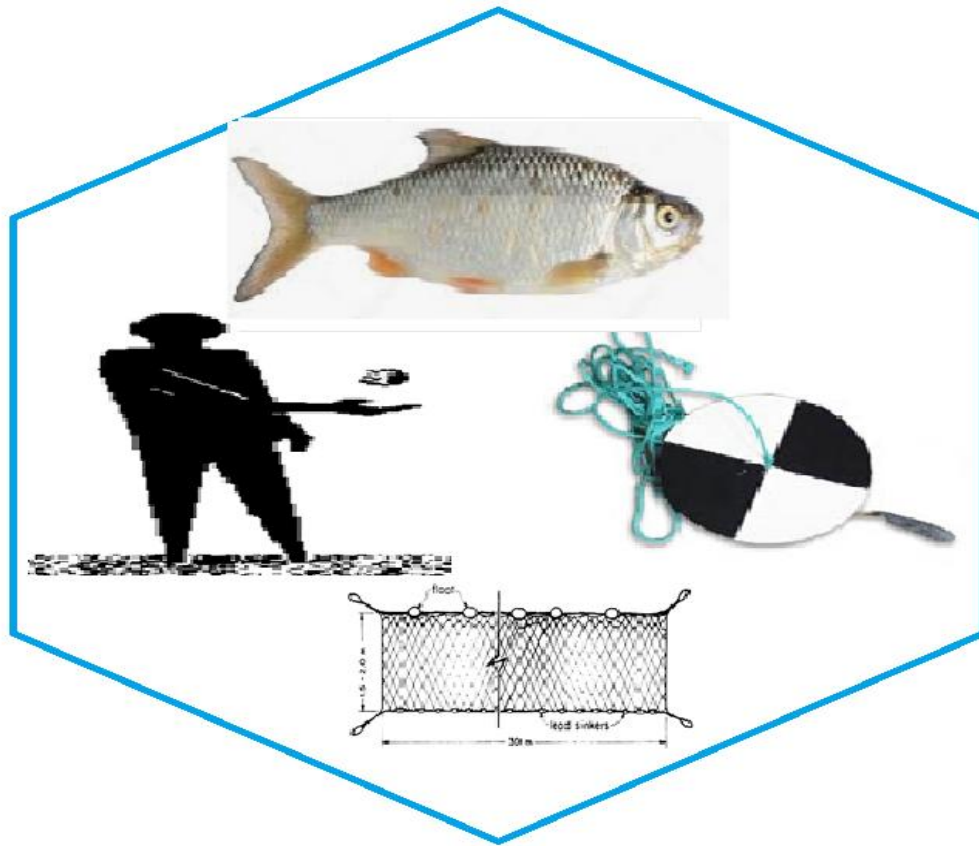


## **Animal Production**

### **Level – II**

**Based on March 2022, Version-4 Occupational  
Standard**



**Module Title: Raising Fish Production**

**LG Code: AGR APN2 M06 LO (1-4) LG (25-28)**

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**Addis Ababa, Ethiopia**

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## Introduction to the Module

This module of compliance focus on the preparing materials tools and equipment's, body parts of fish, undertake fish rising activates and clean up on accomplishments of the work. Fish is an aquatic-vertebrate cold-blooded animal that breathes oxygen by means of gills, and moves and keep balance by fins, reproduce by laying eggs and its body covered by skin and scale. For fish farming,

**Fish-** is an aquatic-vertebrate cold-blooded animal that breathes oxygen by means of gills, and moves and keep balance by fins, reproduce by laying eggs and its body covered by skin and scale.

**Fish** are diverse group of animals that live and breathe in water (any aquatic animal) (or cold-blooded), typically ectothermic covered with scales. All fish are vertebrates (animals with backbones) with gills for breathing. Most fish have fins for swimming, scales for protection, and a streamlined body for moving easily through the water

**Fish farming (culture)** – is the large scale rearing or raising of fish in artificially prepared ponds and reservoirs on controlled and manageable manner for commercial purpose.

**Fish farming** is the intensive production of fish from artificially prepared ponds or reservoirs. Its main objective is to produce large amount of fish with a minimum cost so as to increase profitability of the business.

**Fish farming** is the principal form of aquaculture; it involves raising fish commercially in tanks or enclosures, usually for food. Fish species raised by fish farms include salmon, catfish, tilapia, cod, carp, trout and others.

**Fresh water (Inland water)**-is a water contained in rivers, lakes, underground, rain water and streams.

**Aquaculture** is the farming of freshwater and saltwater organisms including molluscs, crustaceans and aquatic plants. Unlike fishing, aquaculture, also known as aqua arming, implies the cultivation of aquatic populations under controlled conditions.

A **fishery** is a unit, engaged in raising and/or harvesting fish, which is determined by an authority or other entity to be a fishery. Typically, the unit is defined in terms of the following: people involved, species or type of fish, area of water or seabed, method of fishing, class of boats and purpose of the activities

## LG # 25

## LO # 1- Prepare for fish raising activities

### Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying and checking materials, tools and equipment
- Selecting and checking suitable PPE
- Using correct manual handling techniques
- Assessing site selection criteria
- Providing work support to OHS requirements

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify and check materials, tools and equipment
- Select and check suitable PPE prior to use
- Use correct manual handling techniques
- Assess site selection criteria
- Provide work support to OHS requirements

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

## Information Sheet - 1

### 1.1. Identifying and checking materials, tools and equipment

Fish farming require some essential materials, tools, equipment and facilities which are used for varies purposes. Such equipment may be used for maintenance and repairs, harvesting the fish, monitoring and maintaining water quality, packaging stock, excluding predators and pests, and other miscellaneous facilities for maximizing the use of various inputs. This information sheet provides you detail description on materials, tools, equipment and facilities which are used in a variety of categorized tasks in fish farming.

Before starting fish farming activity the necessary materials, tools and equipment should be identifies and prepare as follow:-

- Polyethylene bag
- Lime
- Feed
- Fertilizer
- Stocking materials (fry, fingerlings, egg, larvae) fishing nets
- buckets
- Ice box, refrigerator
- Weighing balance
- Measuring board
- various needles
- knives
- Thermometer
- pH meter
- Do meter
- Wooden ladle with long handle,
- Hoe
- Rake
- Litmus paper
- Conductivity meter
- Secchi desk
- Ammonia and Nitrate test Kits
- Plankton nets
- Benthic sampler
- loaders and vehicles
- spades, forks, rakes and hoe
- harvesting and storing equipment's
- Spray equipment etc.

### Function of some materials, tools and equipment

All materials, tools and equipment's will be checked and reported their proper functions before going to the activities here are some equipment's will list dawn how it works;

## A) Water Quality testing equipment

Water-quality testing is one of the most important jobs in aquaculture. If the water quality of a culture structure, such as a pond or tank is poor, stock can suffer from health problems such as damage and diseases. A range of tools and test kits are used to test water-quality parameters such as the level of dissolved oxygen, pH, alkalinity, water hardness, and ammonia levels etc.

### I. Dissolved oxygen meter

- A dissolved oxygen meter is used to measure the level of *dissolved oxygen* in water. It consists of a probe and a meter. The probe is lowered into water and gently moved from side to side, and then a reading is taken from the meter.



**Figure 1.1: Dissolved oxygen meter**

- Steps to calibrate and use a dissolved oxygen meter:
  - a) Turn the meter on and inspect the probe for damage.
  - b) Place the probe in a holder that contains a sponge which has been moistened with distilled water.
  - c) Allow time for the probe to "warm up" and for the air in the probe holder to become saturated with water vapor.
  - d) Set the altitude on the meter.
  - e) The probe will now be calibrated to 100% saturation.
  - f) Set the salinity of the water sample that you want to measure on the meter.
  - g) Put the probe into the water sample and gently move it from side to side.
  - h) Wait until the reading on the meter becomes stable, and then record the result.

The methods of calibration can be very similar for different types of dissolved oxygen meters, but you should always check the user manual for the specific dissolved oxygen meter you are using for the correct way to calibrate it.

## II. P<sup>H</sup> meter

- A pH meter is used to measure the pH in water. It consists of a probe and a meter. The probe is lowered into the water sample and the pH of the sample will be displayed on the meter



**Figure 1.2: pH meter**

- Steps to calibrate a pH meter:
  - a) Turn the meter on.
  - b) Connect the probe to the meter.
  - c) Place the probe in *buffer 7* solution and wait for the reading to stabilize.
  - d) Press the "Cal" button to enter the calibrate mode.
  - e) Press the "Con" button to set the meter to pH 7.
  - f) This method can be repeated for a buffer 4 and/or a buffer 10 solution.
  - g) Press the "Meas" button and Measure will appear on the display screen.
  - h) Rinse the probe with distilled water.
  - i) The pH meter is now calibrated and ready for use.

The methods of calibration are very similar for most pH meters. However, you should always check the user manual for the meter you are using to find out how to calibrate it.

Use-To use the pH meter:

- place the probe in the sample to be measured
- wait for a stable reading to appear on the meter
- Record that reading.

### III. Salinity meter

- A salinity meter is used to measure the *salinity* of water. A salinity meter has a probe that detects the salinity of a water sample, and a meter that displays the salinity of the water in parts per thousand.



**Figure 1.3: Salinity meter**

- Most salinity meters don't require calibration. However, some salinity meters require the temperature of the water sample to be set on the meter before it can measure the salinity of the water sample.

**Use-**To uses a salinity meter:

- insert the probe into the water sample so that the probe is completely submerged
- allow time for the reading on the meter to become stable
- Record the value of the reading on the meter once it stops changing.

### IV. Thermometer

- A thermometer is used to record the *temperature* of water. To use it, lower the thermometer into the water and wait a minute or two. Then take the thermometer out and read the temperature recorded on it.



**Figure 1.4: Thermometer**

### V. Ammonia test kit

- An ammonia test kit is used to measure the level of *ammonia* in a water sample. It comes with two separate reagents that are added to the water sample.





**Figure 1.5: Ammonia test**

To use the ammonia test kit:

- fill the container with the water sample
- add the first reagent to the water sample
- add the second reagent, then wait for the water to change color
- compare the color of the water sample to the color chart that comes with the test kit
- Find the color on the chart that matches the color of the water sample, and take a reading of the value on the chart. This is the amount of ammonia in the water sample.

**Safety**-Ammonia test kits can contain chemicals that can be harmful to you, to stock, or to the environment. Adopt the following guidelines when using an ammonia test kit:

- Always wear clean gloves when using the test kit.
- Always store used waste reagents in a suitable container for disposal later.
- Avoid contact with skin and eyes.
- Do not swallow reagents.
- Do not smell the reagents.

#### **4. Nitrite test kit**

**Description and use**-A nitrite test kit is used to measure the amount of nitrite in a water sample.

The test kit often comes with two reagents and a sampling container.



**Figure 1.6: Nitrite test kit**

To use the nitrite test kit:

- fill the container with the water sample
- add the first reagent to the water sample
- add the second reagent and wait for the sample to change color
- compare the color of the water sample to the color chart that comes with the test kit
- Find the color on the chart that matches the color of the water sample, and take a reading of the value on the chart. This is the level of nitrite in the water sample.

**Safety-**Nitrite test kits can contain chemicals that can be harmful to you, to stock, or to the environment. Adopt the following guidelines when using a nitrite test kit:

- Always wear clean gloves when using the test kit.
- Always store used waste reagents in a suitable container for disposal later.
- Avoid contact with skin and eyes.
- Do not swallow reagents.
- Do not smell the reagents.

## 5. Secchi disk

The secchi disk is basically a painted disk attached to a length of cord, or a rod. It is used to measure the *turbidity* of water. The cord or rod is often graduated so that the depth the disk has sunk to can be measured.



**Figure 1.7: Secchi disk**

To use a secchi disk:

- hold the cord or rod and slowly lower the disk into the water
- keep lowering the disk until it is just no longer visible
- note the depth of the disk by checking where the water level is on the cord or rod
- Record this depth.

## **B) Measuring equipment**

### **I. Sensitive electric Balance**

A balance (or scales) is used to weigh fish or feed. They are usually electronic and have a keypad, a digital display and a flat metal surface to hold the fish being weighed.



**Figure 1.8: Sensitive electric Balance**

### **II. Measuring tape**

A measuring tape is a tape with increments or graduations used for measuring the length of various items

### **III. Measuring board**

A fish measuring board consists of a board on which a scale is marked in centimeters (cm) and millimetres (mm). It is used to measure the length of fish or crayfish.

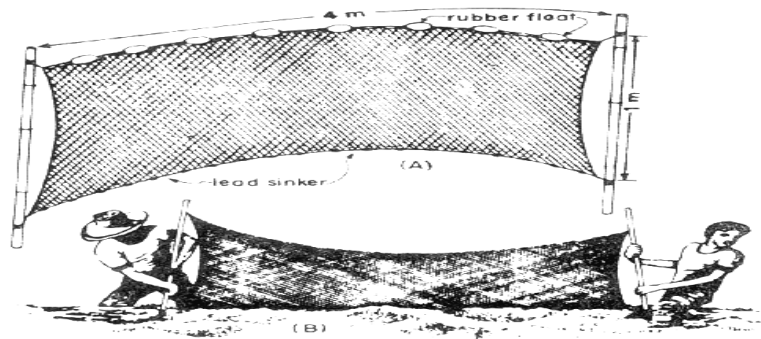
## **C) Harvesting/Handling equipment**

Harvesting is a very labour-intensive process on an aquaculture farm

### **I. Seine net**

Seine nets are the most common and effective to collect all the fish in ponds. During Operation, one end of the net is fixed either by means of a stick or by anchoring to the bottom.

A seine net is also called a drag net. It is usually rectangular, with a cork or plastic float line along the top. The bottom of the net is weighted down by lead weights or a chain, and is called the lead line or weighted end.



**Figure 1.9: Seine net**

The cork and lead lines extend past the length of the net and these are used to haul the net through the water. In some seine nets, a pocket is sewn into the middle section, so that fish are collected and held there as the net is hauled through the water.

