrated System

Source: WorldFish Centre



## 7. Managing Your Pond

The way you manage your pond determines how well the fish will grow. Good management produces fast growth and healthy fish. Poor management results in stunted fish and poor harvests.

Management of fish in the ponds includes:

- Fertilizing the water
- Feeding the fish
- Observing the fish
- Preventing common problems
- 
- Maintaining and repairing the pond



### Fertilizing the Water

Fish eat natural foods in the pond. These include insects, worms, snails, and very tiny animals called zooplanktons and plants called algae and phytoplankton. Some of these animals and plants are so small, you can only see them with a microscope. But if there is a lot of plankton in the pond, the colour of your pond will be green. Tilapia eat the tiny plankton by filtering them through their gills.

You can increase the amount of natural foods in the pond by fertilizing the water. Low cost fertilizers include animal manure and compost. The fish do not usually eat the fertilizer directly. The fertilizer makes natural foods grow, which the fish can eat.

Put recommended rates of fertilizer on the pond bottom before you fill the pond as explained earlier. After the pond is filled, add fertilizer into the compost fences and stir it once or twice a week. This gradually mixes the fertilizer into the water and prevents a muddy build-up on the pond bottom.

The amount of fertilizer you need depends on which type you use and the size of your pond. The best guideline is the colour of the water. If the water is clear, the pond is not fertile and there is not much natural food for the fish. If the water has a rich green colour, the pond is fertile and there are plenty of natural foods for your fish.

You will usually need to add more fertilizer each week to keep the pond fertile and green. In addition to looking at the color of the water, you can follow the guidelines below:

- Chicken manure: 2-3 kg per week for every 100 sq m
- Pig manure: 8-10 kg per week for every 100 sq m
- Cow manure: 10-15 kg per week for every 100 sq m



The most common ways to determine whether it is necessary to continue or stop fertilization is to use a secchi disk or a hand. A secchi disk is painted with black and white colors as seen in figure. If you dip a secchi disk to a depth of 30 cm and you are able to see the disk, then your water is too clear and you need to add manure.



Where a secchi disk is not available, here is a simple test to check fertility: Gradually put your hand into the pond water. When the water reaches your elbow, can you still see your hand? If yes, then the pond needs more fertilizer. If you can't see your hand, then the pond is fertile enough. This is a good environment to help your fish grow well.



## Feeding the Fish

### Fish Feeds and Feeding:

Fish feeds can be broadly categorized as natural and artificial feeds.

Natural food is found naturally in the pond that may include small living organisms in the water that are either animal or plant in nature or rotting plants and animals, worms, insects, snails, aquatic plants and fish.

Natural foods in the pond alone will not be enough to provide for good fish growth. Fish also need supplemental feeds that a farmer puts into the pond. Artificial food is formulated to contain all the nutrients required by the fish for body maintenance and growth. The figure below shows the process of preparing artificial fish feeds.





For optimum growth and profits, fish need to be fed with a protein-based feed. Protein is good for growth. A simple protein feed can be made by mixing 30% ground soya and 70% ground maize bran measured by weight. This feed will give 18% crude protein; however, higher protein levels will improve growth. Farmers are encouraged to adapt new feed formulations as new research findings are released.

The soy should be well roasted. Grind the ingredients into very small particles for the young fish (fry) and medium-size particles for the larger fish. Feed the fish with powdered feed during the first month and in pellet form during and after the second month. Feed the fish twice a day; in the morning (8-10 AM) and afternoon (2-4 PM) when the water is warm. This is the time when the fish are active. It is best to put the food in the same place every day. The fish will know where the food will be and will not have to search for it.

Fish in ponds are fed either by spot feeding using trays or broadcasting at fixed times. Spot feeding minimizes feed wastage and enables the farmer to monitor the feeding behavior of the fish. Using broadcasting method, there is reduced competition during eating but there is a lot of feed wastage as some feed go down to the pond bottom before it is eaten by fish. Below are examples of spot feeding using a sub merged tray and broadcasting.



Fixing submerged tray



Broadcasting feed

How much food will they need? This depends on the type of food you are using, and the amount of fish in the pond. Again, your own observations are the best guide to follow. Give them only what they will eat in one day, no more. Excess food is just wasted and will rot on the pond bottom. You will have to add more food as the fish grow and multiply.

As a guideline, feed fish at 5% of total body weight of fish in the pond when fish are small and at 3% after 3 months from the stocking date. You can use the following table for feeding the soya and bran mixed feed. This is based on feeding a 500 sq m pond and a 1000 sq m for 4 months.



Age of fish	500 sq m pond	1000 sq m pond
Month 1	110 kgs (4 kgs per day)	220 kgs (8 kgs per day)
Month 2	183 kgs (6 kgs per day)	365 kgs (12 kgs per day)
Month 3	236 kgs (8 kgs per day)	472 kgs (16 kgs per day)
Month 4	270 kgs (9 kgs per day)	540 kgs (18 kgs per day)
Total	800 kgs	1600 kgs

These rates are based on a feed rate of 3% average body weight.

