4: Fishpond Management

In fish farming enterprises, efficient operation and high production can only be achieved if ponds are properly managed. Management activities begin with the preparation of the pond for the fish crop and continue with stocking and feeding the fish, ensuring that water quality remains high throughout the culture period, taking measures to prevent invasion by predators and the occurrence of diseases, and harvesting the fish. An important ancillary management practice that should never be overlooked is keeping good records of expenses and income and of all activities and events associated with the pond or farm, so that this information can be used to improve operations in the future.

4.1: Preparing Your Fishpond for Stocking

Introduction

Prior to stocking your fishpond, whether it is a newly constructed pond or is a pond that you have just harvested, there are certain things you should do to prepare the pond for the next crop of fish. Follow the steps below to properly prepare your pond for stocking.

Preparing your pond for stocking with fish

1. For an old pond, drain all water from the pond and allow it to dry for a period of fourteen days.

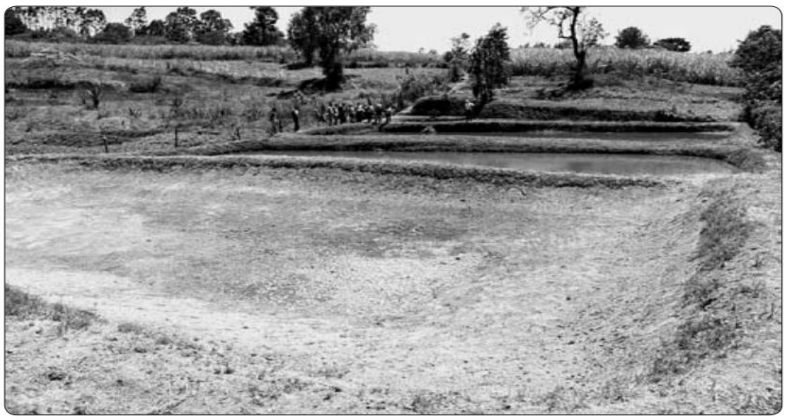


Figure 4.1-1. Drying the pond bottom helps kill potentially harmful organisms in the soil and speeds the breakdown of excessive organic matter (a beneficial process) that remains after previous crops of fish.

2. Apply lime to the pond bottom and dyke slopes.

- You should always choose agricultural limestone ($CaCO_3$) for application in your fishpond. If agricultural limestone is not available in your area, please consult your fisheries officer or extension agent about the possible use of other liming materials, e.g., quick lime or slaked lime.
- Apply the amount of agricultural limestone shown in Table 4.1-1, depending on either the total alkalinity of the pond water or the pH of the soil.
- If unsure of the alkalinity or soil pH of your pond, start by using the lowest recommended amount from this table, i.e., apply 1,000 kg of limestone per hectare of pond surface area until pH or alkalinity can be determined.
- If the pond is located in a dry area, that is, one with little rainfall (<500 mm/yr), it may be unnecessary to lime it.
- Distribute the powder evenly around the pond bottom and on the slopes of the dykes. This can be done using a shovel. Always wear gloves when working with any kind of lime.
- If necessary, you can also apply lime by spreading it over the water surface after filling the pond.

Figure 4.1-2. Applying lime to the pond bottom and sides.

3. Apply organic fertilizer to the pond before filling it with water.

- Determine which organic fertilizers are readily and cheaply available in your area. The most common examples of organic fertilizers are animal manures (e.g., from cattle, poultry, donkeys, rabbits, sheep, goats) and decaying plant matter, such as cut grasses.

Table 4.1-1. Amounts of lime to apply to ponds according to the pH of the pond bottom soil or the alkalinity of the pond water. When neither pH nor alkalinity is known, use the lowest rate shown on the table (1000 kg/ha) until pH or alkalinity can be determined.