It is also important to make sure that the mesh size of the net is not large enough to let fish get caught or gilled as this can kill the fish.

## **II. Cast net**

A cast net is a circular piece of net that is weighted around the edge. There is usually a series of lines that run from this weighted edge to a central ring that is attached to the pulling rope



**Figure 1.10: Cast net**

## **III. Pot trap**

Fishing Traps can be caught with simple locally made traps such as basket from bamboo made in conical shape



**Figure 1.11: Pot trap**

Description-Pot traps have a funnel entrance. Fish enter the trap through the funnel and get caught inside. The body of the trap is made of mesh, which makes the trap light and easy to handle. The mesh also allows water to flow through the trap, preventing the fish caught in the trap from dying due to a lack of oxygen.

#### **IV. Scoop (hand) net**

This net consists of bag of netting materials with the mouth of the bag kept open by circular framing with iron fixed to wooden pole or stick. This method usually used to take out alive fish for sample from the pond. Scoop nets are used to scoop fish out of shallow water, such as in a tank, or the shallow end of a pond.



**Figure 1.12: Scoop net**

Scoop nets consist of three main parts:

- A bag that is made of net of a suitable size as to not damage fish.
- A frame from which the net hangs.
- A handle

#### **V. Angling (Hand line)**

Hook and Line (Angling): The principle used in hook and line fishing is to offer the fish bait (food) fixed to hook and at the end of a line (rope) which is attached to a short bamboo or wooden pole.

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**Figure 1.13: Angling**

The hand line is used with a hook to catch individual fish. It's not usually used on commercial fish farms to harvest large quantities of fish. Fish caught using hand lines are highly stressed and damaged when hooked.

## **VI. Buckets/tubs**

The term "Buckets/tubs" refers to containers of various shapes and sizes used for storing and transporting items like tools, food, chemicals and fish.



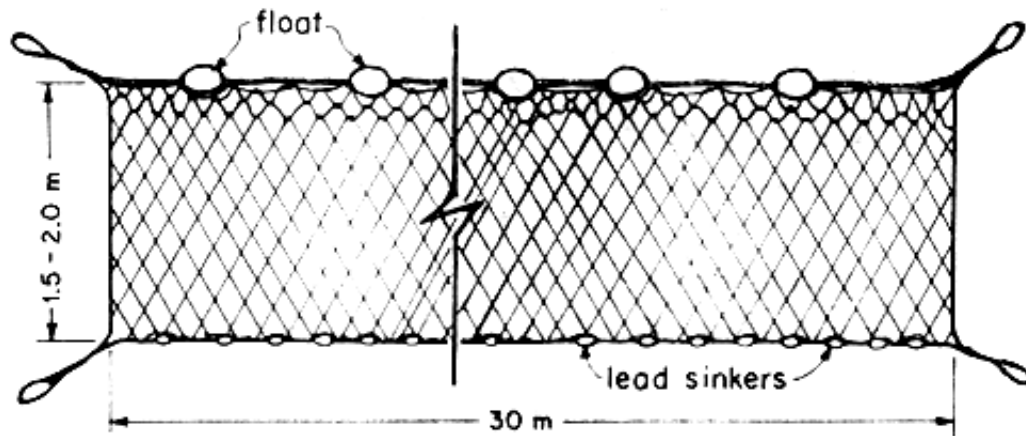
**Figure 1.14A: Buckets**

**Figure 1.14B: Tubs**

## **VII. Gill net**

A gill net can be used to harvest fish from a pond. It works by trapping the fish around the gills and should not be used unless the fish are to be killed.

**Gill Net:** The principle in this method is that if a net is hung in a pond or lake the fish will attempt to swim through the net by selecting the appropriate mesh size the farmer can make sure that any fish smaller than he wishes to harvest will swim through the net while the larger fish will get stuck



**Figure 1.15: Gill Net**

#### **D) Water treatment equipment**

Water treatment involves changing the existing conditions of a body of water, such as that found in a pond, tank or dam. Water can be treated by being aerated, or by adding lime or fertilizer to it.

##### **I. Oxygen cylinder**

Description and use - Oxygen cylinders are used to maintain correct levels of oxygen in water.



**Figure 1.16: Oxygen cylinder**

An oxygen cylinder consists of three main parts:

- The metal cylinder (where the oxygen is contained under high pressure).
- A valve.

- A regulator (controls the pressure of oxygen flowing out of the cylinder) Oxygen cylinders are usually painted black, with a white top. This distinguishes them from other types of gas cylinders.

## II. Water pump

**Description-**A centrifugal pump uses a rotating *impeller* that draws water into the centre of the pump and then throws it out the discharge pipe (other end of the pump). Centrifugal pumps are simple to construct, and easy to use and maintain. These pumps can handle most fluids and suit most pumping needs.



**Figure 1.17: Water pump**

### 1.2. Selecting and checking suitable personal Protective Equipment (PPE)

PPE is used and worn by the worker, so far as is reasonably practicable and is maintained, repaired or replaced to minimize risk to the worker who uses it. Information, training and instruction in the use, maintenance and storage of PPE must provide to the worker.

Should ensure PPE:

- Is used in accordance with the manufacturer's instructions
- Does not interfere with any medical conditions of the worker using it
- Appropriate signs are used to remind workers where it must be worn
- Is periodically assessed to ensure it is and continues to be effective.

All farm staff should have basic pieces of PPE on hand at all times. Workers should know how to check their PPE for faults and damage, and they should understand exactly what do if they discover a problem with their equipment. They should also know how to carry out some basic maintenance on their gear: like how to replace the cartridges in their respirators, for instance:

- Selected to minimize risk to work health and safety
- Suitable for the nature of the work and any hazard associated with the work



- A suitable size and fit and reasonably comfortable for the person wearing it

Using appropriate Personal Protective Equipment (PPE);-

- It is important to reduce the possible hazard at work operation
- The equipment designed to protect handlers from injury. This equipment should be selected based on the procedures to be accomplished, referring to manuals or supervisors if in doubt of its appropriateness.

PPE commonly includes

#### a) Aprons

Description usually made of rubber; aprons protect the body and clothing from splashes and spills when handling large quantities of corrosive chemicals. They are also useful to keep you dry when handling fish. Aprons should cover the body from the shoulder to below the tops of boots.



**Figure 1.18: Apron**

Use- Use aprons especially when handling corrosive chemicals. Place the loop on the top of the apron over your head, and then let the apron fall into place down the front of your body and over clothing. Tie the apron around your waist to secure it in place using the straps on either side. Hang up apron when not in use.

#### b) Gloves

Rubber or latex to protect from caustic or toxic substances, leather or canvas to protect from abrasion, disposable plastic to maintain bio-security. Rubber gloves are often the best type to wear on a fishing boat. Depending on the quality of the glove, they will provide protection against dampness, fish fins and tails, and the cold. They are also effective when handling the

gear. Cloth gloves can be worn underneath rubber gloves for comfort. Chain mesh gloves provide excellent protection when dealing with equipment or gear that has sharp edges.



**Figure 1.19: Gloves**

**c) Boots** [heavy leather or rubber for protection and disposable plastic for bio-security]

- The feet have many small bones that can be easily broken. Safety boots are leather or rubber with a steel toe.
- They offer excellent protection against:
  - ✓ Falling objects
  - ✓ Stubbing your toes
  - ✓ Sharp objects such as hooks
  - ✓ Insulated safety boots protect the feet from cold.



**Figure 1.20: Boots**

**d) Goggles**

- The eyes are sensitive, fragile, and irreplaceable.
- Salt water and fish slime can irritate the eyes.
- Goggles are especially effective because they provide an airtight seal around the eye.
- Maintain equipment properly to avoid potential incidents. Inspect all the equipment before taking the boat out to sea or participating in aquaculture activities.



**Figure 1.21: Goggles**

**e) Respirator**

When you wear a respirator you should choose a filter that best suits the substance you are working with.



**Figure 1.22: Respirator**

There are two main types of filters:

- a) Charcoal filters that remove dangerous odors.
- b) Particle filters that are used for chemicals or paint. Respirators also come in different styles. Some cover the mouth and nose only, while others include a mask and cover the entire face.

**f) Overalls**

Description-Overalls can be worn in place of a long sleeve shirt and long trousers. Overalls may be disposable or re-usable. Overalls should be made of a water-repellent material if possible. Use overalls to protect the body from damage due to hazardous chemicals



**Figure 1.23: Overalls**

**g) Life jacket** –help to prevent drowning



**Figure 1.24: Life jacket**

### **1.3. Using correct manual handling techniques**

Manual handling accident , as a result of pushing, pulling or lifting heavy objects or machinery, account for more than a third of all reported accident each year.

Manual handling is moving and handling also called manual handling, is any action involving physical effort to move or support an object or a person by; lifting, pushing ,pulling, steadying ,carrying ,transporting. Correct manual handling techniques is important to increase productivity and reducing injuries.

During fish loading and unloading the following are required;

- Fish handling equipment's will be ready
- The vehicles will required a cooling facilities since fish are highly perishables products
- Inside of the vehicles shall be clean and neat to avoid contaminations
- If possible unwanted parts of fish first removed before transportation to the processing site
- Add preservatives if the journey is too long
- Fish shall be inside the materials no contact with the vehicles
- If the fish is transported by draft animal or a person it shall be removed the gut and using salt for preservatives.

## **1.4. Assessing site selection criteria**

### **1.4.1. Inspecting location of new or existing site**

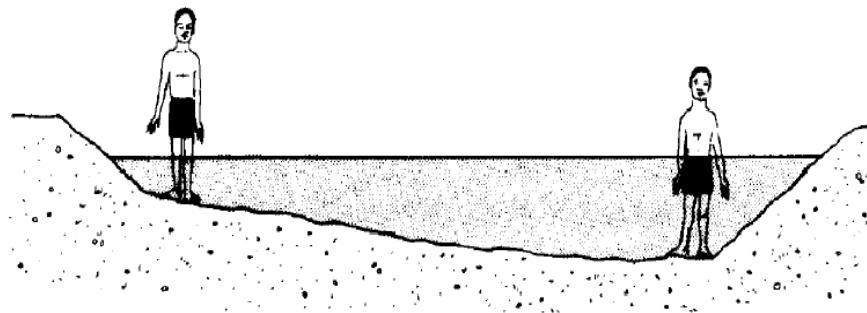
Site selection is the process by which various factors indicated are considered to enable one to decide on the right site for a specific production (culture) system. Success or failure of any fish culture venture largely depends on the right selection of the site for it.

In choosing a site several factors other than the physical aspect of the site are to be considered. Selecting a suitable site for pond is important, and preliminary studies are needed before final design and construction. Analysis and selection of pond sites should be based on landscape structure and associated ecological functions and values.

Relationship of the site to other ecological features within the landscape is critical to achieving planned objectives. If possible, consider more than one location and study each one to select the most ecologically appropriate, esthetic, and practical site. Weighing both onsite and offsite effects of constructing a pond is essential in site selection. Refer to figure 1 and the glossary to become familiar with the components of a pond and associated dam.

For economy, locate the pond where the largest storage volume can be obtained with the least amount of earth fill. A good site generally is one where a dam can be built across a narrow section of a valley, the side slopes are steep, and the slope of the valley floor permits a large area to be flooded. Such sites also minimize the area of shallow water. Avoid large areas of shallow water because of excessive evaporation and the growth of noxious aquatic plants.

In most cases, pond size is limited by topography, availability of inputs and construction costs. Construction costs for ponds less than 100 m<sup>2</sup> in surface area are high relative to the weight of fish harvested, and their construction is not recommended. Ponds larger than one hectare are hard to manage and expensive to build.



**Figure 1.25: Cross-section of a pond**

The site selected for pond construction should be free from flooding and close enough to other farm activities so that the stored pond water is available for multiple uses such as stock watering and supplemental garden irrigation. Common pond sites are small valleys with gradually sloping sides, and flat areas on hillsides or plains. Rainfall springs and streams are often sources of water for ponds. Water should be free of pesticides and chemicals that can kill fish or harm humans and livestock, and should be available year-round.

Avoid pollution of pond water by selecting a location where drainage from farmsteads, feedlots, corrals, sewage lines, mine dumps, and similar areas does not reach the pond.

Use permanent or temporary measures, such as diversions, to redirect runoff from these sources to an appropriate outlet until the areas can be treated.

Be sure that no buried pipelines or cables cross a proposed pond site. They could be broken or punctured by the excavating equipment, which can result not only in damage to the utility, but also in injury to the operator of the equipment. If a site crossed by pipelines or cable must be used, you must notify the utility company before starting construction and obtain permission to excavate.

Ponds may be constructed without expensive machinery using animal power and/or hand labor. This does, however, greatly increase construction time. Pond dikes should be firmly compacted during construction to avoid seepage problems and possible collapse while the pond is full.

#### **1.4.2. Factors to be considered in site selection**

Site selection is the process by which various factors indicated are considered to enable one to decide on the right site for a specific production (culture) system.

There are several factors to be considered in site selection among these are;

##### **A) Water Supply**

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Adequate supply of good quality water must be available year round in the site for fish culture.

- The water sources must be reliable and adequate
- Good quality water is rich in oxygen, nutrients and free from pollutants. The most important sources of water for fish ponds are; Perennial streams, Lakes, Rivers, Springs and wells, and, Water reservoirs and dams.
- If there is no enough water all the year round, it is no good making ponds, as they will dry up and the fish will die. And also the water loss due to evaporation, leakage and percolation should be considered in determining the amount of water required.

## **B) Soil Type and Quality**

- Many soil characteristics, especially those related to texture, determine its suitability for fishpond purposes.
- Soil texture refers to the relative proportion of sand, silt and clay content of the soil.