### Routine Checks

Conduct routine checks of your pond each day. If you do not visit the pond, you will not know what is happening. Daily visits ensure that you will be aware of problems and can correct them before it is too late. Daily maintenance checks include:

- Clean inlet and outlet pipes and screens.
- Add water if the level has dropped
- Check water colour and add fertilizer if needed
- Remove weeds from pond
- Cut grass on pond dykes
- Repair leaks and cracks in the banks
- Check for signs of theft and predators

### Preventing Common Problems

Fish farming is not difficult compared to raising other types of animals. Even first-time fish farmers have a good chance for success. Once you have built your pond and stocked fingerlings, you can often continue to raise fish easily for many years.

But problems can arise. If they do, don't become discouraged. All farmers face problems, whether in raising maize, beans or rice, cattle, chicken or rabbits. You wouldn't stop growing maize because of a few problems, would you? The same should be true for raising fish.

The most common problems that fish farmers face are:

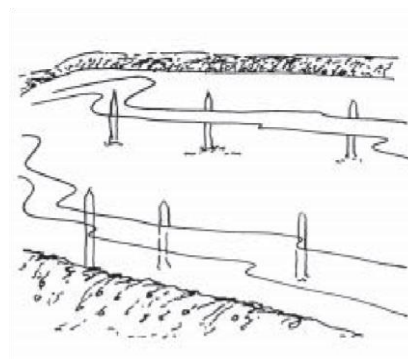
- Theft
- Predators
- Stunted fish
- Fish kills
- Seeping ponds
- Diseased fish



The simplest and best solution for all these problems is *prevention*. When you use good planning and management from the beginning you will avoid most problems. But if they happen, here are some suggestions:

### **Theft**

It is not easy to know if someone is stealing fish from your pond, because you cannot count all the fish until the final harvest. To discourage thieves, build your ponds close to your house. To make it hard for thieves to enter, put a fence or thorn hedge around the pond.



Visit the pond frequently. Be especially careful to watch your pond when the fish are large and ready to harvest. You can put sticks under the water to keep thieves from using nets in your pond. Remove the sticks when draining the pond for harvest.

### **Predation, theft, disease and parasite control**

Fish in ponds is vulnerable to theft, predation and disease infections and these cause severe losses to the farmer. Ponds should be watched and proper community sensitization should be done to avoid issues of vandalism and theft. Aquatic insects can also do a lot of damage to fish and fry in nursery ponds.

### ***Predators of Fish***

Various kinds of animals prey on fish and the most common predators include: otters, monitor lizards, birds (king fisher, pelicans, cormorants and herons), frogs, crabs, aquatic insects and snakes. The figure below shows some of the examples of fish predators.



Therefore it is important to take necessary measures to prevent predation. The table below lists some of the control measures of predation in fish farming.



## List of Predators and Control Measures

Predator	Possible control measures
Otter/monitor lizard	Set trap on otter's tracks Fencing pond.
Birds	Construct ponds close to houses Chasing birds Stretch strings across the pond Birds scarier (tins, bamboo rattlers)
Frogs and tadpoles	Destroy frog eggs by scooping them from the edge of the pond with scoop net. Pond liming will also kill the eggs and tadpoles. Kill large frogs.
Predatory fish e.g. Catfish	Put screens on the inlet pipes
Aquatic insects	Draining and keeping the pond dry before re-filling. Lime the pond to kills insects

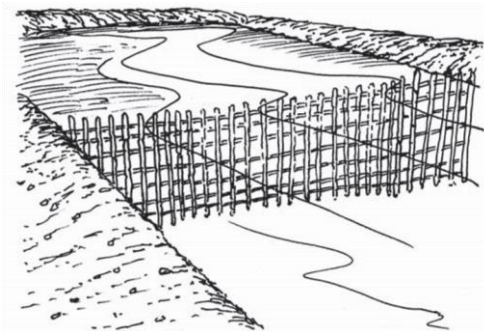
## Predators

### Birds

Kingfishers, herons, fish eagles and other birds love to eat fish. If they come to your pond, try to scare them away or trap them. Keep the pond water fertile. Dark green water makes it hard for birds to see the fish. Make sure there are no areas of very shallow water where the birds can stand and attack the fish. You can also put bird scares such as dead birds, cloth flags, imitations of human beings etc. around your pond.

### Otters and Monitor Lizards

Put a thorn hedge or fence around the pond to stop otters from entering and eating fish. Or, trap them as they enter the pond by leaving a small opening in the hedge and putting a trap there. Another effective method is to erect a fence across the middle of the pond with spaces that are large enough to allow fish to pass through, but not big enough for otters or monitor lizards. These predators prey on the fish by chasing them. The fence allows the fish to escape the predators by swimming to the other side through the small spaces.



### Frogs

If you see eggs and tadpoles in your pond, take them out right away before they grow larger. Raising ducks on the pond can help, since the ducks will eat the frog eggs and tadpoles. After harvesting, make sure to dry the pond completely to destroy frog eggs.





## **Snakes**

The best way to discourage snakes is to cut the grass short on the pond banks and clear the area around the pond.