Total Alkalinity	**Soil**	**Apply this amount of limestone**	
(mg $CaCo_3$/L)	pH	kg/ha	g/m^2
<5	<5	3000	300
5–10	5.0–5.4	2500	250
10–20	5.5–5.9	2000	200
20–30	6.0–6.4	1500	150
30–50	6.5–7.0	1000	100

- Apply available animal manure to your fishpond at a rate of 50 g of dry matter per m^2 per week. This is equivalent to 5 kg/100 m^2/week.
- Apply the manure to your pond in one of the following ways:
  - Spread dry manure on the pond floor before filling with water.
  - Spread (broadcast) dry manure on water surface periodically.
  - Place dry manure in a crib or compost bin in a corner or along the side of the pond, as shown in Figure 4.1-3.
  - Set sacks filled with manure to float within the pond and shake them daily to allow nutrients to leach out and enhance water fertility.
  - Construct poultry houses or pig pens above or adjacent to ponds to facilitate easy movement of the manure to the fishpond. See Section 1.2 of this manual to learn more about integrating fish culture with other activities on your farm.
- Apply plant matter in one of the following ways:
  - Combine dead plant material with animal manure to form compost, which can then be applied into pond waters.

Figure 4.1-3. Placing compost in bins or cribs is one way to provide nutrients to fish ponds.

Figure 4.1-4. Building poultry houses over the edges of ponds is another way of fertilizing them.

- These materials can also be mixed as compost heaps in cribs in a corner or along the side of the pond.
- Hay and other grasses can also be spread over the pond water as fertilizers.

- Repeat applications of organic fertilizers at these rates on a weekly basis throughout the fish rearing period.

4. Fill the pond with water.

5. Apply inorganic fertilizer to the pond after it has been filled.

- Inorganic fertilizers, sometimes called "chemical" fertilizers, are manufactured from mineral deposits for use in land agriculture. They are usually available from farm input shops in 50- or 100-kg bags. Inorganic fertilizers commonly used in fishponds in Kenya are Di-Ammonium Phosphate (DAP) and UREA.
- Apply DAP and UREA to your fishpond at the following rates:
  - DAP: 2 g/m^2/week (or weekly applications of 15 tablespoons DAP for every 100 m^2)
  - UREA: 3 g/m^2/week (or weekly applications of 30 tablespoons urea for every 100 m^2)

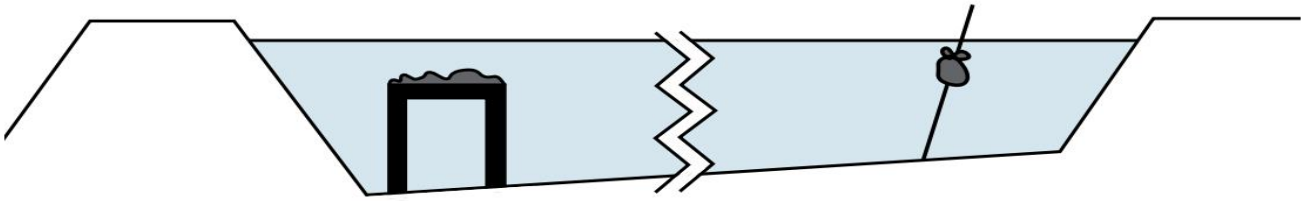


Figure 4.1-5. Inorganic fertilizers can be placed on a small platform or in a small, porous bag suspended from a stick (the stick is anchored in the pond bottom). In either case, the fertilizer should be placed near the water surface to keep it from interacting with the pond soil.

Figure 4.1-6. Inorganic fertilizers can also be dissolved in water and broadcast over the pond surface.

- Apply inorganic fertilizers to your pond using one of the following methods:
  - Dissolve the fertilizer in a bucket of water by stirring with a stick and then sprinkle the solution around pond.
  - Place small mesh bags of fertilizer on platforms just under the water surface in the pond, where the material can slowly dissolve and become available to phytoplankton.
  - Suspend small bags of fertilizer from stakes just under the water surface.
- Do not apply inorganic fertilizers directly to the pond bottom, because important nutrients may be absorbed by the mud and not be available to benefit your pond.
- Plan to continue applying fertilizers to your pond at the given rates on a weekly basis throughout the culture period.
- Avoid applying too much fertilizer to your pond, however, as this can lead to water quality problems as well as higher costs for you.