### **i. Types and characteristics of soils**

- **Sandy soil** - this soil can't be used for constructing fishpond, because it can't keep water. Its clay content <12.5%, sand content >87.5%.
- **Clay soil**- This soil can be used for constructing fishpond, but it has much poor aeration. Clay conserves water well. It can be used on the pond bottom; however, because it cracks when dry, it is unsuitable for dike construction. **Clayey soils** are preferable because they are superior material for diking and holding water. They have good compaction characteristics and low permeability. A very simple general rule can be followed: As a clay content of the soil decreases, its suitability for fishpond construction also decreases.
- **Loamy** soils are also recommended. They have good organic matter content which favors the culture and growth of natural fish food.

### **ii. Desirable soil texture for ponds**

Soils belonging to the following textural classification are desirable for fishpond development: clay, clay loam, silty clay loam, silty loam, loam and sandy clay loam. These types of soils are characterized by;

- High water retention (holding) capacity
- Good aeration



- Adequate nutrient
- Favorable chemical properties.

Soil characteristics greatly affect the quality of pond construction and influence fish yields. Therefore, soil quality should be carefully determined. In determining soil quality, it is insufficient to just examine the topsoil. Enough samples must be taken from various representative spots. The sampling depth should be 1 m. The soil should ensure that pond dikes would not leak or collapse.

### iii. Soil Quality Testing

There are several methods to test the quality of soil for pond construction, the most easy and practical methods includes;

#### a) The ball method

- Dig about 50cm deep pit, take a handful of soil from the bottom of the pit, and moisten it with some water. And squeeze it into a ball (**figure 1.26**)
- Throw the ball of soil into the air and catch it (**figure 1. 27**).



**Figure 1.26A: Soil sample    Figure 1.26B: Throw ball of soil    Figure 1.26C: Testing soil**

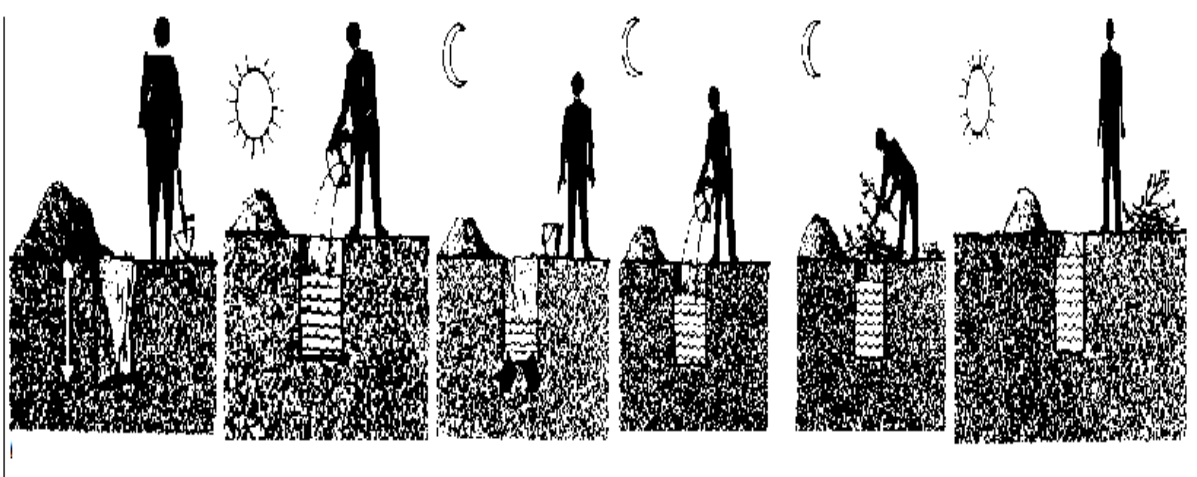
- If it sticks together it is good soil and will held water well.
- Bad soil with sand or gravel in it will not stick together and will not hold water.
- Now dig a hole as deep as your waist and test the soil from the bottom of the hole in the same way as before.



Conclusion: Bad soil with too much sand or gravel in it will not stick together and the ball will fall apart then *reject the site*. If the ball sticks together well the soil maybe be good, but you can't be sure. Now you should make a second test to be sure that the soil is good.

#### b) The pit method

- Dig a hole as deep as your wrist early in the morning fills it with water to the top.
- By evening some of the water will have sunk into the soil
- Then fill the holes with water to the top again. Cover the hole with boards or leafy branches
- The next morning if most of water is still in the hole at least 60%, the soil hold enough water, therefore the soil is suitable to build fish pond. If there is some or no water remaining reject the site.



**Figure 1.27: Procedures in soil checking for pond by pit methods**

#### C) Topography of the site

Topography refers to the “lay of the land” or the changes in the surface elevations of the ground whether flat, rolling or sloping, undulating, and hilly. Fishpond design, layout and specifications are made largely in accordance with the land topography.

A suitable site for fishpond has a topography that can be converted into a pond economically. The cost of construction can be greatly reduced if the surface features of the land are used to advantage.

It is desirable or ideal to construct a fish farm on flat land with moderate slop. However, there is no problem in setting up a farm on sloppy side of hills or valley areas. The topography should be suitable for;

- Gravitational flow of water can be exploited (water can easily enter into the pond)
- Reduce soil excavation and energy consumption, and
- Easy to drain water from the pond

#### **D) Other criteria**

There are other factors which are significant in fishpond site selection. These are equally as important as those previously mentioned and likewise require the same careful evaluation during the survey.

- i. Accessibility:** This is important for the transport of construction equipment and material, and for production inputs required for daily operations. Transporting costs can considerably increase if materials are manually carried through long distances. It is better if the site is accessible throughout the year by means of land and water.
- ii. Availability of labour:** The cheapest sources of labour are those which can be provided by the local residents, or people living within or near the area. It is important that the customs and tradition of local laborers are known. The pattern of labour distribution and utilization should be considered as this is important in preparing the calendar of activities.
- iii. Availability and cost of material:** In fishpond production, it is important that critical production inputs such as fish seeds, fertilizers, pesticides and other related materials are readily available when needed. For some inputs, especially inorganic fertilizers, the supply is restricted and the cost is uncontrolled for non-agricultural uses. Other inputs like organic manures are difficult to obtain, or may be available only at certain times of the year.
- iv. Availability of marketing outlets and prices:** Aquaculture products are highly perishable. Immediately upon harvest, products must be disposed of to maintain good quality and for better prices. If marketing outlets are located at a distance, larger quantities must be harvested and transported requiring some post-harvest marketing practices. If so, then the required support facilities especially ice-making plants must be available.
- v. Availability of credit and technical assistance:** Fishpond operations require high initial capital investment. In this respect, credit at reasonable terms play a major role in providing the needed cash outlays. Technical assistance may be obtained from government extension

services, public or private university research stations and lending institutions. The services rendered by these agencies are important especially in cases of emergency.

**vi. Pattern of land and water use:** It is important to assess the pattern of land and water use in the area to determine the impact of this on the project. Activities such as navigation, fishing, industries, public utilities, and recreation and nursery areas must be included in the overall assessment. It is best that a complementary rather than competitive relationship between these various uses and the project be established.

**vii. Peace and order situation:** Good peace and order conditions at site are favorable for both public and private interests.

### 1.5. Providing work support to OHS requirements

Fish farming operations afford many injury risks, combining some of those common to all modern agriculture operations (e.g., entanglement in large machinery, hearing loss from prolonged exposure to loud engines) with some hazards unique to these operations. Slips and falls can have particularly bad outcomes if they occur near raceways or pens, as there are the dual added risks of drowning and biological or chemical contamination from polluted water.

The main activities followed in fish farm;

- use relevant protective clothing and equipment
- workplace environment and safety
- handling of materials
- use of firefighting equipment and enterprise first aid kits
- control hazardous materials and substances
- following occupational health and safety procedures designated for the task
- checking and fulfilling required safety devices before starting operation

Apply safe operating procedures regarding:

- electrical safety
- machinery movement and operation
- manual and mechanical lifting and shifting
- working in proximity to others and site visitors

Apply emergency procedures:

- emergency shutdown and stopping of equipment,
- using extinguishing fires,

- First aid application and site evacuation.

### **Safety practices in handling chemicals**

Chemicals can be nasty things to deal with. They come in different forms: solids, liquids and gas. Many chemicals can affect your health. Some chemicals, such as ozone and formalin, can kill within seconds. Other chemicals can burn your skin, destroy your lungs, give you cancer, affect your digestive system, poison you, and even make you sterile. Even other chemicals are volatile and can burn or explode if not handled correctly.

All chemicals must have an MSDS (Material Safety Data Sheet) that tells the user what the dangers are and how the chemical should be treated. This information must be provided in the workplace and can be obtained from the chemical supplier. Always read the relevant MSDS before using the chemical. This information sheet covers safe handling and storage of chemicals.

Poor workplace housekeeping can often lead to workplace injuries from:

- Being hit by falling objects
- Tripping over objects on the floor, stairs and platforms
- Slipping on wet, greasy, dirty or icy surfaces
- Hitting projecting items and stacked materials
- Cutting, puncturing or tearing the skin on projecting nails, wire, etc.

When handling chemicals, there are some basic rules that should be followed:

- a) Eye protection should be worn at all times.
- b) Do not eat drink or smoke while handling chemicals.
- c) Always have the appropriate safety equipment available and use it.
- d) Wash hands after handling chemicals
- e) Do not store chemicals too high.
- f) Ensure all labels are intact and legible.
- g) Never write over labels.
- h) Keep all containers sealed when not in use.
- i) Always return chemicals to the correct storage area.

<b>Self-check - 1</b>	<b>Written test</b>
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Name..... ID..... Date.....

**Directions:** Answer all the questions listed below.

**Test I: Multiple choices**

- Which one of the following factor/s is/are to be considered in site selection? (3 points)  
A/water supply      B/Soil type      C/Topography      D/All      E/None
- Which type of soil is **cannot** be used for constructing of fish pond? (3 points)  
A/Sandy soil      B/Clay soil      C/Clayey soil      D/Loamy soil

**Test II: Short Answer Questions**

- Write the functions of pH meter, thermometer, and Dissolved oxygen meter? (3 points)
- What do we do before loading of fish? (2 points)
- What is the purpose of putting hazard sign in work places? (2 points)
- What are the two methods to test the quality of soil for pond construction? (2 points)

Satisfactory rating - 8 points      Unsatisfactory - below 8 points

You can ask you teacher for the copy of the correct answers.

## Operation Sheet -1

### Technique of soil testing for fish pond construction by ball method

#### 1. Tools and equipment's

- Hoe
- Meter
- Water

#### 2. Procedures

- Dig about 50cm deep pit,
- Take a handful of soil from the bottom of the pit,
- Moisten it with some water
- Squeeze it into a ball.
- Throw the ball of soil into the air and catch it.

Conclusion it will not stick together and the ball will fall apart then *reject the site*. If the ball sticks together well the soil maybe be good.

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LAP TEST-1	Performance Test
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Name..... ID.....

Date.....

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within **1 hour**. The project is expected from each student to do it.

**Task:** Perform soil testing for fish pond construction by ball method

<b>LG #26</b>	<b>LO # 2- Participate in construction or installation work</b>
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### Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Building or installing farm stock structure
- Determining pond type and size
- Carrying out pond lay out
- Excavating and constructing pond
- Assembling and fixing fixtures and fittings
- Constructing water supply and disposal systems

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Build or install farm stock structure
- Determine pond type and size according to production plan
- Carry out pond lay out according to the enterprise requirements
- Excavate and construct pond
- Assemble and fix fixtures and fittings
- Construct water supply and disposal systems

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”



## Information Sheet -2

### 2.1. Building or installing farm stock structure

#### 2.1.1 Undertaking construction work plan

In order to plan the construction work properly, a detailed contour map will have to be properly. This is usually can be done only after the site has been cleaned.

The general feature of farms includes;

- The boundary of the site, lay out, number and size of the pond
- Water supply and drainage
- Location of water control structure etc. show on the detailed map aid construction work

The sequence of construction work of the farm has to be decided in advanced and followed, in order to achieve good quality construction. The quantity of earth required for the construction of dike for 4 hectare pond is estimated to be 30% - 50%.

In order to complete a project in the proposed time at the estimated cost, the work has to be well organized. To ensure that all the work being performed is in accordance with the plans and specifications, adequate and continuous supervision must be provided by the Owner of the project during the construction period. The Engineer in charge, or the Resident Engineer, as the representative of the Owner, is responsible for the proper execution of the construction work, and he should control, supervise and help the Contractor to provide the best quality of work and complete the construction in accordance with the deadline given in the contract.

For the implementation of a project, small or large, good preparation compatible with the dimensions of the project is needed. Adequate coordination between the Contractor and the Engineer in project preparation ensures that the work will be properly executed both in time and quality.

The Contractor's duties are as follows:

- Review and study all the detailed plans thoroughly.
- Report all questions and comments to the Engineer, particularly those which have a bearing on timely execution of the project.
- Request any additional drawings, calculations or other clarifications from the Engineer.
- Make application for any and all permits required for the construction work from the public authorities.
- Arrange for all necessary sub-contracts.

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- Prepare a detailed schedule of requirements for all items of work, materials and equipment.
- Order all equipment required for the construction, e.g., pumps, generators, etc. The Engineer's duties are as follows:
- Provide to the Contractor all permits required before and during the construction work.
- Arrange, if necessary, for provision of adequate water source for construction work.
- Supply any additional drawings, calculations or modifications to the work plan which may be required by the Contractor.

### **2.1.2 Methods used in organization of construction work**

Several methods can be used in the organization of the construction work. Continuous organization of production can be applied when the existing equipment and laborers are to be utilized constantly and continuously. Scheduling of succession can be used when several similar or identical projects are to be executed in the same region, to ensure continuous and equal progress for the different working groups and to reduce the total period of construction.

#### **a) Network scheduling**

To meet the basic aim of the organization of construction work, i.e., to ensure execution of the project, as far as possible, within the minimum time, the use of network scheduling may be the most suitable solution. A simple network may be sufficient, or in larger projects a complex network requiring the use of a computer might be needed. There are several different kinds of network in use, such as the Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), and Least Cost Estimating and Scheduling (LESS). We will limit our discussion here to the Critical Path Method which is the most commonly used in construction work. In large-scale projects, it has been found that approximately 20 percent of construction time can be saved by using this method.