## **Wild Fish**

If wild fish get into your pond, they can compete with your cultured fish for food; they also disturb reproduction nests or may even eat the young fish. Placing a screen on the inlet pipe will stop them from entering the pond. If wild fish do get in, there is no way to get them out except to drain the pond and refill it more carefully. Restock it with only fast growing tilapia fingerlings recommended for pond culture — especially chambo, for which these standards are based.

## **Stunted Fish**

When fish stop growing and stay small, they are becoming starved and “stunted.” This is almost always caused by poor management by the pond owner, for example by:

- Stocking too many fish in the pond
- Not adding enough feed and fertilizer
- Not harvesting on schedule
- Allowing the water level to drop too low

Do not let your fish get stunted! Stock the proper numbers of fish in the pond, care for them well, and drain the pond completely for harvest every 4 to 5 months.

Tilapia are very hardy and thrive in most ponds. But some problems can cause them to die. If you see fish dying, add fresh clean water to your pond. Then study the situation carefully to discover the problem causing them to die. The most common causes are:

- Poisoning
- Sudden temperature change
- Low oxygen levels
- Disease

## **Poisoning**

Many chemicals used on animals and crops are poisonous to fish. Fish can die when chemicals run into the pond or inlet canal from nearby fields or chemical sprays blow into the water. Treated animals can also bring poisons into the pond.



Be very careful when you add new water to your pond. It must not contain chemicals from fields. On windy days, do not spray chemicals in the area around your pond, or in your fields. The wind can blow chemicals on the pond surface. Build ditches around your pond to prevent runoff water from fields from entering your pond. Fence the pond to keep animals out.

### **Sudden Temperature Change**

If the fish begin to die within a few days after stocking, it is probably from stress during transport and stocking. The problem is often improper tempering. Remember to change the water temperature slowly in the transport container before stocking fish into the pond. Replace twice the number of dead fish immediately.

### **Low Oxygen Levels**

Fish need oxygen dissolved in the pond water to live, just as people need oxygen in the air they breathe. Low oxygen levels result when too much fertilizer or spoiled feed builds up in the pond, or the pond becomes overcrowded with fish. When the weather is cloudy for several days there is more danger of low oxygen levels.

Signs of low oxygen are fish gulping at the surface and refusing to eat. If you see fish in your pond with these signs, you must act quickly to save them. There are several ways to add oxygen to the water:

- Add fresh water
- Beat and stir up the pond water with sticks
- Stop feeding for several days
- Take the compost out of the fence

If the fish start to die, you may have to do all of these things until the fish begin to look and act healthy again.

### **Fish parasites and diseases**

Spots or growths on the bodies of the fish can be a sign of disease. Another sign is fish swimming in irregular ways. Fish that show signs like these should be removed immediately. If the disease spreads to many fish, remove all of the fish and drain the pond dry. Let the bottom dry out for two weeks. This will help destroy any remaining disease germs. Then refill the pond and stock with new fingerlings from a different pond.

In intensive fish farming there is likelihood of outbreak of diseases and parasites. These cause production and economic losses due to mortality, reduction in growth and high cost of treatment. Diseases and parasites occurrence is expected to increase with variability in climatic conditions. Diseased fish usually exhibit either physical or behavioral signs or both. Transmission of most fish diseases is unquestionably water borne. It is therefore necessary



that water is fresh, clean, and free of pathogens and parasites. Further general steps that must be taken to check the transfer of disease- causing organisms from one fish enclosure into another. The table below lists some of the common diseases and parasites in fish farming, their causative agents, symptoms and their treatment.

List of Diseases, Causative agents, Signs and symptoms and their treatment

<b>Name of disease</b>	<b>Causative agent</b>	<b>Signs and symptoms</b>	<b>Treatment and control</b>
Columnaris	<i>Flexibacter columnaris</i>	It appears on scaled fish as dull patches on the sides with some scale loss. Fins especially caudal fin is badly frayed. In advanced cases, the tail fin is lost and the muscles is eroded to the bone.	Use disease free water Elimination of wild fish Use of copper sulphate bath for 20 minutes at 33 mg of Copper sulphate per litre of water Use of potassium permanganate at 2mg of potassium permanganate per litre of water until fish condition improves
Saprolegnia infection	Fungi	The fish has grey- white or lightly brown spots on the skin, fins, eyes, mouth or gills.	Apply 400mg/L salt solution and 400mg/L sodium bicarbonate (baking soda) over the pond.
Branchiomycetes infection (Gill rot)	Fungi	Portions of the gill appear brown and decayed.	
Trichodina (External parasite)		Round wormlike with flagellates Fins are often fray and gills damaged The fish exhibit abnormal behavior or coloration The fish become sluggish and lose weight	Apply salt bath at 3% for 3-5 minutes
Chilodonella (Ectoparasite)		They are found in large numbers on the skin, fins and gills of fish They cause massive clubbing of the lamellae and fusion of the gills Infected fish become irritable, jump clear of the water and eventually become weak and unresponsive.	5 – 10% salt bath for 5 minutes
Anchor worms	<i>Lernaea</i> spp	Red pimple on or near base fins Threadlike body may protrude on the wounds	



## Seeping Ponds

Water can seep out of ponds for different reasons. Some of these include: poor pond construction, poor soils and animal burrows. If your pond leaks, first find out why, then repair it and try to stop it from happening again.