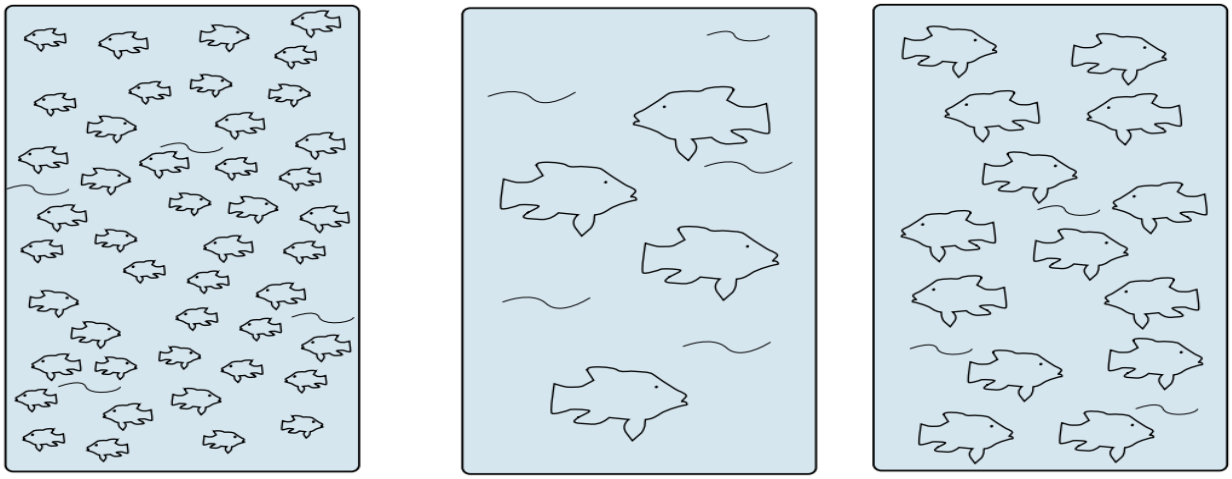
Moving on

When you have completed the above steps your pond is ready for stocking with fingerlings. Refer to the next section for the proper stocking rates and instructions for the safe transfer of fingerlings into your pond.

4.2: Stocking Your Fishpond

Introduction

To get a good crop of marketable fish it's necessary to stock the pond with the correct number of fingerlings. Stocking too few fish may result in fast growth and large fish but this isn't an economical use of the pond. However, stocking too many fish will result in slow growth and a large number of very small fish.



Too Many | Too few | Just right

Figure 4.2-1 Left: Stocking too many fish results in a large number of very small fish. Center: Stocking too few fish results in a few very large fish, but the pond space is not fully utilized and more fish could have been produced for the same cost. Right: Stocking just the right number gives many large, marketable fish.

Stock your ponds or tanks with the following numbers of fish:

Tilapia

- For all-male (monosex) culture of tilapia for the market, stock fish of 20-40 g size in properly prepared ponds at a density of 1-2 fish per m^2.
- If only mixed-sex tilapia are available to you, stock them as you would all-male fingerlings (i.e., at 1-2 fish per m^2), but stock catfish fingerlings along with them. For every 1000 tilapia fingerlings stocked you should stock 50-100 catfish fingerlings (5-10% by number). At the time of stocking, the tilapia fingerlings should be four times bigger than the catfish fingerlings so that they cannot be eaten by the catfish. Later the catfish will help control the tilapia population by consuming small tilapia that begin to appear when the tilapia you originally stocked reach spawning age (about 3 months).
- If you plan to rear tilapia fry to fingerling size, either for further stocking or for hand sexing, stock 1-3 g fish in properly prepared nursery ponds at 10 fish per m^2.