Planning: the project is broken down into activities and each activity is listed separately.

#### **b) Analyzing and scheduling**

This involves establishment of the relationship between activities in order to determine their interdependency. Time duration for each activity is arrived at with reference to general availability of laborers, materials, equipment, etc. The total project time is the summation of the duration times of all activities to be undertaken from the initial start of work to the finishing point through the longest time-consuming route.

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The longest duration is defined as the critical path, and the activities on this path are called critical activities. If a project must be completed within the time scheduled by the critical path, there must not be any delay of the critical activities.

**Controlling:** this consists of assessing the progress of work, including comparing the actual performance with the planned performance of each activity. Precise evaluation of actual performance time against that scheduled can provide useful data which may be adopted for another project. A well-built fishpond means lower costs and better production.

Artificially built ponds are subject to natural forces especially waves and flood waters. But with proper design, layout and construction, the harmful effects of flood and waves can be prevented and minimized.

**Building your pond:** some of the most important in pond buildings are:-

- a. Surveying the land
- b. Clearing vegetation from the site
- c. Removing topsoil from the site
- d. Determining pond, drain pipe, and supply canal elevations
- e. Pegging out the dykes and core trenches
- f. Constructing cores
- g. Excavating the pond area
- h. Constructing the dykes (levees)
- i. Installing the drainage system
- j. Installing the water supply system

Farm stock structure includes;

- Building
- Green houses, hot houses, igloo
- Fences
- Ramp
- Waste holding disposal structures
- Water supply and effluent systems, pipes and channels
- Tank, pump and blower stands
- Tracks, roads and path ways
- Soil conservation works

- Equipment storage
- Shelters and shade cloth
- Security systems
- Surrounding grounds/gardens

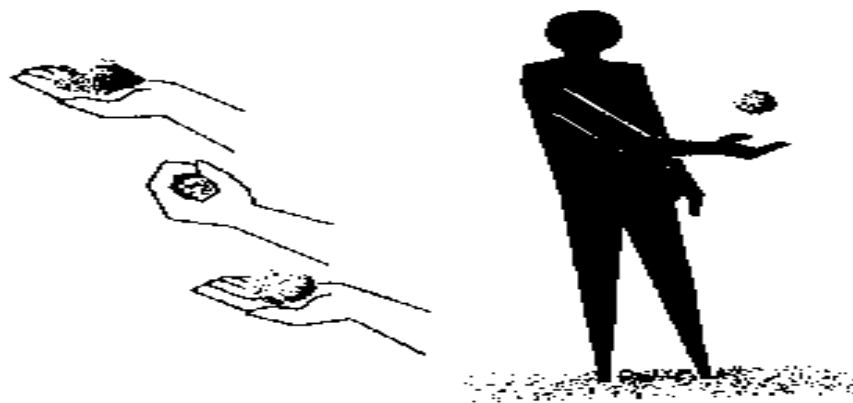
### **2.1.3 Constructing fish pond and construction materials**

In planning construction generally, there is an option to use mechanical equipment or manual labor for much of the work involved. From an economic point of view, mechanical methods of construction have much advantage.

A Point that needs to be emphasizes in pond farm construction is the choice of construction material. As cost and availability of materials differ so much between areas one cannot suggest a uniform standard of materials. Example bull dozer, compactor, excavator, drag line etc.

#### **i. Steps in Pond preparation**

- You must choose a good place to put your pond.
- Remember that a pond for fish is only one use for your land. Be careful not to build a pond on land that could be better used for something else.
- It is best to choose a piece of land that has a gentle slope.
- Do not build your pond on a steep hill or where it can be flooded in the rainy season.
- Choose a sunny place for your pond, close near to your home so people will not come and take your fish away. Near your home it is also easier to take care of the fish.
- The pond should be near to water such as a stream or a spring, or in marshy ground where the water in the soil will fill up your pond.
- The soil in the place you choose must be good for a fish pond.
- To test if you have good soil, take a handful of soil from the surface and squeeze it into a ball.
- Throw the ball of soil into the air and catch it.



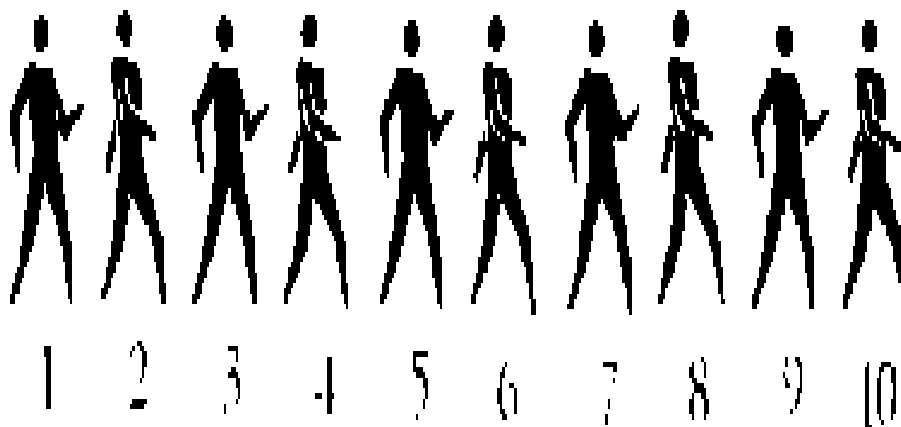
**Figure 2.1: Testing the soil**

- If it sticks together it is good soil and will held water well.
- Bad soil with sand or gravel in it will not stick together and will not held water.
- Now dig a hole as deep as your waist and test the soil from the bottom of the hole in the same way as before.
- If the soil from the surface is good, and the soil from the bottom is good, this is a good place to dig your pond.

## **ii. Ways of digging pond**

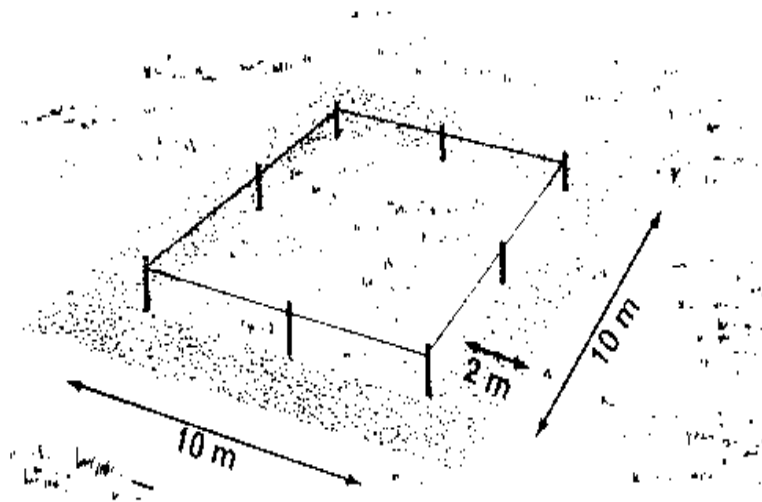
How to dig your pond?

- Mark out the size of the pond on the ground you have chosen. Each side should be about 14 meters long, 10 meters for the pond and 2 meters for each bank of the pond.  
Mark the size of the pond



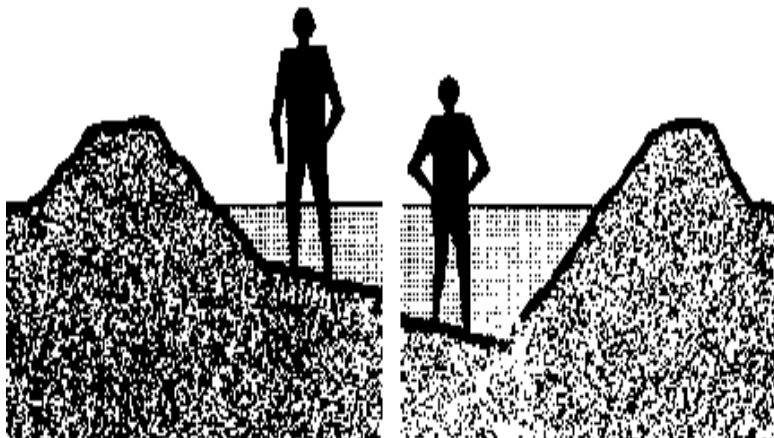
**Figure 2.2: Mark the size of the pond**

- Clear this area of all trees, bushes and grass and take away all the roots.



**Figure 2.3: Pond's dimensions**

- Take away 20 centimeters of topsoil from all the cleared area and put it aside.
- Now you can dig your pond.
- The bottom of the pond should be even and sloped toward the deep end.
- In the shallow end, the water in the pond will have to be about knee- deep.
- In the deep end, it will have to be waist- deep.



**Figure 2.4: The deep end**

- As you dig the soil out, put it on the 2- meters strips to be the banks of the pond.
- Do not make the sides too steep, but slope them to make them stronger.

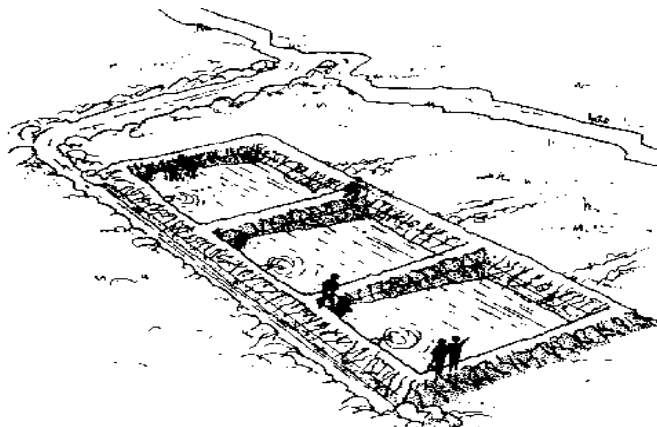


**Figure 2.5: Make the pond's sides stronger**

- Compact the soil as you take it out, to make banks strong enough to stop the water from pushing them out. The banks must be watertight.
- You will need to make an inlet at the shallow end above the water level to fill your pond.
- At the deep end you will need to make an outlet to keep the banks from overflowing if there is too much water in the pond.
- The inlet and outlet for your pond can be very simple. Large bamboo pipes will work very well.

When you have finished digging your pond, put the topsoil you have set aside on the banks. Then plant grass on the banks to stop the soil from being washed away by the rain.

- If you need more land for growing crops, instead of planting grass on the banks you may grow food crops such as rice, sweet potatoes or groundnuts.
- It is good if other farmers build ponds beside yours. It is easier if others help you in fish farming, and one bank can be used between two ponds.



**Figure 2.6: Using a bank between two ponds**

#### 2.1.4 Constructing Sewage treatment tank

- Mechanical treatment: Sewage first subjected to screening and filtration then led to sedimentation tank through pipe.
- Chemical treatment: the sewage for disinfection and deoxidation. Then allow standing in oxidation tank, before adding sewage water to fishery pond it is diluted with fresh water, the treated sewage water added to fishery pond.

#### 2.1.5 Constructing / installing cage culture

There is no fixed design or size of the cage culture. They are made of galvanized welded wire and nylon meshes or split bamboo of various sizes for crop culture generally 2m deep. For marine fishes 3-5m. Shape usually rectangular

Pen culture structure: enclosure along the bank, shore line, the bank as its one side.

Procedure;

- Bamboo poles fixed in circular / rectangular.
- Cover with nets.
- The sinker put 20cm depth below silt bottom.
- The bamboo pole about 0. 6m below soil bottom.

### 2.2. Determining pond type and size

#### 2.2.1 Identify types of fish pond

The fish culture practice may be classified as the following basic categories depending on the structure, the nature of water, mass and manner of farming.

There are different types of fish pond which are classified based on;

- Materials / Methods of construction: Fish pond can be build constructed from different materials. Cement pond, Plastic earthen and compact earthen pond.
- Types of fish pond based on **place** and design of construction (Embankment pond. Example- contour pond a wall across small stream, Excavation pond, Cages, Recirculation systems and Reservoirs (Culture in man); such as;

#### I. Earthen ponds/ Pond fish culture (excavating)

Constructing by digging, removing soil and dig wall / dyke/ on the side of pond. In this case, the water mass consists of natural or artificial fresh water pond. Fish ponds are classified e.g.

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nursery, rearing, stocking and spawning. The nursery and spawning ponds are shallow, others are moderately deep.

Earthen ponds are still the most common system of aquaculture. Although they are relatively simple to build, great care is needed in selecting the location and in constructing the pond. Poor site selection and construction have led to the failure of many aquaculture endeavors. For example, building a pond that cannot be fully drained can lead to problems with harvesting and disease and can create water quality management problems. When using earthen ponds, soil and water quality management become important.

## **II. Cages**

Cage culture can be a damaging form of aquaculture for several reasons. Excess feed, wastes, and pollutants are released into the environment and can accumulate on the bottom substrate in areas with poor water circulation or if fallowing is not practiced. Cultured organisms can also more easily escape in this form of culture. Due to these factors, cage culture can place greater threats on natural fish stocks and ecosystems than other forms of aquaculture. For example cage culture of metal or bamboo structure supporting by wire nylon or split bamboo and mesh, mats.

## **III. Reservoirs (Culture in man)**

Large number of dam and reservoirs are constructed for providing water for irrigation and power generation. The successful fish farming is possible in dam and reservoir. Reservoirs that are used as source water for agriculture may be acceptable sites for aquaculture. However, reservoirs used as source water for drinking water should be avoided, as wastes, antibiotics, and other chemicals used in fish farming will render water unfit for human consumption.