### Poor Pond Construction

Water will seep out through the pond bottom and walls if the pond is not well built. To prevent leaks, build a clay core, compact the soil while building the wall, and don't put sand, rocks or debris in the dam. If you find water leaking around the base of the walls, try to seal them up by packing clay soil along the inside wall of the pond. If this does not work, drain the pond and rebuild the wall and clay core more carefully.

### Animal Burrows

Water can seep out of cracks and holes made by moles, ants or termites. These pests often enter the pond if it is left without water for a long period of time. If you find animal burrows in the pond wall, trap and kill the animals. Then pack clay soil into the holes before you refill the pond.

### Poor Soils

Ponds built in areas with soils that do not contain enough clay will often seep. Many ponds seep a little when they are newly built, but ponds usually seal up with time. If the water level in your pond continues to drop quickly for more than one month, try: when the pond is filled with water, loosen the top layer of the pond mud with a hoe, and let it settle again. The clay will settle on top and help to seal the pond. Or spread a layer of manure all over the pond bottom.

If this does not help, drain the pond. While the soil is still moist, dig up the top six inches, then compact it. Or, add clay soil or manure and dig this into the pond bottom with a hoe, and then compact it. Then refill the pond.

### Health Hazards

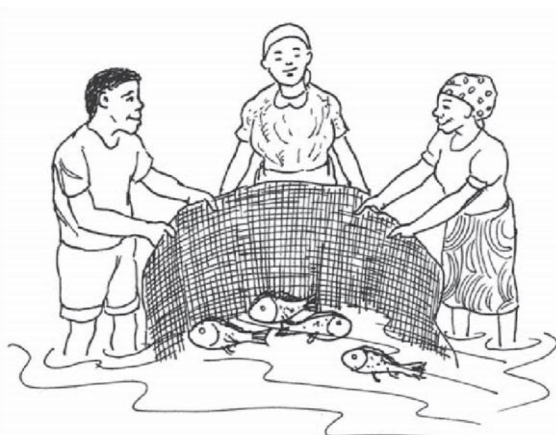
**Malaria?** Some people are afraid to build a pond near their house because they think it will attract mosquitoes that carry malaria. Fishponds *do not* increase malaria because tilapia feed on the mosquitoes and their young. It is recommended to keep weeds out of the pond and cut grass short around the pond, since these are hiding places for mosquitoes.

**Schistosomiasis** (or bilharzia) is a disease people get from infected water. The disease germs live in urine and feces of people who are sick. They also live in several types of snails. If bilharzia is a problem in your area, try to keep all snails out of your pond. Keep the pond banks steep and free of grasses and weeds. Make sure that no one ever uses your pond as a latrine! If snails do get into the pond, stock the pond with a few catfish or raise ducks on the pond. They will eat the snails.



## 8. Harvesting

Harvest your fish after 4 months if it's in the warm season or after 5 months during the cold season. During this time the fish would have grown to an average weight of about 150 g. Most people in Malawi like this size of fish, therefore creating a high demand for this size. Keeping your fish too long would result in losses because the fish do not grow very fast after 4 months, and therefore you waste a lot of feed. Be sure the fish have reproduced so you will have fingerlings to restock the pond.



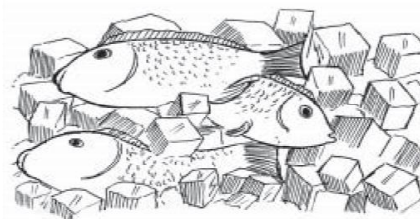
Completely harvest your pond. Complete harvesting is done by draining all the water out of pond and removing all fish. You can drain through the drainage canal, through the pond bank or drainage pipe.

Remove the fish quickly and wash them. When preparing your fish for market. Be sure to separate fish of different sizes. This is called "grading." Grading your fish offers you better prices.

### Preserving Fish

At the final harvesting you will have a lot of fish that need to be transported to good markets. Good quality fresh fish fetches high prices. You need to preserve them and store them properly to maintain their freshness for a long time. Take good care of the fish during harvest, and keep them in water in a shaded area while you work. When you finish harvesting, clean and prepare the fish as soon as possible.

It is good to ice your fish if you are travelling long distances. There are ice plants in most urban centers, but you could also arrange to get ice from people who have deep freezers. Put your fish in cooler boxes or in boxes covered by wet hessian sacks. It is also advisable to sell wholesale which will reduce the cost of preserving.



If you have more fish than you want to sell by retail, you can preserve your fish by salting and drying. The following are steps for salting or drying fish:

1. Clean and scale the fish.
2. Split the fish lengthwise and open it up.
3. Salt the fish by soaking it in brine or packing it in a container between layers of salt.
4. Hang the fish up in a shaded spot to let the excess drip out.
5. Now dry the fish in the sun or in the smoke over a fire. For sun drying, put the fish on racks or hang them on lines in a sunny spot for 3 to 5 days until they are crisp. For



smoking, lay the fish in a single layer on a wire rack and keep this above the fire for several days until dry.