Catfish

- If you are stocking catfish fingerlings to rear to market size, stock them at a density of from 2 to 5 per m^2. Stocking with the lower number ($2/m^2$) should give you fish of up to 500 g each after 6-9 months of culture. Stocking at the higher density will give you smaller fish over the same rearing period, resulting in perhaps 200-250 g fish, depending on water temperatures and the amount of care you give to the pond.
  - For nursing to fingerling size, stock catfish fry in tanks or aquaria at 50-150 fry / L. Nurse them in the aquaria or tanks for at least 14 days and then move them out to ponds or hapas, and stock at a density of 100 fry / m^2 and rear them for another 35-40 days.

Follow these guidelines for safe handling and movement of fish:

- Stop feeding your fish one to two days prior to moving them.
- Handle fish only during the cool parts of the day, preferably early in the morning.
- Use seines and dipnets manufactured from the softest netting material possible to minimize abrasion to your fish.
- Periodically inspect your tubs, dipnets, buckets, and other fish handling equipment to be sure there are no sharp edges or corners that can injure the fish.
- Keep fish in water during all stages of moving from one place to another.
- Do not crowd the fish too closely in seines, dip nets, tubs, or transport tanks.
- Move fish to their next location as quickly as possible; do not leave tubs or buckets of fish out on the pond bank for a long time, especially on hot days.
- When putting the fish into a pond, take some time to equalize the water temperature in the transfer container (plastic bag, bucket, tub, etc.) with that of the pond water. This can be done by floating the transfer container in the pond water for approximately 15 minutes prior to releasing the fish.
- You can also gradually mix the pond water into the transfer container; this has the advantage of equalizing not only the water temperatures but also other water chemistry differences that may exist.
- Whenever possible, provide a spray or gentle flow of clean, fresh water to fish that are crowded together during handling.
- Clean all of your fish handling equipment thoroughly after each use. This can be done by thoroughly rinsing it in clean water, picking all debris, fish, or other materials out of it, and drying it briefly in the sun. This helps preserve your equipment and minimize the spread of fish diseases.

Figure 4.2-2. Plastic fish transportation bags should be floated in the pond long enough to equalize water temperatures prior to releasing the fish.

Moving on

Now that you have properly prepared and stocked your pond, you are ready to settle in to the daily fish farming routine of monitoring, feeding, fertilizing, managing water quality, controlling predators, sampling your fish, and so forth, right up to the time of harvest.

4.3: Feeding Your Fish

Introduction

You can increase the productivity of your pond and speed up the growth of your fish by providing them with supplemental food, i.e., prepared feeds they can consume in addition to the natural foods they find in the pond. This is one way of intensifying your fish production system. Refer to Section 4.8 if you are interested in other ways of intensifying production.

Feeds for fish

Manufactured fish feeds are not widely or readily available in East Africa. Exceptions exist where larger commercial operations such as TamTrout produce their own feeds for their own fish and may have excess quantities available for sale. Where manufactured feeds are available, they might be found in one or more of the following forms:

- Meal
- Crumble
- Dry sinking pellets
- Moist sinking pellet
- Floating pellet

Several different diet formulations have been tested at Sagana Aquaculture Centre, with the most effective formulation having the following composition:

Cottonseed cake	37%
Wheat bran	57%
Freshwater shrimp (*Caradina* spp.)	6%
Vitamin mix	minimal

Some farmers are successfully using feeds they have mixed for themselves. Examples of mixes that are easily prepared and economical to use include:

- Mixture of 76% rice bran and 24% fish meal
- Mixture of dried freshwater shrimp (*Caradina* spp.) and maize bran, sometimes with some omena meal added