Normally, fish fry are stocked in the reservoir and then harvested once grown. This often resembles a natural fishery and requires some of the same management considerations. Unfortunately, this form of aquaculture rarely allows the operator to manage the culture well, which may lead to losses and slower growth rates. For this reason, the use of cages or pens may be a more appropriate alternative. The pump raises the level of water in the reservoir so that gravity flow through in the rearing ponds

#### IV. Recirculation systems

Recirculation systems can minimize environmental impacts and water use while internalizing the production costs of aquaculture; their use in developed countries is increasing. Recirculation systems are generally tanks or raceways where water is recycled by a bio-filter. Bio-filters vary greatly in design but usually contain materials with a large surface area that hosts bacteria capable of removing nitrogenous compounds from the used water, therefore improving the water quality to a level where it can be re-used. In some cases, the bio filter may be artificial wetlands or tanks that contain plants and/or sediments that help remove potentially toxic waste products from the water.

- Types of fish pond depending upon the **function** (Hatching, Spawning pond, Nursery pond, Breeding pond, Growing pond (Stocking pond) and Marketing pond)
  - **Fry acclimatization pond-** Sometimes called fry box this is the smallest unit in a pond system usually 4 to 8 m<sup>2</sup>. Fry are first stocked in this pond for 1 to 4 days and then allowed passage to the nursery pond proper by just cutting open the small dike partition.
  - **Nursery pond-**The nursery pond is small in size, about 1 to 4 percent of total production area and usually square or rectangular in shape. It may be a single pond unit or made up of two, four, six, etc. sub-compartments which form the whole nursery unit. A manageable area ranges from 500 to 10 000 m<sup>2</sup> per compartment, although 1 000 to 5 000 m<sup>2</sup> is preferred.
  - **Transition pond-**The transition, holding or stunting pond is located adjacent to the nursery pond in order to have efficient and quick transfer of fingerlings. Depending on the management scheme, close to 10 percent of the total production area is usually allocated for this purpose. The fingerlings or post-fingerlings are reared here for varying periods before finally stocking them in the production or rearing ponds. The fish can be retained in the transition pond longer or up to a few months especially when the number of fry stock is sufficient for several cropping within the year. A manageable area for transition ponds ranges from 1 000–20 000 m<sup>2</sup> per compartment but 5 000–15 000 m<sup>2</sup> is preferred.
  - **Production or rearing pond-** This is also called grow-out pond. It is the largest compartment in the pond system occupying about 80 percent of the total farm area.

- **Catching pond**-This pond serves as a concentration area or basin for the fish during harvest. It is constructed adjacent to the gate inside a bigger pond compartment. Catching ponds may be provided also for nursery ponds, transition ponds, and rearing ponds. The catching pond for the nursery and transition ponds is usually about 2 percent of the respective compartments' water surface area; for rearing pond, it is usually 1–1.5 percent.
- **Food growing pond**-This pond is optional and may be built, if deemed necessary. Named “kitchen pond”, it is a compartment set aside for growing live food organisms at high density. this is a recent innovation and is intended to augment the availability of food in fishpond areas where natural food organisms does not grow well or in farm set-up where high density stocking of cultured fish is used.

### 2.2.2 Identify pond Size

**Pond size:** depend on the objective of the fish producer. If it is for home consumption then smaller size may be used (20m by 10m). For commercial purpose large size is needed (40m by 20m).

**Length:** There is no definite rule of length of pond but any way longer-narrow-dipper pond is better than broad-shallow ponds.

### 2.2.3 Pond Shape

**Pond shape:** there is different shape of pond. Select the easier to work that may be rectangular form. The easiest and perhaps best shape is the rectangular with a length twice the width. However, the shape could be modified based on the topography of the area.

Rectangular ponds are usually the easiest to build and manage. However, ponds must sometimes be built with irregular shapes to fit the topography and shape of the available space.

- The Long side of pond direct to east to west.
- The short side of the pond direct to North to South.
- The ratio length and width is 2: 1 or 3: 2.

### 2.2.4 Pond Depth

**Pond depth:** pond should be deeper near the outlet for easy drainage. The size of a prospective fish pond should be based on the purpose of the pond. The average depth of fish pond could be 1m to 1.5m. The best pond depth depends on the fish species, size of fish, and production

system to be used. The recommended average water depth is 1 meter for non-aerated static water ponds. The water depth in the pond should be at least 80 cm at the inlet and no more than 1.2 m at the outlet. If the pond is meant to provide additional food for the family, then it need not be larger than 0.1 ha (1000 m<sup>2</sup>). Larger ponds produce more fish and are usually more efficient producers of fish per unit of land than ponds less than 1000 m<sup>2</sup>. A pond of 0.2- 0.3 ha (2000-3000 m<sup>2</sup>) is easily managed by a small farm family. Such ponds can be maintained with a minimum of effort.

A well designed pond allows for a water depth of about 1 meter and has embankments (dykes) with inside slopes of 2 to 1 or greater, depending on soil type.

- The deep end can be from 80 to 120 cm deep, but the best for medium and large ponds is 90 to 110 cm. Areas deeper than 1 m are likely to be less productive: They are cooler than the surface, lower in oxygen, and can become stratified, so most fish will avoid them.
- A small pond of 150 m<sup>2</sup> (e.g., 15 m x 10 m) with dyke slopes of 2:1 should have a shallow end 50 cm deep and a deep end 75 cm deep.
- The deepest point should be at the outlet.
- The total height of the dykes of such a pond will be 80 cm on the shallow end and 105 cm towards the outlet.
- Remember that sunlight can penetrate up to 1 metre into clear waters, for example in unfertilized ponds. In fertilized fishponds light penetration beyond 60 cm below the water surface is minimal.

### **2.3. Carrying out pond lay out**

Before beginning the construction of a new fishpond, carefully consider the design.

A properly designed and constructed pond will be easily managed and will last longer, saving extra work and bringing greater profit.

#### **2.3.1. Construction design and direction**

- Determining the shape and lay out of fish farm/ pond.
- Lay out of fish farm depends up on the area available and types of farm to be practiced (restricted farm and complete farm.)

Arrangements of ponds – ponds can be arranged in one of the following ways;

A. Ponds are constructed in series: - One behind the other and connected to each other. In this case;-

- Water from the sources supplied to the pond by canals.
- The last pond has an out let to drain excess of water.
- Ponds are connected to each other and one over flow in to another.

B. Ponds are arranged in parallel to each other. In this case;-

- They have separated inlet and out let.
- Water from one pond does not over flow in to another.
- They may be built in one raw or two raw.
- The screen is always provide inlet and out let.

### 2.3.2. Types of pond designs

- Embankment ponds are constructed by building a dam (wall) across a narrow valley or along sides of a valley to conserve water coming from stream or river.
- They are the most frequent type of pond used in fish farming; because they can be build in a wide range of topographic conditions.
- Constructing ponds in this way allows for a large volume of water to be retained with very little work. Examples of embankment type of pond are:
  - ✓ **Contour ponds** - are made on sloping ground along the sides of valley and the water coming in a furrow (canal) from a stream or sometimes a conservation dam.
  - ✓ **Barrage ponds**- are made by building a wall across a small stream and the ponds are like small conservation dams.

### 2.3.3. Layout of ponds

Pond layout is how different ponds are arranged. Remember if you wish to be a fingerling producer, you will require more small ponds, whereas a food fish producer will require relatively large ponds.

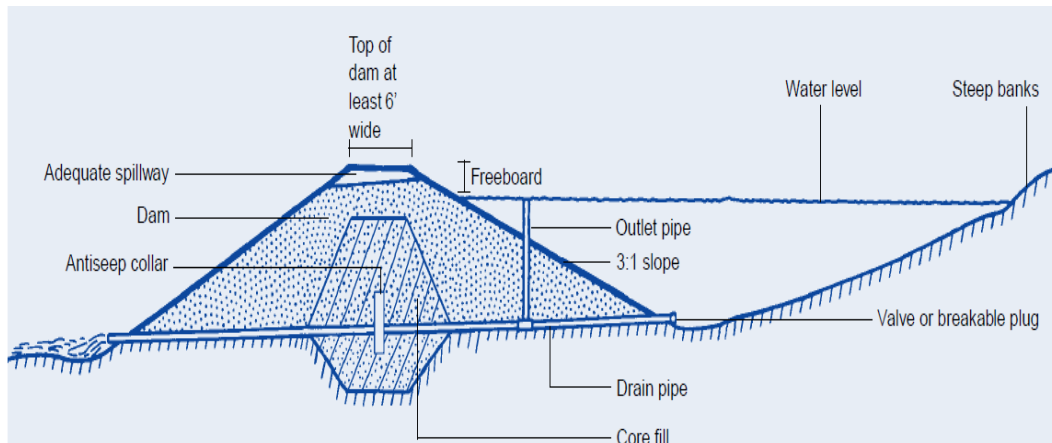
**Brood Stock** (Spawning) pond: It is used to keep parents fish to (spawn and fertilize) or bred naturally.

**Nursery pond:** It is small and less deep fish pond can be used to raise fry and fingerlings fish. It should be convenient to manage and harvest. **Production (grow-out) Pond:** It is big and deep pond can be used to raise marketable and big fishes.

A logical pond layout provides for easy movement of fish from one rearing phase (pond) to another.

Good pond design and construction is a key to efficient functioning of the farm and the costs of construction and management. A well-designed and properly constructed operation also makes controlling potential environmental impacts easier.

Ponds designed and constructed according to recommended standards are relatively safe, easy to manage, and fairly economical to build. Ponds constructed haphazardly are unsatisfactory and difficult to maintain. It pays to obtain information and expert advice before you start construction.



**Figure 2.7: Pond construction**

### **I. Top Width and Side Slopes of Dam**

The top width of the dam depends on the height of the structure. In most cases, the dam should be wide enough to permit limited use as a roadway for vehicles. The minimum top width should be 6 feet if the dam is less than 10 feet tall. The minimum top width increases to 14 feet for a dam that is over 25 feet tall.

### **II. The slope of the pond bottom**

- The pond bottom must have sufficient slope for good drainage. In general, slopes with a drop of 2 cm for every 10 meters along the pond bottom are appropriate.
- If the slope is too gentle, the pond will not be easily drained.

- If the slope is too steep, it may be too shallow at one end or too deep at the other end.

A well designed pond slopes slightly from the shallow end to the deep end, with a drop of about 2 cm for every 10 meters of length.

All earth dams should be constructed with side slopes stable enough to prevent erosion and keep the earth fill in place. In most instances, a slope of 3 feet horizontal to 1 foot vertical (3:1) on both the upstream and downstream faces of the dam will be satisfactory.

Under no circumstance should either face of the dam or any excavated slope is steeper than 2:1. Proper slope is especially important in the shallow edges of the pond. Water should be at least 3 feet deep at a point 6 feet out from the shoreline to discourage growth of algae and aquatic weeds. Experience indicates that it is best to slope the banks properly at the time of construction.

### **III. Emergency Spillway**

An emergency spillway is necessary to provide a safe overflow outlet for floodwater. Be sure that your pond has one.

The spillway should be constructed in the undisturbed bank at one end of the dam. It should have a flat-bottomed channel large enough to handle the overflow caused by a 10- to 50-year rainstorm, depending on the size and watershed area.

The spillway, including the side slopes and channel bottom, should be planted with a mixture of grass seed that will produce a thick, tough sod. Good sod prevents rushing floodwater from scouring deep cuts in the channel. The pond should not be filled with water until the sod becomes well established and the spillway is ready for use.

### **IV. Freeboard**

The crest, or top, of all earth dams must be higher than the normal water level to keep waves and high water from breaking over the top and cutting channels through the structure. After settling, the top of the dam for a one acre or smaller pond should be at least 1.5 feet above the high water level or the elevation of water designed to flow through the emergency spillway (see above). The interval between the water level and the top of the dam is called the freeboard. The freeboard interval is maintained by the emergency spillway and the outlet pipe.

#### **2.3.4. Body parts of fish pond**

##### **a) Pond dykes**

The pond's sides are called levees or dykes. The pond levees should be well compacted and have a gentle slope. A good dyke is constructed with good soil quality and compaction so that it cannot be penetrated by water.

Pond dykes are important for;

- Avoid flood, avoid escape of fish because overflow.
- Convenient for fertilizing and casting medicine.
- Disinfect the bottom.
- Harvesting fish

##### **Height of dykes**

- Dyke height will be set by the depths that you have chosen for the shallow and deep ends of the pond. However, dykes must be built higher than the full water level to guard against overflowing.
- The additional height of the dyke above the full water level is called “freeboard.” The minimum height of the dyke is 50cm. The additional height of the dyke above the full water level is called “freeboard.” Freeboards for ponds less than 1000m<sup>2</sup> should range between 20 and 30 cm, but for larger ponds they can be up to 50 cm.

##### **Dyke Slope**

- Slopes that are too steep lead to problems such as erosion and sliding of the dykes.
- Gentle slopes are better due to water pressure, which is highest at the pond bottom; however, slopes that are too gentle encourage the growth of weeds in the pond.
- The slope of the dyke depends on soil type: The inside slope should be 2:1 to allow water pressure dispersion. The slope should be increased to 2.5:1 if the soil is of lower quality. The outside slope can be 1:1.

##### **Dyke Width**

- The width of the dyke at its top should be equal its height but never less than a meter wide.
- Dyke Bottom should be 2.5-3m wide and dyke top should be 1-1.5m.
- The width should be great enough to allow transport of materials, fish, and farm equipment.



## **b) Screens**

- Avoid fish to escape.
- The pond walls Materials: Bricks, sand, cement

## **c) Pond drainage systems (Water inlet & Water outlet)**

### **I) Water inlet**

Pond water inlet is the place water can be let into the pond. There should be a screen (wire net) to prevent wild fish entering pond and gate to open or close when water is needed or not. The inlet pipe should be at least 20cm above the water surface to prevent fish from escaping. With some sort of screens to prevent the entry of wild fish or others wild creature namely filtrate the water, prevent the escape of resident (cultured) fish and simple furrow type or made from bricks and concrete.