6. Store the dried fish in a container with a tight lid in a cool and dry spot.

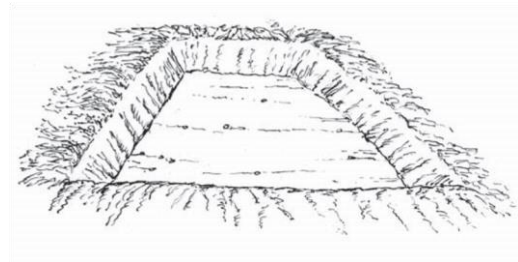
After Harvest:

1. Check the fingerlings holding pond every day, and add plenty of fresh water. Do not add feed or fertilizer.
2. Dry out the fish pond for 2 weeks.
3. Check the pond, do repairs, and add fertilizer.
4. Fill the pond with water.
5. Count out the number of fingerlings you need from your holding pond and put them in buckets. Check for a difference in the water temperature from the big pond, and temper the fish if needed. Then restock into your pond.

### Drying the Pond

It is important to completely drain all the water out of the pond, not leaving any pools of water. Letting the pond bottom dry for 2 weeks helps to:

- Kill the fish eggs and small fry left in the pond
- Destroy germs and prevent diseases
- Get rid of frogs and insects
- Increase pond fertility



When the pond is dry you have a chance to check it carefully for leaks and other problems. You can re-slope the pond banks, fill holes, and make repairs. Remove some of the bottom mud if it is more than 30 cm deep, but be careful not to remove all of it. Mud is good fertilizer in the pond. Be sure to leave mud in ponds that were seeping after construction, because the bottom mud helps to seal up the pond bottom and prevent leaks.

Refill the pond after 2 weeks.

### Nets and Traps

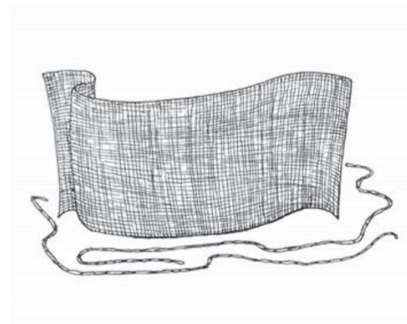
Different traps and nets can be used to capture fish in ponds.

A **Seine Net** is a long shallow net that is pulled through the pond by 2 to 4 people. The size of the spaces in the net will determine the size of fish you will catch. For capturing food fish, a 1" mesh size is most common. For fingerlings you will need a 1/4" inch to 1/2" mesh size.

A **Gill Net** is shaped like a seine net, but it is made of very fine twine. It is not pulled through the pond, but set in one place. The fish swim into the net and get caught in it. A 2" to 3" mesh size is common for gill nets.



A **Lift Net** is made of seining material. It can be any shape and size, and is set on the pond bottom. When the fish swim over it, it is lifted up, capturing the fish.



A **Dip Net** is a small net with a handle that you hold in one hand. It is used to scoop up the fish in a seine, container, etc. It is helpful when counting and weighing fish and fingerlings.

A **Cast Net** is a round net that is thrown into the pond from the shore to capture fish.

### Care of Nets

A net is very important tool for a fish farmer, but it takes a lot of money to buy a net, or a lot of time to make one. You may want to form a fish farmer's cooperative to purchase this and other supplies together. Once you obtain a net, take good care of it so that it will last for a long time:

- Use your net only in well-built ponds. Don't use it in ponds with rocks, stumps, or other debris that will snag it. Never use it in a lake or stream.
- If the net does catch on a snag, don't pull it. Take it off carefully so it will not tear.
- Don't lift heavy weight in the net. This can tear it. Avoid getting the net full of mud.
- Clean the net with fresh water after you use it.
- Dry it in the shade. Sunlight will destroy the netting material.
- Store the net in a dry, shaded spot where it will be protected from rats that can chew holes in it.
- Repair holes and tears right away. If you use the net again without repairing it, the holes will grow larger.



## 9. Marketing

Good marketing means providing the right product, at the right time, to the right place, at the right price, making sure your customers know that it's available and where and when they can buy it. If you want to be successful at fish farming, it is not enough to produce a good product, you must have customers to buy it. Marketing involves building good relations with your customers, paying attention to their needs and wants, delivering on time, and selling at a good price. Producing quality fish, building a strong customer base and serving them well are essential for building a lasting fish farming business.



### The Product

Demand for fresh fish is very high, especially in places that are far from lake sources. Various surveys have shown that most people prefer the taste and freshness of farmed fish more than lake fish. This implies that maintaining freshness adds value to the harvest.

Farmers should therefore be encouraged to sell fresh fish rather than other forms. Other ways to prepare fish, such as smoking or sun drying fillets should only be considered if volume and local competition increase.

### The Market

Although fish are not hard to market, the best prices are obtained outside the farm, mainly at urban centers along the main roads of Malawi. Rural fish farmers will get better prices for their goods and improve their financial stability if they develop strong rural-urban business connections. Lack of stable market links with nearby towns and cities forces farmers to sell their products at poor prices.

### Transportation

Transportation is a major cost of marketing fish. Selling fresh fish in large quantities, accompanied by effective advertising, can reduce these costs. Effective transportation will help in delivering quality fresh fish to the market. Remember that any reduction in freshness will lower its value. You can reduce transport costs by increasing production levels or by producing and selling as a group.





