CHAPTER 7

HANDLING, SAMPLING AND HARVESTING

The objective of every activity where fish are handled is to effectively and efficiently accomplish the task with the minimum amount of stress to the fish. Effectiveness, efficiency and minimum stress are interrelated. Therefore, before undertaking any activity that requires handling of fish:

1. plan when and what will be required,
2. prepare the materials, including all personnel beforehand,
3. execute the procedure and evaluate the results,
4. improve upon the process each time.

7.1. Handling Fish

Stress can be avoided or minimized at handling by observing the following:-

1. Only handle fish that have not been fed for at least 24 hours.
2. Ensure fish are always in water with adequate dissolved oxygen (ideally about 5 mg/l). Only take fish out of water when necessary (e.g., during weighing) and for not more than a few seconds at each time.
3. Work with fish when water temperatures are warm, preferably above 24 °C. The optimum water temperature for raising the African catfish is between 26 °C and 28 °C. Handling fish in cold water pre-disposes them to stress and disease. Unlike many places were the African catfish is found, southern and western Uganda have cooler than optimal temperatures, especially in early morning and at night.
4. Stock fish when water temperatures are preferably above 25 °C.
5. Do not expose fish to temperature differences of more than 3 °C without adequate acclimation.
6. Avoid exposing catfish adults to conditions of low dissolved oxygen without access to the water surface. For juveniles below 100g, the dissolved oxygen levels should not go below 4 mg/l for long periods and/or several days in a row.
7. Avoid exposing fish to chemicals and pollutants. If you must treat fish, do so using only approved treatments and only as prescribed. The only exception is with salt for reducing stress on the fish during handling and transport (use 0.5 % salt solution).
8. **Avoid holding fish temporarily in tanks and similar strict confinement for longer than necessary.** If you must, use aeration or flowing water. Hold adult catfish preferably in containers with a wide open surface area so that in the event the dissolved oxygen levels drop, they can easily come up to the surface to gulp air.

### 7.2. Sampling

*Sampling* is the temporary removal of fish from the pond. The major reasons for *sampling* are to:

1. monitor growth and general performance,
2. re-calculate feed requirements,
3. determine when fish are ready for market
4. determine if the pond has reached its *carrying capacity*
5. assess the *health* of the fish

After making the observations required, fish are returned to the pond. *Sampling* is a stressful process for the fish because they are crowded, physically handled and removed from water during the process. Handling can lead to physical rubbing of the fish's body causing the removal of the surface mucus layer and injuries which make it easier for infectious agents (for example bacteria or parasites) to enter the fish's body through the skin. Therefore, *sampling* should only be done when necessary and in the least stressful manner. Grow-out ponds should be *sampled* once a month in order to monitor growth and re-calculate feed requirements.

#### 7.2.1. How Best to Sample

The sample taken should be random and truly representative of the rest of the population. If it is not, then the *sampling* information will not give an accurate picture of the status fish population in the pond at that time. This could lead to over or underfeeding.

During *sampling* fish become *stressed* because they are physically handled, suddenly confined into a small space and removed from water. In order to reduce the levels of *stress* one must:

- a. Reduce the time the fish are exposed to the stressors mentioned. Execute the task at hand fast and efficiently.
- b. *Only sample* a small part of the pond; do not seine the entire pond.
c. Keep the fish in water all the time or as much as possible. The only time they should be out of water is when the fish basket is lifted to the weighing scale (see Plate 7.2c).

If fish are stressed during sampling, mortalities can occur for up to three days after sampling.

7.2.1.1. The Day Before the Sampling.
1. Plan and obtain the requirements for sampling in advance. This includes setting the sampling day and determining in advance what materials and personnel will be required. The tools required for sampling are:
   i. Seine net (preferably one with a bag) with the proper mesh size
   ii. Fish baskets
   iii. 'Dead' men (about 4)
   iv. Weighing balance or scale
   v. Large basin or tub (See Plate 7.1)

2. Do not feed fish the afternoon of the day before and before sampling on the day of sampling. Adult catfish fed once a day, should not be fed the day before sampling. This is to ensure that their guts are empty during sampling. Physically handling fish with full stomach is stressful to the fish and results into mortality.