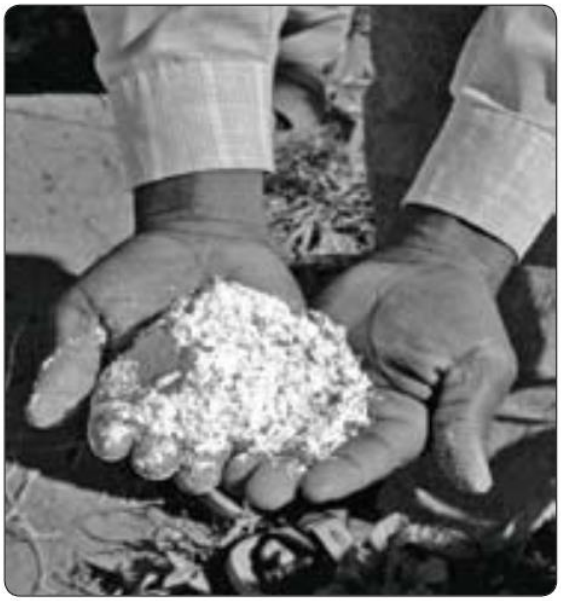


Figure 4.3-1. Good feeds can easily be prepared at the farm by mixing ingredients such as corn bran and ground freshwater shrimp

Feed processing usually includes a number of steps, including grinding, mixing, binding together, fat coating, drying/cooling, crumbling, and bagging. In the East African region, most on-farm feed preparations are made in small quantities, using improvised machinery that is operated either manually or mechanically, with outputs of not more than five 90-kg bags daily.

Feed ingredients can be hand ground or a manual grinder can be used. The ingredients are then mixed in a hand-operated mixer. After preparation, feeds can be made into pellets using a pelleting machine.

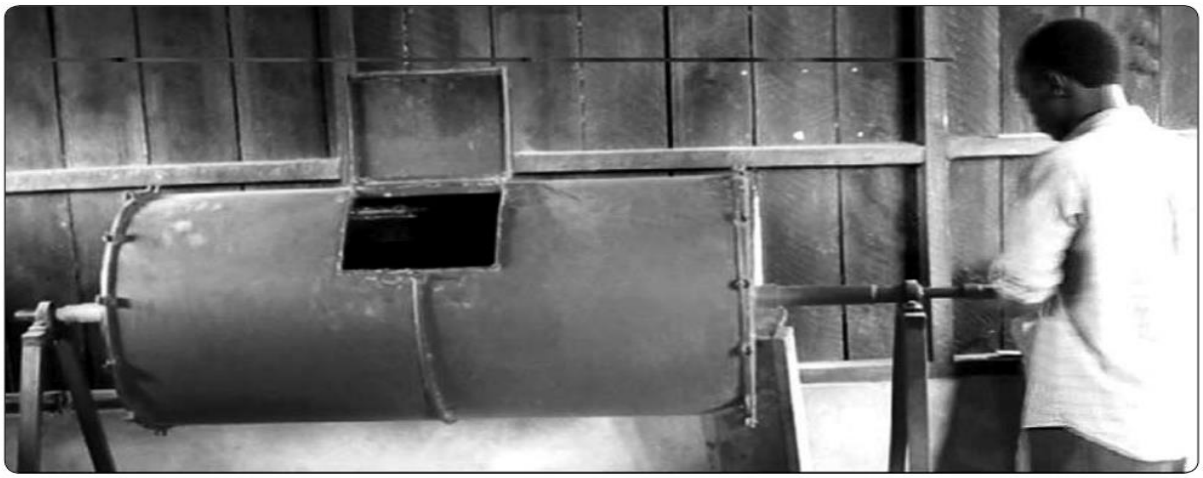


Figure 4.3-2. A hand-operated mixer is used to mix feed ingredients at Sagana Aquaculture Centre.

Figure 4.3-3. A simple pelleting machine is used to prepare fish feeds on the farm at Sagana Aquaculture Centre.

Storage of feeds

To ensure good quality and palatability, fish feeds should be stored in cool and dry stores. Avoid buying excess feed that may expire before its use.

How much to feed your fish

You must know how many fish you have in your pond to properly calculate how much feed to give them. You will have a good idea of the number of fish present if you properly prepare the pond for stocking (Section 3-1), know how many fish were stocked, and make frequent observations of the pond to know whether or not fish have died. Refer to Table 4.3-1 to determine the amount of feed you should give your fish each day.