## Pricing Fish

Pricing means deciding how much money you want to get for each fish or per given quantity. Pricing should be done carefully to avoid creating a huge gap between buyers and the seller. Poor pricing may lead to a situation whereby a producer has fish but cannot sell them, and buyers who want fish but cannot buy them because they are too expensive. Conversely, a price that is too low will reduce your income and hurt your business because you won't have enough cash to buy fertilizer and other supplies for the next cycle. Prices of fish are determined by supply and demand; you must calculate break even costs based on your total expenditure and consider the quality of your product, among other things.

The following should also be considered for optimal prices:

- One advantage of fish farming is that it is not heavily affected by seasons. Production cycles can and should be planned in order to increase harvest during closed seasons when supply from natural waters is low. Fresh fish prices will increase during these periods.
- Producing species that are in demand by the market will ensure higher prices.
- Consider market preferences in terms of size and produce to meet these demands. The preferred size is likely to fetch higher prices.
- For optimal profits, ensure a minimum of two 4 -5 month production cycles in a year.

## Promotion

To create demand it is necessary to promote your products. Large companies spend lots of money to promote their products through adverts, sporting competitions, etc. Fish farmers also need to promote their products through adverts, branding, packaging, etc. Most fish farmers advertise in simple ways, putting up posters on trees and in gathering places, or sending someone around their area on bicycles to tell people when the next harvest will be available.

You can advertise through posters put up in major towns and other public places, through newspapers, national and community radios. The community radio stations do not charge a lot and they reach lots of people. Adverts should be clear on the products available, date of harvest and quantities.



## Re-Investing

Fish farming is a profitable business; however, just like any agricultural business, income is not continuous. Fish Farmers spend money and work hard for 4-5 months, only to be paid when they sell their harvest. The availability of large amounts of money at one time prompts some individuals to spend money irresponsibly, indulging in unhealthy behaviors such as drinking and risky sexual behavior that can lead to contracting HIV/AIDS. Households affected by HIV/AIDS experience long-term economic hardship through loss of productivity and income,



high expenses for treatment and widespread exclusion from mainstream programs targeted at economic innovation and growth.

It is important to save and spend your money wisely, remembering that fish farmers must buy feed, fertilizer and supplies for the next production cycle, and to sustain themselves while they wait for the next sale. The best thing to do with your money is to save it in a commercial bank. Decide how much money you will need for operating expenses for the next production cycle, or to expand your business. Money that is not immediately needed for expenses should be put in a bank. Always spend your income wisely by considering your family's needs first.



## 10. Benefits of Working with Other Fish Farmers

### Farmer Organization



There is significant power that comes from working in a group. Farmers within a geographic location should work together. Working together has many benefits such as:

- **Bulk procurement.** It is normally cheaper to buy in bulk than in small quantities. However, it is very difficult for a single farmer to buy in bulk. If farmers are well organized, they can afford bulk purchasing.
- **Product branding.** Branding and smart packaging adds value to your product. If you work in a group, it is easier to deliver a continuous supply of fish to your market and to brand it. For example, giving your product a name like “Thyolo Fresh Pond Fish” helps people identify it; if they bought it before and liked it, they are more likely to buy it again. That is the value of branding.
- **Higher prices.** Marketing your fish as a group can fetch higher prices. This typically involves selling the fish into the national price grid, which is along the main roads of Malawi. Transport costs can be shared, resulting in higher returns for each member of the group.
- **Lower Costs.** Working in a group can lower costs for purchasing feed, fertilizer and equipment. Also, sharing equipment helps each member save money.
- **Economies of scale.** When a number of small fish farmers work together to produce and market their fish, together they can spend less money and make more money. They can buy feed and fertilizer in large quantities and have more product to sell, therefore taking in higher prices at harvest and saving money in transportation and other expenses.
- **Training.** The training costs for each individual farmer are reduced when they join other farmers in a group training.
- **Sharing Skills.** Working in a group makes it easier to share skills and experiences.



There are individuals within a group that have special skills which, when combined, can make fish farming more successful. For example, in a group there could be a retired bank officer who is good at keeping records, a group of men who are good at pond construction, a group of women who are good at pond management, etc. Each person contributes their particular skill to make the group stronger.

**Accessing loans.** When farmers form organizations, the group can create social collateral that can make it easier to borrow money from commercial banks to expand the business. Banks are more confident about giving out loans to well organized groups.



## II. The Business of Fish Farming

### Why Start a Fish Farming Business?

There are many reasons why a person would want to start fish farming as a business. Some of the important reasons are:

- Fish farming can increase the amount of fish eaten in homes around Malawi. Fish provides much-needed protein and boosts the nutrition of people who eat it.
- Fish farming has the potential to provide much needed income for meeting the everyday needs of a household, such as soap, clothes, housing and school fees etc.
- Fish farming is a very productive use of land.
- Fish farming can provide an opportunity to employ family members in need of a job and turn family labor into money.
- The decreasing fish supply in natural bodies of water means that fish farming is the only way to increase fish production.
- The steady reduction in the supply of fish from the lakes guarantees fish farmers a strong market for as long as they continue farming.