7.2.1.2. On Sampling Day.
1. Set everything needed by the pond side first, personnel inclusive. Everyone should also know before embarking on the exercise, exactly what they are going to do. Practice makes perfect and saves fish.
2. Seine the pond when the water quality is optimal. When pond dissolved oxygen levels are picking up (from 4 mg/l and above) and water temperatures are not too low or too high (from 24°C to 28°C).
3. Seine about a quarter of the pond by 'cutting off a corner with the seine. Keep the fish held in the bag while they are waiting their turn to be weighed. Avoid crowding the fish too much (see Plate 7.2b). When catfish are crowded, the fish at the bottom cannot get access to the water's surface to gulp in air in the event that dissolved oxygen levels drop too low. The fish may consequently drown.
4. All the fish caught in the bag should be weighed and counted. It is important to do so, in order to avoid bias. When one hand-picks fish from a container, one tends picks out the larger (i.e. they are easier to see) fish. Also, check their general body condition (e.g., look for wounds, discolouration, etc.). It is sufficient in grow-out ponds to only obtain batch weights. It is extremely stressful to the fish and time consuming to weigh each fish individually on the farm.

5. Weigh a basket of fish at a time. Do not overload baskets with fish as the fish at the bottom become stressed by the pressure of those above when the fish basket is lifted out of the water. Load not more than two thirds of a basketful at a time. After weighing the fish, return the basket to the water and count out the fish from the basket as you gently let them swim out. DO NOT PHYSICALLY HANDLE OR THROW the fish back into the pond as you count, but let them back into the water gently. It is extremely traumatic for fish when thrown into the ponds. Minimize touching the fish as this rubs off their protective layer of mucus (See Plate 7.2d).

6. Obtain the total batch weight and count of fish caught. From these data, calculate the average weight (total fish weight of sample/total number in sample). Do not measure and weigh fish individually, unless there is some specific need for that information and the fish are expendable. For aquaculture production, batch weights are sufficient because it is the weight of fish that is sold. Remember that after sampling, the fish should still be in good condition to survive and continue growing.

7. From the feeding records, total up how much feed the fish consumed from the last sampling and calculate the FCR for that interval as well as the overall FCR from stocking. This provides an indication of feed performance and allows any management adjustments necessary to ensure that the overall FCR does not go above 2 at the final harvest.

7.2.2. When Not to Sample Ponds

Do not sample ponds when:

1. Fish are sick and show signs of extreme stress.
2. When there is lightning during a rain-storm. This is because if the lightning strikes the pond, the people in the pond can be electrocuted.
3. If it has just rained and there has been a lot of muddy water run-off into the pond. (catfish will already be stressed from this)

4. When the water quality is poor, such as when:
   a. there is a bad smell from the pond,
   b. one notices fish gasping for air,
   c. the water temperatures are 22 °C or lower at the time you intend to sample, or above 34 °C.
   d. low dissolved oxygen levels of less than 4 ppm beyond mid-morning.

   In such situations, one should postpone the sampling until when the water quality and fish’s condition have improved.

7.3. Harvesting

When fish are removed from the pond and not returned, they have been harvested. Fish are normally harvested for the following reasons:

1. sale and/or consumption.
2. transfer to other ponds,
3. mortalities are also regarded as “harvest”, in the pond record because they are fish removed. They should be noted as mortality.

As much as possible, harvest based on your marketing plan. The pond should finally be harvested before it gets to its carrying capacity.

7.3.1. How to Harvest Ponds

Ponds may be harvested with a seine net or by draining. Draining the pond marks the end of a production cycle because all the water from the pond will have been removed.

When a pond is to be harvested completely, it is better to pass a seine two or three times before completely draining it in order to reduce the number of fish in the pond. This may be done on the same day or over a period of time. It is much easier to harvest a pond by seining rather than by draining and picking up the fish from the mud.