If the inlet is set at or near the level of the water, fish will swim against the current of the inflowing water and escape from the pond. When the inlet is above the water level and properly screened, fish are unable to jump into the pipe and escape through the inlet pipe. The screen also prevents fish outside from the pond entering it.

It is recommended that the pond inlet and outlet be located at opposite ends of the pond to facilitate flushing (good water in and poor water out) when poor water quality becomes an issue.

### **II) Water outlet / drainage**

Pond water outlet water can be let out of the pond .This is usually a pipe fitted with screen and valve to avoid escaping of fish.

- Pond drains are normally located at the deep end of the pond with the bottom sloping toward them. Most of the ponds used by small scale farmers do not have drains. In the case of very small ponds, it is of course uneconomical to provide individual drainage facilities.
- Periodic draining and drying of ponds is important because it helps in harvesting fish, eradicating predators, improving the bottom condition of the ponds, and raising production rates.
- Pond outlets should have an anti-seep collar and an anchor-collar.

**Canal:** long and narrow pit leading water from the source into the inlet of the pond.

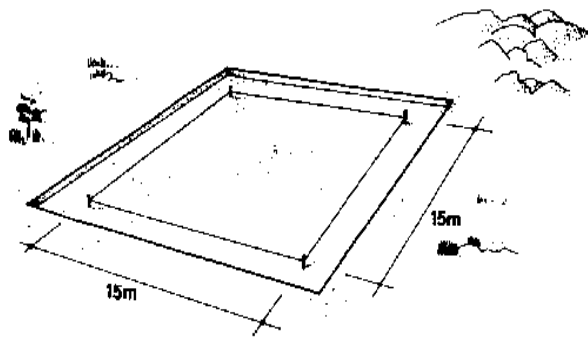
<b>Page 47 of 117</b>	<b>Ministry of Labor and Skills</b> <b>Author/Copyright</b>	<b>Animal Production</b> <b>Level - 2</b>	<b>Version -1</b> <b>September, 2022</b>
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Drainage type and position of construction;

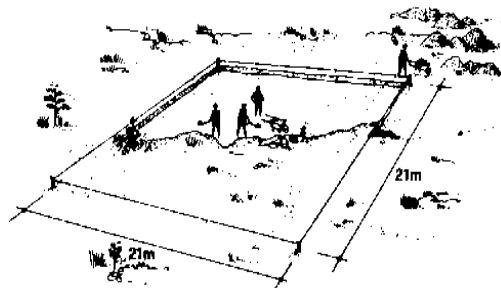
- elbow joint
- bottom over flow
- double sleeve over flow
- hose or pipe



**Figure 2.8. Measuring and marking the selected site for construction**



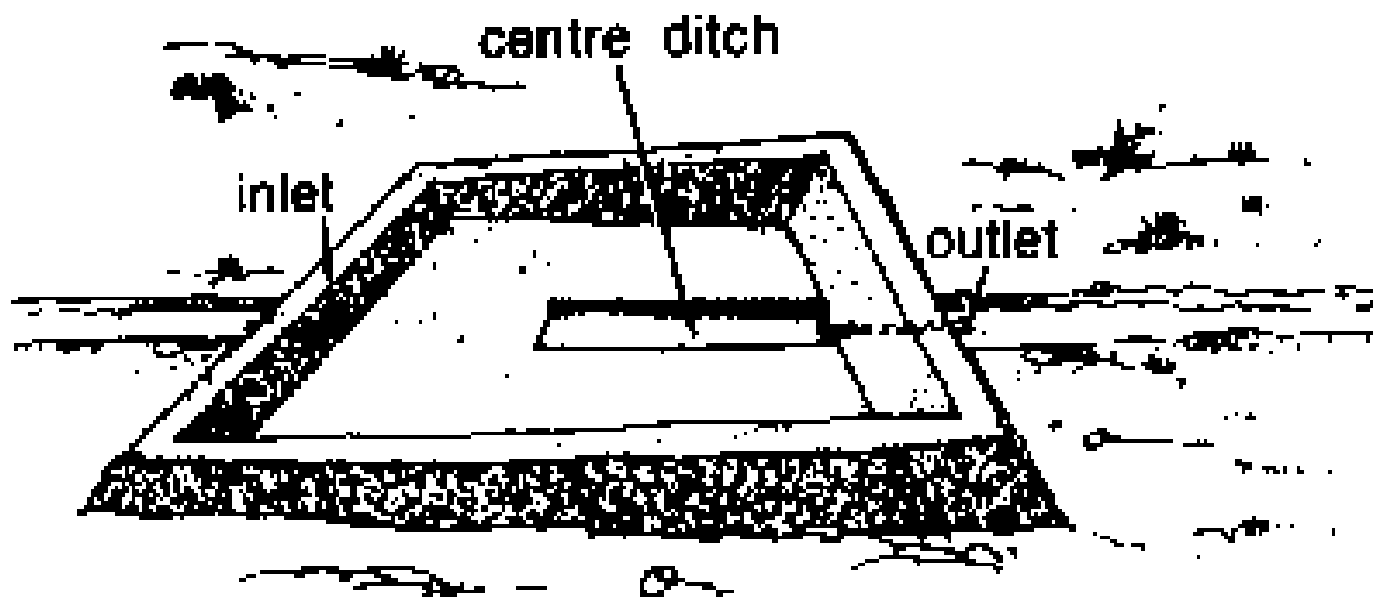
**Figure 2.9: After clearing the area**



**Figure 2.10: Excavating (digging) the pond**



**Figure 2.11: Compacting the pond dyke (embankment)**



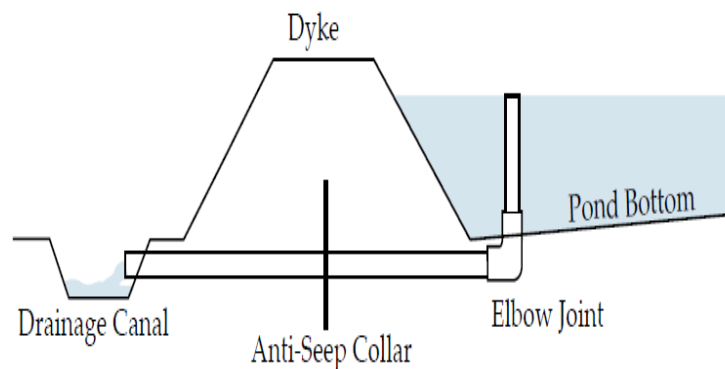
**Figure 2.12: Body parts of a fish pond indicating water inlet, outlet and dyke**

### 2.3.5. Procedure to construct fish pond

- Measure the length and width of the pond on the ground and mark it. Then, clear any vegetation grown.
- Begin the excavation (digging). It could be done by machine or manpower.
- The earth that comes out should be thrown upon the sides to form embankment (dyke).
- The pond dyke should be well compacted and strong enough to withstand the greatest water pressure exerted on them, and to avoid water seepage
- The dyke should be sloppy that face the water to avoid sliding of earth.
- Then make the water inlet, outlet, and canal

**The anti-seep collar-**The anti-seep collar prevents water seepage from the ‘joint’ where the outlet pipe and clay soil meet. These two substances do not bond together. This is a common weak point from where seepage from ponds and eventually leakages occur. During production, the drainage pipes are full of air, which makes the pipe tend to float. The force of the water from the bottom of the pond can push up the pipes and dislodge the bend or begin the infiltration.

**Anchor-collar-**Anchor-collar just after the pipe bend prevents this by keeping the drain pipe and its bend down



**Figure 2.13: Anchor-collar**

### **Standpipes**

The simplest drain is a standpipe protruding from the pond bottom. The lower end of the standpipe is screwed into an elbow which connects to the main drain. The upper end controls the level of water in the pond.

### **Monks**

The monk is part of the drainage system. It is constructed in front of the dyke (inside the pond) and consists of two parallel lateral walls and a back wall. It can be made of brick or concrete.

### **Harvest Basins**

Having a harvest basin set in the pond or between ponds is optional but recommended. Harvest basins make it possible to hold and handle fish alive while draining ponds. They also reduce the amount of labour required during complete pond harvests.

#### **2.3.6. Pond orientation**

Fish ponds should be planned in such a way that the length of the pond is positioned parallel to the prevailing wind direction.

Because of the following advantages:

- The length of dike exposed to wave action is lessened, thus, the cost of repairs also less.
- The position also takes advantage of the wind energy in effecting good water aeration through mixing and circulation.

## **2.4. Excavating and constructing pond**

### **2.4.1 Excavating pond**

Excavated ponds are constructed by digging and removing soil or earth and building dikes (walls) on all sides of the pond. They are utilized only in areas of flat topography. Water for these ponds is diverted from water sources such as a stream; river or lake water is coming in a furrow or canal.

The completed spillway excavation should conform as closely as possible to the lines, grades, bottom width, and side slopes shown on the drawings and staked at the site. Leave the channel bottom transversely level to prevent meandering and the resultant scour within the channel during periods of low flow. If it becomes necessary to fill low places or depressions in the channel bottom caused by undercutting the established grade, fill them to the established grade by placing suitable material in 8-inch layers and compacting each layer under the same moisture conditions regardless of the placement in or under the embankment. The construction site should be cleared of all large rocks, trees, brush, roots, and other debris. The topsoil should be removed and stockpiled for later use.

Most earth dams should have an anti-seepage core built into the structure. A trench for this core should be dug along the centerline of the dam and then refilled and packed with the best fine-grain soil available.

This trench should extend the full length of the dam and be at least 3 feet deep, preferably deeper. The core is necessary to prevent seepage and to establish a good bond with the undisturbed foundation.

The earth fill used in the dam should be free of boulders, stumps, roots, tree limbs, and decaying vegetation. Organic material buried in the dam will eventually decay and leave channels through which water can seep and cause the dam to fail. Earth fill should be spread in 6- to 8-inch layers and compacted with a heavy roller. The top of the dam should be built about 10 percent higher than the designed height, to allow for settling.

If the material can be formed into a firm ball that sticks together, the moisture content is adequate for compaction. Laboratory tests of the fill material and field testing of the soil for moisture and compaction may be necessary for large ponds or special conditions. If the material varies in texture and gradation, use the more impervious (clay) material in the core trench, center, and upstream parts of the dam.

Construction equipment can be used to compact earth fill in an ordinary pond dam. Equipment that has rubber tires can be routed so each layer is sufficiently covered by tire tracks. For dams over 20 feet high, special equipment, such as sheep foot rollers should be used.



**Figure 2.14: The sod and topsoil in a pond construction area can be stockpiled for later use**

Two kinds of excavated ponds are possible. One is fed by surface runoff and the other is fed by ground water aquifers, usually layers of sand and gravel. Some ponds may be fed from both of these sources.

### **2.4.2 Pond Construction**

Once you have designed your pond there is a logical sequence of steps that you should follow to build it. These are:

- 1) Survey the land
- 2) Clear all vegetation from the site
- 3) Remove the topsoil from the site
- 4) Determine pond, drain pipe, and supply canal elevations
- 5) Peg out the pond, including core trenches, dyke tops, and dyke toes
- 6) Dig core trenches and pack them with good soil
- 7) Excavate the pond area
- 8) Build the dykes
- 9) Install the drainage system

10) Install the water supply system

**a) Farm Designing**

Farm should be designed according to a production plan (production method)

Important sections of a farm such as:

- Preparatory brood stock
- Brood stock
- Nursery and sorting area
- Grow out
- Grading area
- Sales section
- Holding area
- Packing area
- Quarantine unit

Should be designed in separated areas within the farm

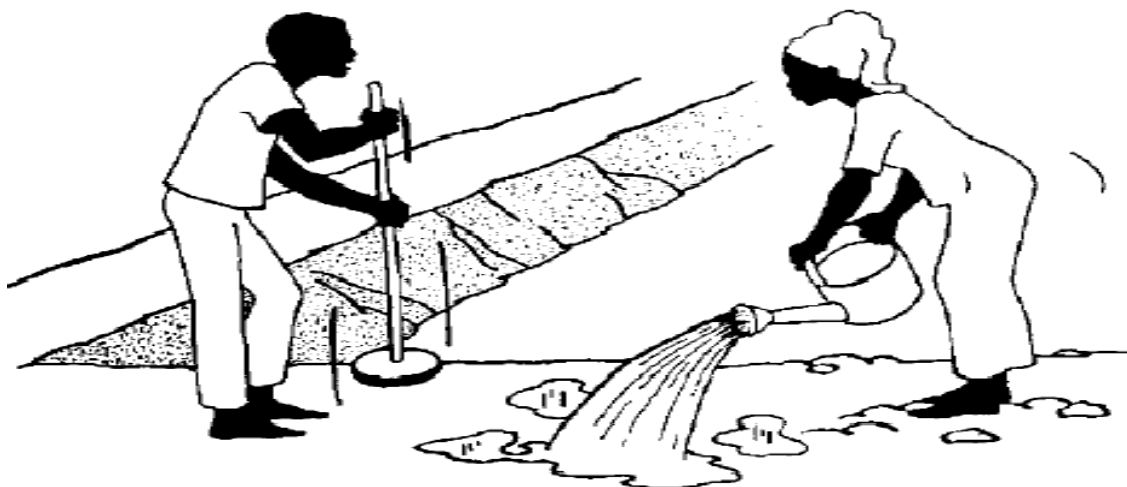
**b) Construction**

- A clay core is the foundation for the pond dike, which makes it strong and prevents water leaks. A clay core is needed in contour ponds and is built under those parts of the dike where the water will be above the original ground level. A clay core is not needed in excavated ponds because there the water level is below the original ground level.
- Remove all the topsoil in the area of the pond dikes and dig a ‘core trench’ in the same way as you would dig the foundation for a house. The trench needs to be dug out along the lower side of the pond and halfway along each short side of the pond.
- Fill the trench with good clay. Add several centimeters of clay at a time and then compact it well. This will provide a strong foundation upon which the pond dikes can be built.