Starting a business like fish farming requires taking a risk. The farmer invests resources to build a system that he believes will enable him to convert these resources into outputs that produce profits. When it is done well, fish farming can provide a good income and other benefits for individuals, but there are some important personal characteristics that are needed for a person to be a successful fish farmer.

These individuals should have:

- Willingness to take a risk
- Willingness to work hard without immediate rewards
- Willingness to learn new skills
- Self-discipline
- A friendly disposition



## Things to Consider when Starting a Fish Farming Business:

### Demand for Your Fish

The farmer must consider the needs of the market when deciding whether to produce fingerlings to sell to other farmers or table fish to consumers and when determining the type of fish preferred by the specific market. The table below can assist in choosing your production type.

Market Composition	Type of Production
Fast growing commercial aquaculture industry.	Fingerling production
Availability of big institutions e.g. hospitals, boarding schools, prisons, colleges, hotels	Table fish production
Rural or urban low income people	Small size table fish production

It is also very important to determine the nature of the demand, whether seasonal or long-term. As a farmer you have control over your harvests, therefore knowing when fish products are in high demand can help you plan your production cycles. For example, timing one of the harvests to coincide with the closed season in the lake can help you get a better price.

### How far are your ponds from your markets?

The distance of your ponds from the markets may influence your decision to sell processed fish or fresh fish.

### Existing Regulations and Laws that Effect the Fish Farming Business

Consideration of laws and regulations may be helpful in avoiding frustrations when the business has already started. For example, to be told to vacate the land, when ponds are already constructed, simply because you never followed proper procedures to acquire the land, can be very frustrating. Hence you should always find out what the law or the customary procedures require regarding: land ownership and right of use, water use rights, and laws pertaining to the use of exotic species.

### Forms of Ownership

Form of ownership plays a significant role in determining the extent to which a business will be able to obtain a loan for financing its operations. For the purpose of this guide, only two forms of ownership will be discussed. The two have been selected because of their great relevance to rural small-scale businesses.



### **Sole proprietorship** (ownership by one person)

This is the most common, simplest and oldest form of all ownership used by small-scale entrepreneurs. It is a form of ownership whereby the business is owned and managed by a single person or single family. This form of ownership seems good and simple; however, there are advantages and disadvantages as shown in the table below.

<b>Advantages</b>	<b>Disadvantages</b>
I. Few formalities are required to start the business	I. Usually lacks capital
II. The owner runs it and has control of how it is managed	II. The owner may lose his assets should he
III. The owner gets all the proceeds	III. fail to pay debts (unlimited liability)
IV. Easy to make decisions for adopting changes	IV. Life of business depends on the life of the owner
V. Reduced transaction costs	V. It is difficult to obtain loans since lenders find it hard to trust one person

### **Partnership** (ownership shared between individuals)

This is a business owned by 2 or more people but usually not more than 20. They would either do everything together or share the work according to their agreement. A partnership is suitable for a group made up of people who would not be able to provide all the resources to start a business as an individual. For example, one person may have suitable land for fish ponds but is not physically capable, and another who is physically capable may not have suitable land. The two can agree to work together so that each person provides what the other does not have. The table below shows the advantages and disadvantages of a partnership.

<b>Advantages</b>	<b>Disadvantages</b>
I. Partnerships are financially stronger than	I. Liability is unlimited. This means that members would lose their assets in the event that they failed to pay debts
II. sole proprietorships	II. Profits are shared among partners
III. Partnerships may obtain loans easily	III. May need a few formalities and agreements before starting
IV. Joint decision-making produces better performance	IV. Partnerships may have some legal requirements during establishment and dissolution
V. Skills and knowledge can be pooled from group members, resulting in better performance	
VI. Labor may not be difficult to obtain	



## Business Capital

Capital refers to the money, tools, supplies and buildings that are required to start and operate a business. In the case of fish farming, capital refers to the value of assets like fish ponds, fishing nets, stocks of fish, feed and operating cash. Assets refers to the belongings of a business and can be classified as either Fixed or Current.

Fixed assets are those that are paid for once, but can be used over and over again (during more than one production cycle) for the production of fish. A pond is the best example. There is usually a high one-time cost to build it. A small building to keep your feed and fertilizer dry and safe is another example of a fixed asset.

Current assets are those assets that are converted into cash within one production cycle. Feed, fertilizer and fish stock are good examples of current assets.

The table below gives some examples of fixed and current assets for a fish farmer:

Fixed Assets	Current Assets
Ponds	Stocks of fish
Fishing nets	Feed for fish
Hoes and spades	Operating cash

## Sources of Capital

### Own Capital

This is money or assets belonging to the owner of the business.

### Borrowed capital

This is money or assets sourced from friends and loans from micro-finance or commercial banks such as NBS and National Bank.

### Supplier's Credit

Your suppliers have an interest in your success. If you do well, you will become a frequent customer, so it is in their interest to help you succeed. One example of supplier's credit could be purchasing fingerlings or fertilizer on credit during stocking, and paying for them when you have money at harvest time.