Once the number of fish caught in the successive seines drops to about a quarter of the estimated stock, the water level in the pond can be reduced to about half-way for the last seining. After this, drain the pond completely and gather the fish using scoop nets. During drainage ensure that the screen on the outlet (as well as inlet pipe) is properly fixed to
prevent fish going out of the pond, unless you intend to use an exterior harvest basin. Make sure there is someone around to watch out for birds and other potential predators (including man).

Because seine nets for grow-out ponds are costly, one may have to hire a net for harvesting and sampling. Therefore, the number of times a pond has to be seined before it is completely harvested matters as it has a bearing on one’s operational costs, and consequently returns. One should also endeavor to minimize the amount of labour required during sampling and harvesting. Therefore, it is better to use a seine with a bag (i.e. the recommended commercial pond seine) and have the ponds constructed as recommended. To save labour and time, each pond should be accessible by a vehicle especially if one plans to harvest 100 kg or more of fish at a time (See Plate 7.3).

7.3.2. Considerations when Harvesting Fish for Market
When fish are to be harvested for market, ensure that the market has been arranged first and is ready to take the fish. It is advisable, not to feed fish two days prior to harvesting for sale. If possible get a sample of fish out yourself to check the flesh quality and/or taste. Catfish fed on offals tend to be extremely fatty. They should be kept completely off feed for at least two weeks to burn off extra fat depending on how fatty the fish are.

7.3.3. Holding Fish for Market
If you are to meet a large order, harvest the fish required the day before and keep the fish for the market in a cage within the pond (see Plate 7.4). In this way, when the customer comes, all that needs to be done is load the fish. Being able to hold fish in this manner enables one make deliveries on time, especially the early morning ones. Small sales can also be made from the holding cage. Hence, the number of times the pond is seined for a farmer who sells small amounts at a time is minimised. Consequently, the less stress inflicted upon the fish that remain in the pond and survival rates improve. However, what makes life easy for the farmer also makes it easy for thieves.

When in a holding cage for market, fish should not be fed. Fish can remain in a cage for a few days if the cage is well covered so they do not jump out. A customer who made an appointment for supply should not have to come to the pond and wait for you to seine the pond.
7.3.4. Post-Harvest Handling and Value Addition

A farmer's aim is to get the best price possible for the fish he/she has raised. Hence, the farmer must be in position to produce and maintain good quality to the customer. The advantage with fish farming, is that one has the ability to control and improve quality right from the start of the production process. Some of the factors that affect fish quality in fish farming are:

1. Quality of the feed and feeding regime which affect flesh composition, flavor and texture. Avoid using feeds with higher energy and fat than is recommended because the flesh becomes fatty.
2. *Stress* to the fish that result in extreme reduced feed intake. This results in increase in the water content of the flesh and poor texture. Therefore minimize fish stress during production.
3. Stop feeding if one is using pellets for at least 1 day before harvest. This allows the gut time to empty which aids gutting and cleaning of the fish. When one has used offals to feed catfish, the fish should be kept off feed longer to ensure their guts are empty because it takes longer for the offals to digest and to burn off extra fat.
4. Catfish fed only on offals should therefore be kept off feed for a minimum of 2 weeks, or longer if they are still too fatty.
5. Kill the fish rapidly before gutting or filleting. Do not allow them to jump all over the place before slaughter as the violent body movements can cause bruising on the fish flesh.

**After harvest:**

Avoid contamination. Use clean water and containers and avoid placing fish directly on the ground.