- These amounts can be used for ponds stocked with tilapia or ponds with both tilapia and catfish (polyculture).
- These amounts can be fed all at once or divided into two equal portions given in the morning and in the evening.
- For better feeding efficiency, weigh a representative sample of your fish every second week, using their actual weight to determine the amount to feed rather than an assumed weight.

Table 4.-3-1. Daily feed rations (per fish), determined either according to the time since stocking or the present size of the fish. The amount of feed shown should be multiplied by the number of fish present in the pond.

Time since stocking (months)	**Assumed size of fish** (grams)	**Amount to feed per day***	
		Wheat bran	*Pelleted diet* (26% protein)
1–2	5–20	1 g/fish	1 g/fish
2–3	20–50	1–3 g/fish	1–2 g/fish
3–5	50–100	3 g/fish	2 g/fish
5–8	100–200	4 g/fish	3 g/fish
8 or more	Over 200	5 g/fish	3–4 g/fish

*using supplementary feed at Sagana, e.g., bran and a diet of 26% protein

In the beginning throw out small amounts of feed at a specific time of the day and observe the response. After the fish have accepted the prepared feed and learned when and where they will receive it they should become very enthusiastic feeders. Normally fish take about 15 minutes to consume the food.

You should be prepared to reduce the amount fed per day when one or more of the following occur:

- Fish are clearly not consuming their normal amounts of feed
- Water temperatures are noticeably higher than normal for the time of year
- Dissolved oxygen levels are low

All of the above may occur simultaneously when you are nearing the end of a production cycle, especially if the planned harvest time is during the hot months.

When to feed your fish

Keep the following points in mind while deciding when to feed your fish each day:

- Tilapias have small stomachs and often browse all day long.
- The best time to provide supplementary feed is between 10 a.m. and 4 p.m., when the water temperature and dissolved oxygen are reasonably high.
- It is advisable to feed from the same position and time each day for each pond. The fish soon learn when and where they can expect a good meal.
- The feeder must be a reliable and dedicated person.

How to feed your fish

Some of the ways fish feed can be offered to fish include:

- Broadcast the feed into the water as you walk along the pond bank.
- Place the feed on a feeding platform or table under the water.
- Use a demand feeder, which releases fish food when the fish bump a lever.
- Use an automatic feeder, which releases or broadcasts feed at pre-determined times.
- Neither the demand feeder nor the automatic feeder requires that an attendant be present at feeding time, but both need to be refilled regularly and periodically checked to be sure they are operating properly.

A benefit of feeding by hand is that the feeder has the opportunity to observe how well the fish are feeding, as well as how fast they are growing. Healthy fish usually eat enthusiastically, and any deviation from enthusiastic eating suggests a problem may be developing. The following are some reasons why fish such as the Nile tilapia may not feed as well as expected.

- The water is too cold.
- The dissolved oxygen level is too low.
- The fish may have died.
- The fish are ill.
- The feed is very heavy and sinks so fast you do not see the fish eating it.

Figure 4.3-4. Dry, powdered feeds can be broadcast onto the pond surface.

Summary on fish feeding: "Four Fixes:"

- **Fixed feed quality**: Feed should be fresh and palatable with a high nutritive value. Spoiled food should be thrown out to prevent disease.
- **Fixed feed quantity**: Fish should be provided with a fixed amount of feed every day. Uneven feeding causes poor digestion, poor absorption, and slow growth..
- **Fixed feeding time**: Feeding should be around 10:00 am and 4:00 pm.
- **Fixed feeding location**: Feed should be given at the same place at each feeding, e.g., on a feeding platform.

Moving on

Whether or not feeding is part of your pond management scheme, you should carefully monitor the condition of your pond on a daily basis, paying particular attention to water quality and fish behaviour. The next section describes some of the most important water quality concerns faced by pond managers and provides suggestions on how to prevent problems from developing.