**c) Keep compact**

- Keep compact the soil at regular intervals while you are building the dike. After adding each 30 cm of loose soil trample it well while spraying water on the dike. Then, pound it with your hoe, a heavy log, or a piece of wood attached to the end of a pole. This will make the dike strong.





**Figure 2.15: Compacting the dike**

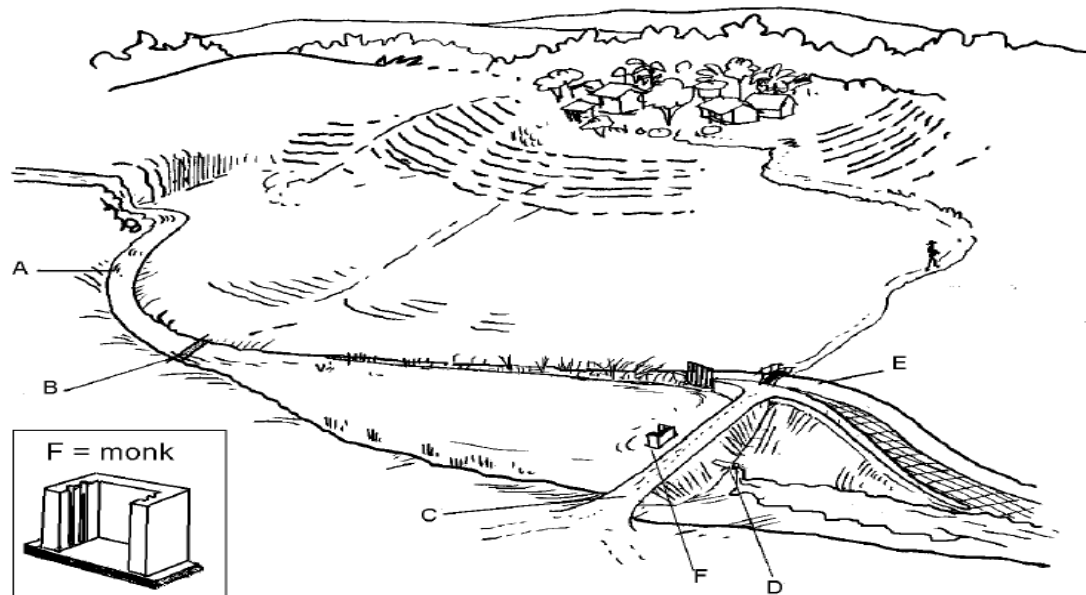
**d) Bottom Soils**

- Since the pond is simply a container for holding water, its dam and bottom must be composed of a soil that minimizes seepage. Soils with high clay content are preferred because clay particles tend to swell when wet and, thereby, help to seal the pond bottom.
- It's impractical to build a pond on soils that will not hold water. Sites located in gravel or sandy soils are often too porous to seal effectively. Similarly, sites in limestone are frequently unsuitable because of the high risks of fractures that create leaks.
- Sites in swampy areas may also be unsuitable because they are often difficult to drain and costly to maintain.

**e) Bottom Seals**

- Although it is usually expensive, leaky ponds can be sealed using one or more of a variety of compounds. The most commonly used pond sealant is bentonite clay.
- Bentonite is most effective on sandy soils that contain insufficient amounts of clay. This clay has the capacity to expand up to 20 times its original size when moistened. For best results, bentonite should be spread evenly over the dry pond bottom at a rate of 50 lbs./100 ft. (20,000 lbs. /acre) mixed with the existing soil, moistened, and then compacted with a roller.
- Other sealants, including soluble salts and polyphosphate chemicals, are effective on certain soils. Laboratory analysis of the soil is essential to determine the appropriate type of sealant and its rate of application.





**Figure 2.16: Barrage pond. A: stream, B: inlet, C: dam, D: outlet pipe, E: spillway and overflow, F: monk**

#### **f) Cement pond Construction**

- Size, shape and depth – Depends on the life stage of the fish and the fish species.
- Bottom of the pond should have a good slope and smooth surface. Tanks should be able to drain out completely.
- Inlet and outlet should be established in opposite directions near to a corner of the tank.
- Size of the outlet pipe should be 1.5”-2”
- Tank construction should be carried out in a solid manner. Bottom of the tank should be concreted at 2” thickness. Walls of the tank can be constructed with cement slabs (Cement: Sand 1:3, Thickness 1”) to minimize the cost.
- Each tank should have an access at least from two sides for the easy maintenance.
- Cement tank should be covered with a black shade net (70% - 80%) at a height of 8-10 ft. to cut off excess light. Sides should be covered with a suitable bird nets. (Light cut off 35 %.)
- Supporting structure for covering nets should be constructed using suitable galvanized pipes.
- Tanks can be aerated. However aerators should not have dead ends. It means, the pipe system should be interconnected in a circulatory manner.

## **2.5. Assembling and fixing fixtures and fittings**

Fixtures and Fittings means references to any of the fixtures, fittings, furniture, furnishings, or effects, floor, ceiling or wall coverings. Fixtures and Fittings means all fixtures, fittings, plant, machinery and equipment in or on the Property from time to time including by way of example bar server, back fittings, counters, boilers, Pipes, and equipment relating to heating, ventilation and air conditioning and the provision of hot and cold water, cellar cooling system, pumps, septic tanks, sprinkler systems, sanitary ware, electrical installation (except interior light fittings), tiles and similar fixed surface coverings, external lighting and signage, lifts and hoists, and any other fixtures, fittings or equipment in or on the Property which do not form part of the Trade Inventory. Fixtures and Fittings means built in furniture, refrigerator, stove, air conditioning unit, floor coverings, fixed awnings and solar panels.

Fixtures and Fittings means all fixtures and fittings (other than tenant's fixtures and fittings) in or upon the Premises including plant and machinery, lifts, boilers, central heating, air conditioning, lighting, plumbing, sanitary and sprinkler systems and any other apparatus from time to time in or upon the Premises. Fixtures and Fittings means all items contained in the Inventory and signed on behalf of the parties at the commencement of the Agreement or any items replacing them, including reference to any of the fixtures, fittings, furnishings or effects, floor, ceiling and wall coverings.

Fixtures and fittings are types of assets that come with a building. Fixtures are assets that are attached to the building or land, while fittings are assets that are not permanently attached to the building or land.

What is the difference between fixtures and fittings?

The difference between fixtures and fittings is whether or not they are physically attached to the property or the land it occupies. Fixtures are things that are physically 'fixed' to the property and can't be easily moved or lifted. Fittings are either free-standing (like most household furniture) or loosely attached with nails or screws (like pictures, hooks, etc.). All buildings include fixtures and fittings Employer's requirements, drawings and specifications, contracts and health and safety manuals refer to them. However, the term FF & E (furniture, fixtures and equipment) is frequently used as an alternative.

- A fixture is any item that is intended to be reasonably permanent and is affixed to the property through the application of plaster, cement, bolts, screws, nuts, or nails
- A fitting/ furnishing is any item that is free standing or hung by screws, nails or hooks.

- Below is a list of items that typically fall within each category.

Again, fixtures are classified as something that's bolted directly onto the property but isn't structural.

Common examples of fixtures include:

- Boilers and heating systems
- Built-in wardrobes and storage features
- Bathroom suite items including baths, showers, sinks and built-in storage
- Carpets and flooring
- Fixed partitions and doors
- Light fittings
- Security alarm systems
- Plumbing installations
- Bathroom suites and other sanitary ware installations
- Sinks
- Built-in furniture, including proprietary reception desks, worktops
- Built in wardrobes/ cupboards/ shelf units (e.g. if they use a wall to form one of their sides and would thus be incomplete if they were removed)
- Plants and shrubs [rooted] in land belonging to the property

After the fixtures, fittings make up the rest of the items you would typically see in a property.

Examples of fittings include:

- All free-standing furniture, regardless of size
- Free-standing white goods – fridges, washing machines, etc.
- Decorative items – lampshades, pictures, mirrors, ornaments and artworks shelving, curtains and curtain rails (as they are easily removable)
- Garden furniture
- Edge-fitted and loose-laid carpets
- Notice boards
- Plumbed-in/ connected but free-standing equipment (e.g. commercial catering equipment, laboratory equipment)
- Free-standing ovens, refrigerators, washing machines and other white goods
- Lockers, changing room furniture, etc.

## **2.6. Constructing water supply and disposal systems**

Major constraints to aquaculture development are shortages of suitable land and water space and pollution problems. Rapid urban development in the new territories has increased land values leading to the conversion of freshwater fish ponds for residential development or their use as open storage sites for containers.

But water quality is based on water parameter and environmental parameter.

So the quality of water dependent on:-

- Natural feed inside the water like algae
- The amount of ozone
- Soil pH i.e. pH should be range from 7-8
- The amount Carbon dioxide
- Chlorophyll
- The amount of minerals in the water is like phosphorus, calcium & orthophosphate
- The types of Sediment/deposit in the water etc. are the basic parameter of water.

Water quality is a dynamic web of the physical, biological and chemical factors, which constitute the water environment and influences the production of fish and other aquatic environment. There are many water quality variables in pond fish culture.

### **Water quality parameters**

Water quality parameters, which are of prime importance, are mainly temperature, turbidity, oxygen, CO<sub>2</sub>, nitrogen, ammonia, pH, alkalinity, hardness, etc.

#### **a) Temperature**

The water temperature is considered to be one of the most important factors in aquatic environment because it affects all metabolic, physiological activities and life processes of different trophic levels of pond ecosystem. In addition, it also affects the speed of chemical changes in soil and water. Water temperature plays an important role in influencing the periodicity, occurrence and abundance of phytoplankton as it had a direct relationship with total plankton. Fishes are cold-blooded animal and dependent upon the water temperature in which they live. Every fish species has an ideal temperature range within which it grows quickly. The

optimum temperature range for 'cold water' and 'warm water' fishes are 14-18°C and 24-30°C respectively

#### **b) Turbidity**

The turbidity is a term that refers to the suspended solids particles, plank tonic organism and humid substances produced through decomposition of organic matter. In aquaculture ponds, turbidity from plank tonic organism is often desirable to an extent, whereas that caused by suspended particles is undesirable).

However, heavy blooms limit heat and light penetration, then reducing the effective volume of productive zone. Optimum Secchi-disc visibility of fish ponds is considered to be 30 - 40 cm. In ponds with Secchi-disc visibility of 10-20 cm, dissolved oxygen concentration may fall so low at night that fish are stressed or even kill. Turbidity due to suspended solids can be controlled by application of organic manure 500 -1000 kg/ha or gypsum @ 250-500 kg/ha or alum @ 25-50 kg/ha.

#### **c) Dissolved oxygen**

Dissolved oxygen is one of the most important chemical parameters in aquaculture. Low dissolved oxygen levels are responsible for fish kills, either directly or indirectly. The concentration of dissolved oxygen in natural water is influenced by the relative rates of diffusion to and from the atmosphere, photosynthesis by aquatic plants and respiration by aquatic biological community. Dissolved oxygen along with the turbidity could provide information about the nature of an ecosystem better than any other chemical parameters (Hutchinson, 1975). It was also observed that dissolved oxygen content of pond water in the range of 5 mg/litre to saturation level favour good growth of flora and fauna.

#### **d) Carbon dioxide (CO<sub>2</sub>)**

The primary sources of carbon dioxide in fish ponds are derived from respiration by fish and the microscopic plants and animals that comprise the fish pond biota. Decomposition of organic matter is also a major source of carbon dioxide in fish ponds. The fish producers are rightly concerned with maintaining adequate concentrations of dissolved oxygen. The problem with the potential toxicity of carbon dioxide can be related to the daily fluctuating pattern of dissolved oxygen and carbon dioxide concentrations. Carbon dioxide concentrations are highest when

dissolved oxygen concentrations are lowest. Carbon dioxide concentrations are maximum during winter and minimum during summer. However, carbon dioxide is rarely a problem in winter because dissolved oxygen concentrations are usually well above saturation levels. Freshwater fish pond should contain a low concentration of free CO<sub>2</sub> (<3 mg/litre), although it can tolerate high concentrations of CO<sub>2</sub> (Boyd, 1978) Aeration and increasing of pH can control the high concentration of CO<sub>2</sub>. Experiments have shown that 1.0 mg/litre of hydrated lime can remove 1.68 mg/litre of free CO<sub>2</sub>.

#### **e) Ammonia**

Ammonia is the first measurement to determine the health of biological converter. Fish are very sensitive to unionised ammonia and the optimum range is 0.02-0.05 mg/litre in the pond water. When ammonia accumulates to toxic levels, fish cannot extract energy from feed efficiently. If the ammonia concentration gets high enough, the fish will become lethargic and eventually fall into a coma and die. In properly managed fish ponds, ammonia seldom accumulates to lethal concentrations. However, ammonia can have so-called "sub-lethal" effects such as reduced growth; poor feed conversion, and reduced disease resistance at concentrations that are lower than lethal concentrations. The main source of ammonia in fish ponds is fish excretion. Protein in feed is the ultimate source of most ammonia in ponds where fish are fed. Another main source of ammonia in fish ponds is diffusion from the sediment. The decomposition of this organic matter produces ammonia, which diffuses from the sediment into the water.

There are two main processes that result in the loss or transformation of ammonia. The most important is the uptake of ammonia by algae and other plants. Plants use the nitrogen as a nutrient for growth. The other important process of ammonia transformation in fish ponds is 'nitrification'. Bacteria oxidize ammonia in a two-step process, first to nitrite (NO<sub>2</sub>) and then to nitrate (NO<sub>3</sub>).

#### **f) pH**

PH is a measure of hydrogen ion concentration in water is acidic or basic.

It has direct effects on fish growth and survival of food organisms. Hence, to achieve good fish production pH of the water should be monitored regularly to ensure its optimum range of 6.5-8.5.

It also exerts considerable influence on toxicity of ammonia and hydrogen sulphide as well as

solubility of nutrients and thereby water fertility. The generalised effects of pH on fish are presented in Table 1.