## **Informal Credit Market**

The informal financial sector in Malawi operates both in urban and rural areas. It is very active and plays an important role in servicing low-income groups. Because of the ease and flexibility in lending procedures, this sector provides smallholders with some options.

The common forms of informal credit market are:

- “Katapila” (Informal lending)

An informal financial lending sector associated with high interest rates that range from 25% to 100%. This high interest makes it an undesirable source of business capital.

- Savings-and-credit associations

These are community initiatives or organizations where members contribute to a lending fund with the aim of providing credit to its members. The members agree upon the interest rates, although they may be higher than the formal sector.

## **Financing Decisions**

Financing decisions involve determining which sources of money or capital are to be used for the financing of a business. The most important things to consider are:

- Loan repayment period

Too short a period of repayment may erode the profits of a business and make the business appear unprofitable.

- Rate of interest

Preference should be given to loans with low interest rates.

## **Collateral**

Loans with strict collateral requirements may result in loss of ownership of the business.

## **Investment Decisions**

These decisions involve determining how much should be invested in fixed assets and in current assets. In this case, a farmer needs to make sure that capital is divided wisely between fixed and current assets. For example, it would be unwise to spend all the money on pond construction and be left with no money for stocking and feeds or vice versa.



## Record Keeping

Keeping good records is helpful for fish farmers in many ways. You will know when to stock and harvest fish, how many fish have been stocked, harvested, sold and so on. If you do not write this information down, you can easily forget. Records will help you to keep on schedule, figure out how much fish you have produced, and calculate profits. Good records will help you to compare results from year to year. In this way you can learn from your own experiences and know the methods that work best for you.



See the Appendix for examples of record sheets.



## 12. Summary

Your fish farming business will be successful if you follow these 6 basic principles.

### 1. Choose your pond site carefully

- Make sure your site has a clean water source and good soil.
- Make sure your site doesn't flood.
- Build ponds close to homes for easy management and protection from predators and theft.

### 2. Construct your pond and maintain it well

- A minimum size would be 200 sq m, however fish farming becomes profitable when the total area of your fishponds equals at least 1,000 sq m.
- Fertilize it, fill it with water and allow it to sit.
- Check for problems, add more fertilizer and begin stocking.

### 3. Use the best quality fingerlings you can find

- Buy initial fingerlings from specialized fingerling producers.
- Avoid stocking stunted fingerlings; they will not grow well.
- Stock it with chambo of about 20-30 g at the rate of 5 fingerlings per sq m.

### 4. Feed your fish well

- Continue to fertilize your pond until the water looks green.
- Supplement with feed made of 18% crude protein (which can be made from 30% roasted soya mixed with 70% maize or rice bran).
- Feed your fish at 3% body weight.

### 5. Manage your ponds well

- Manage key factors: amount and quality of feed, water temperature, and oxygen content.
- Maintain the water level at 1 m in the deep end and 50 cm in the shallow end. Add water only if there are signs of oxygen depletion or when water levels drop by 15 cm.
- Be careful to control predatory animals and prevent theft.

### 6. Market your fish and manage your money well

- Sell fresh fish to urban markets at optimal prices.
- Plan for effective transportation and ice your fish to maintain freshness.
- Reinvest your income in new equipment as well as feed and fertilizer for the next cycle.
- Use your profits wisely.

Fish farming can be a profitable business, but success and profit will not happen overnight. You have to work hard, be patient, learn well and keep on learning.



# Appendix

## Cash Journal

Date	Customer	Type of Transaction	Cash Received	Cash Paid Out



## Pond Record Sheet (part I)

Farm name \_\_\_\_\_ Pond # \_\_\_\_\_ of \_\_\_\_\_ ponds

### Construction

Date	Size of pond (sq. m.)

### Liming (first application)

Date	Kgs

### Fertilization (first application)

Date	Kgs	Type

### Stocking

Date	Number of fish	Species

### Mortality

Date	Number of fish

### Replacement

Date	Number of fish

### Reproduction

Date fry observed	Number observed
Date skimmed	Number skimmed



## Pond Record Sheet (part 2)

### Harvest

Consumed by farm (date)		number / estimated kgs
<b>Maintenance</b>		
Date	Description (repairs, water quality changes, predator prevention, etc.)	
Sold (date)	Kgs	

**Total Harvest (kgs)**

### Liming

Date	Kgs

### Fertilization

Date	Kgs	Type

### Restocking

Date	Number of fish	Species



Name of farm \_\_\_\_\_ Pond # \_\_\_\_\_ of \_\_\_\_\_ ponds Stocking date \_\_\_\_\_

(Fill in amount of feed (kgs) used for feeding)

Week # (since stocking)	1	2	3	4	5	6	7	8	9	10	11	12
<b>Sunday AM</b>												
<b>PM</b>												
<b>Monday AM</b>												
<b>PM</b>												
<b>Tuesday AM</b>												
<b>PM</b>												
<b>Wednesday AM</b>												
<b>PM</b>												
<b>Thursday AM</b>												
<b>PM</b>												
<b>Friday AM</b>												
<b>PM</b>												
<b>Saturday AM</b>												
<b>PM</b>												

Feeding Record Sheet