If fish are to be sold fresh, the best way to guarantee freshness is to sell the fish alive or deliver it live to the customer, if possible (see Plate 7.5a). When table-sized catfish are being transported live to the market, use a container with a wide opening rather than one like a water tank with a narrow spout and do not fill the tank with water to the brim. Troughs or buckets can be used. This is because adult catfish can come up to the water surface to breathe air in the event that the dissolved oxygen level in the tank drops. If the spout is narrow, the surface area of water exposed to air is small and only a few fish will be able to come up to breath at a time. The result will be several of the fish in the tank dying. Cover the tank with netting to make sure the fish do not jump out.
Alternatively, large catfish can be kept alive in wet jute bags as long as they are not wrapped too tightly. They must be able to work their gill covers (opercula).

If fish cannot be kept alive, keep them iced in form of fillets or whole gutted. Whole fish can also be filleted. The fillets can be sold fresh or smoked (See Appendix 7 for how to fillet fish).

Smoking catfish not only improves the shelf life but also adds value to the fish. However, to get the best quality, only smoke the freshest fish, not fish that is going bad (see Appendix 8 on how to smoke fish).

7.4. Records

Record the details of all samplings and harvests in the pond management record sheet. When the pond has been drained at the end of each production cycle, calculate the survival rate and overall FCR (see figure 9.2 in section 9.1.1. (pages 155-156) for an example of properly filled in record sheet).

Then draw a line across the sheet to begin a new production cycle or begin a new sheet for that pond. Remember that calculations based on sampling are only educated guesses. It is only at pond draining that the real survival rate, FCR and yield can be calculated.
Summary Guidelines for Handling, Sampling and Harvesting Fish

1. Plan beforehand and collect all the materials and personnel you require.

2. Do not feed fish for a day or two prior to major handling (sampling and harvesting). In cases where fish have been fed offals, do not feed for a minimum of four days prior to harvest.

3. Use the right equipment and ensure fish are always in water except for when it is really necessary to remove them (e.g., at weighing).

4. Confine the fish for as short a time as possible.

5. Work fast and be efficient.

6. Do not sample more fish than necessary and avoid seining the entire pond. (a sample of 15 to 30 fish is usually sufficient)

7. Record the sampling and harvest data as well as any details of the activity in the pond management record sheets.

8. Assess the data and improve the next time.

Guidelines for Post-Harvest Handling

1. Do not place the fish directly on the ground. Keep the harvested fish in a clean container – the basket, basin, tank.

2. If the fish is to be processed, slaughter and bleed the fish quickly rather than let it die own its own slowly to ensure a good texture.

3. Use only clean utensils and tables. Use materials that are easy to clean.
a. Seine Net (a Bag is not necessary for small ponds or small sample sizes)  

b. Fish Basket

c. Weigh balance

d. Field note Book and Pencil (usually, the data are recorded in the field book and later transcribed to the respective pond record sheets.

Plate 7.1: Tools Used to Sample
a. Seining a Grow-out Pond with a Commercial Pond Seine.
   When sampling, only a quarter of the pond needs to be seined off.

b. Holding the sample.
   Fish are held in the bag until they are ready to be handled. Only what can be weighed at each moment is removed using the fish basket.

Plate 7.2: Sampling a grow out
c. **Weighing the Fish.**
   The only time fish should be out of water is when the fish basket is lifted to the weighing scale.

Plate 7.2: Sampling, continued

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d. **Returning Fish into the Pond.**
   Release the fish gently into the water. Do not throw them back into the pond. They should be counted back into the pond so the average weight can be calculated.
Plate 7.3: Accessibility to Ponds
Being able to access all ponds with a vehicle is important especially when large amounts of fish are to be harvested at a go.

Plate 7.4: Temporary Holding of Fish in Ponds for Market
Catfish can temporarily be held in the pond for market in a cage or hapa. The cage or hapa must have a secure cover to prevent the catfish jumping out or other predators entering the cage. In this case, the cage or hapa can be placed on the pond bottom.
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a. Live Fish Sales.
The best way to guarantee freshness is to deliver and sell it alive to the customer. It also draws a crowd, which give free publicity.

Plate 7.5: Marketing and Adding Value to Farmed Catfish Products

b. Smoking Catfish with a Chokor Smoker

c. Catfish Fillet and Tools Used to Fillet Catfish