**Table 1:** Effects of pH on fish

<b>pH</b>	<b>Effects</b>
4.0	Acid death point
4.0-6.0	Slow growth rate
6.0-9.0	Best for growth
9.0-11.0	Slow growth, lethal to fish over long period of time
11 <sup>+</sup>	Alkaline death point

#### **g) Hardness**

Water hardness is similar to alkalinity but it represents several facts. It is important to fish culture and is commonly reported aspect of water quality. Hardness is the measure of calcium and magnesium, but other ions such as aluminium, iron, manganese, strontium, zinc and hydrogen ions are also covered. Calcium and magnesium are essential in the biological process of fish. Fish can absorb calcium and magnesium directly from the water or food. Hardness values are of at least 30 mg/litre should be maintained for optimum growth of aquatic organisms. Low hardness levels can be increased with the addition of agricultural lime.

#### **h) Nutrients**

Nutrient a major constituent of protein occupies a predominant place in aquatic ecosystem. Though a relatively minor constituent, phosphorous is often considered to be the most critical single element in the maintenance of aquatic productivity (Moyle, 1946). Dissolved inorganic nitrogen in the range of 0.2 to 0.5 mg/litre may be considered favourable for fish productivity and phosphorous fertility for aquatic productivity ranges from 0.05 to 2.0 mg/litre.

<b>Self-Check – 2</b>	<b>Written test</b>
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Name..... ID..... Date.....

**Directions:** Answer all the questions listed below.

**Test I: Multiple choice**

- Which one of the following equipment is measure the hydrogen ion in the water? (6pts.)
  - Dissolved oxygen meter
  - PH meter
  - Salinity meter
  - Thermometer
- Which one of the following equipment is measure the salt content in the water? (6pts.)
  - Dissolved oxygen meter
  - PH meter
  - Salinity meter
  - Thermometer

**Test II: Short Answer Questions**

- What are the methods used in organization of construction work? (3pts)
- Write the criteria of cement pond Construction?(5pts)
- What are the structure of fish pond?(4pts)
- What are the types of fish pond? (3pts)
- What are the size and shape of pond (4pts?)
- Why topsoil should be removed?(4pts)

Note: Satisfactory rating - 18 points      Unsatisfactory - below 18 points

You can ask you teacher for the copy of the correct answers.



## Operation Sheet -2

### Technique of performing fish pond construction

#### 1. Tools and equipment's

- Hoe
- Rope
- Water level
- Meter
- Peg

#### 2. Procedures

- Decided the pond shape, size, and depth.
- Measure the length and width of the pond on the ground and mark it.
- Clear any vegetation grown.
- Begin the excavation (digging). It could be done by machine or manpower.
- Throw the soil that comes out upon the sides to form embankment (dyke).
- Compact well the pond dyke to make strong enough.
- Then make the water inlet, outlet, and canal.

<b>LAP TEST-2</b>	<b>Performance Test</b>
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Name..... ID.....

Date.....

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within **1 hour**. The project is expected from each student to do it.

**Task:** Performing fish pond construction

<b>LG #27</b>	<b>LO # 3 - Undertake Fish Farming Work</b>
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**Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Following instructions and directions
- Identifying fish feed sources and types
- Undertaking fish farming activity
- Reporting problems or difficulties in completing work

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Follow instructions and directions
- Identify fish feed sources and types
- Undertake fish farming activity according to industry guidelines
- Report problems or difficulties in completing work

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

### Information Sheet-3

#### 3.1. Following instructions and directions

Instructions and directions provided by supervisor are followed and clarification is sought when necessary. Any employee who works in industry which fish rising or any farmer who raise his own stock must follow the following instruction and direction:-

- Enterprise policies and procedures
- Manufacturer instructions
- Material safety data sheets (MSDS)

The MSDS is a detailed informational document prepared by the manufacturer or importer of a hazardous chemical. It describes proper handling and rising activates of fish.

MSDS's contain useful information such as:

- Flash point
- Toxicity
- Procedures for spills and leaks and
- storage guidelines

Information included in a Material Safety Data Sheet aids in the selection of safe products, helps you understand the potential health and physical hazards of a chemical and describes how to respond effectively to exposure situations

- OHS standards and procedures
- Specifications for tools, equipments and materials
- Standard Operating Procedures (SOP)

It is a set of step-by-step instructions compiled by an organization to help workers carry out complex routine operations. SOPs aim to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with industry regulations

- Verbal directions from manager or supervisor
- Work instructions and standards
- Work notes

Instructions and directions provided by supervisor must be followed and if we have any question we can ask when necessary. And also employee must observe and follow Enterprise policies and procedures in relation to workplace practices in the handling and disposal of materials.

### 3.2. Identifying fish feed sources and types

#### 3.2.1. Types of fish feed

Eating is one of the most important ways of keeping healthy as humans. This is the same in fish. If you're going to produce healthy, valuable fish, you need to get feeding right. This topic will help you identify different kinds of feed so you can work out what is best for your farm, and your situation;

There are three types of feed used in fish ponds:

**1. Natural feed** is found naturally in the pond. It may include detritus, bacteria, plankton, worms, insects, snails, aquatic plants and fish. Their abundance greatly depends on water quality. Liming) and fertilization in particular organic fertilization can help you to provide a good supply of natural food to your fish.

**Plankton** is a collective term applied for very small (microscopic largely) extremely diverse forms of organism, both plants and animals that are floating forms, drifting into currents. The plankton occurs in all natural water as well as in artificial ponds, reservoirs, irrigation channels, etc.

**Phytoplankton:** the organisms are exclusively of plant origin and are thus autotrophs belonging to the first trophic level (producers).

**Zooplankton:** the organisms are exclusively animals, and are therefore heterotrophs, belonging to the second trophic (primary consumer) level.

Natural feeds:

- are made up of aquatic animals and plants that can be grown in farm ponds or dams
- are commonly used to reduce costs
- are often cheaper than live or artificial feeds
- Are produced by helping natural growth using organic and/or inorganic fertilisers.

Advantages of natural feeds

- Low cost. This is a 'home grown' food source
- Always available (fish can feed when they like).

Disadvantages of natural feeds

- There is less control of the food source. For example, anything that affects the healthy growth of the natural feed will affect the growth of the stock.

- Natural feeds may not meet the nutritional requirements of the cultured species. This often leads to reduced survival and growth rates compared with those achieved by artificial feeds.

Natural feed prefer for fish

The feed preferred by fish varies considerably, depending on species and development stage.

Fish larvae do not actively feed but survive on reserve food in their yolk sac. A short time before the yolk sac is absorbed, early fry start eating natural foods, which usually consist first of the smallest plankton such as microscopic algae and rotifers. As their mouth size increases, the fry eat increasingly larger plankton (cladoceres/copepods) and insect larvae/pupae. Little by little, as the fry grow older, food preferences change to resemble more and more those of adult fish.

Adult fish belong to different categories according to their feeding preferences:

- I. Herbivores prefer plant materials such as:
  - Phytoplankton\*, for example the Chinese silver carp;
  - Higher plants, for example Tilapia rendalli, grass carp, and the Asian cyprinid Pontius.
- II. Omnivores eat a mixture of various natural foods, although most of them have preferences for certain foods such as:
  - Zooplankton\*, for example the Chinese bighead carp;
  - Bottom fauna, for example common carp;
  - Bottom detritus for example mrigal, an Indian cyprinid;
  - Phytoplankton, for example the Nile tilapia;
  - Fruits and seeds, for example the South American Colossoma.
- III. Carnivores prefer animal food such as insects, tadpoles, frogs and smaller fish, for example trout and catfishes such as African Clarias and Asian Pangasius.

**2. Supplementary feeds** are feeds regularly distributed to the fish in the pond. They usually consist of cheap materials locally available such as terrestrial plants, kitchen wastes or agricultural by-products. Supplementary feeds;

- are usually agricultural by-products such as wheat and rice bran
- are not specially formulated to meet the nutritional requirements of fish species
- are traditionally used in semi-extensive forms of aquaculture
- Generally complement the use of natural feeds eg. yabby farming

- Can increase the amount of stock and the size, and still keep feed costs to a minimum.

Advantages of supplementary feeding

- Cheaper than artificial feeding
- Easy access to the food supply.

Disadvantages of supplementary feeding

- It has not been produced to meet the exact nutritional requirements of fish stock and may not have all the essential nutrients necessary to produce the best fish.

Use of supplementary feeding

There are several reasons why should supplement the natural feed available within the pond with artificial feedstuffs originating from outside the pond, for example:

- when natural foods become insufficient to feed the fish well and ensure good growth;
- When wish to raise more fish in the pond to produce a higher crop and still have good growth.

As make more use of supplementary feeds, change from an extensive system to a semi-intensive system of production.

**3. Complete/Artificial feeds** may also be regularly distributed. They are made from a mixture of carefully selected ingredients to provide all the nutrients necessary for the fish to grow well. They must be made in a form which the fish find easy to eat and digest. These feeds are quite difficult to make on the farm and are usually quite expensive to buy.

Artificial feeds are specially made to meet the nutritional requirements of the species.

Artificial feeds are widely used for a number of reasons:

- a) They increase growth and production rates much faster than natural or supplementary feeds.
- b) Farmers know they can get feed easily and quickly.
- c) Artificial feed is available all the time.
- d) A wide range of pellet sizes can be made to suit fish of different sizes.

Artificial feeds for cultured fish should:

- be cost efficient
- meet the nutritional requirements of the animal
- be palatable to the fish and recognized as food
- be easily digested and metabolized by the aquaculture species

### 3.2.2. Fish feeding

There are four (4) main principles in fish feeding for optimum growth; these are called ‘the 4 fixed feeding principles. These are:

#### a) Fixed feed quality

Feed should be fresh and palatable with a high nutritive value that fulfills the nutrient requirement of the fish.

#### b) Fixed feed quantity (feeding rate)

Fish should be provided with a fixed amount of feed every day. In order to avoid over or under feeding the fish, the right amount of feed must be given each time. The amount of feed to be provided to the fish per day (feeding rate), depend on the fish’s body weight.

**Table 2:** Amount of feed provided

Fish stock type	B.Wt. of fish (grams)	Feeding rate (% B.Wt./day)
Fry	1-5	8%
Fingerling	6-20	5%
Juveniles (Grower)	21-100	4%
Juveniles (Grower)	101-200	3%
Adult	200-400	3%

Amount of feed= average fish size (weight) x feed rate (%) x total number of fish in the pond.

Examples on calculating the daily feed requirement

e.g. If a Catfish weighs 5 grams, which requires a ratio of 8% of its B.Wt., how much food should it be given per day?

Amount of feed to be fed per day =B.Wt. of fish x Feeding rate (%B.Wt.)

= 5 grams x 8/100 = 0.4 grams feed per fish per day.

If there are 1000 fish in the pond, then;

= 0.4 g x 1000 fish = 400 g of feed should be given per day

ii. If a Tilapia fish of 180 g requires a ratio of 3% of its B.Wt., how much food should it be given per day?

Amount of feed to be fed per day = B.Wt. of fish x Feeding rate (%B.Wt.)



= 180 grams x 3/100 = 5.4 grams feed to be fed per fish per day.

If there are 1000 fish in the pond, then;

= 5.4 g x 1000 fish = 5.4 kg of feed should be given per day

The amount of feed required per day (feeding rate) can be estimated with the help of a feeding chart and calculated as follows (see table below):

The feed rate is the amount recommended in the feeding chart as a percentage of the fish's average weight at that time.

#### **c) Fixed feeding time (feeding frequency)**

The feeding frequency is the number of times fish in a pond are fed in a day.

The best time to provide feed is between 10 a.m. and 4 p.m., when the water temperature and dissolved oxygen are reasonably high.

#### **d) Fixed feeding location (feeding place)**

Feed should be given at the same place at each feeding, e.g., on a feeding platform.

Some of the ways 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.
- Use a demand feeder, which releases fish food when the fish bump a lever.
- Use an automatic feeder, which releases or broadcasts feed at predetermined times.

### **3.2.3. Factors to consider in fish feeding**

The type of feeds and nutritional requirement of fish depend on the following factors;

- the species being cultured
- age of the animals being fed
- culture conditions (Environmental condition)
- level of intensification

The objective of feeding fish is to provide the nutritional requirements for good health, optimum growth, optimum yield and minimum waste within reasonable cost so as to optimize profits.

Every farmer should be particular about the quality of feed fed to the fish because it is the feed that determines the:

- a) Nutrient loading (and ultimately carrying capacity) in the pond, hence water quality within the culture system
- b) Fish growth rate,
- c) Economic viability of the enterprise. 60-70% of variable production costs in a normal production cycle are due to feed.
- d) Health status of the fish.

The system of production can be defined according to the type of feed given to the fish:

- **Extensive:** fish production depends entirely on natural food;
- **Semi-intensive:** fish production depends on both natural food and supplementary feed; more fish may be reared in the pond;
- **Intensive:** fish production depends entirely on complete feed, and the stocking rate no longer depends on food availability but on other factors such as water quality.

### 3.2.4. Amount to feed fish (Quantities to use)

How much to feed your fish?

In order to avoid over or under feeding the fish, the right amount of feed must be given each time. The amount of feed to be provided to the fish per day, the feeding rate (ration), is dependent on the fish's body weight. 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, know how many fish were stocked, and make frequent observations of the pond to know whether or not fish have died.

The amount of feed required per ration can be estimated with the help of a feeding chart and calculated as follows = average fish size (weight) x feed rate (%) x total number of fish in the pond.

The aim at providing all the feed the fish need to:

- Maintain body functions such as blood circulation and routine respiration; and
- Grow, increasing in size and producing eggs, for example.

If the quantity or quality of feed available is limited, fish may not grow, may lose weight, or may even die from food deficiency. Growth will occur only after maintenance needs are satisfied. These needs increase with water temperature, because the activity of the fish also increases. They are relatively greater in small fish compared with larger fish.

**Table 3:** Average fish size and feed requirement

Average fish size (g)	Feed required for maintenance	
	Kg/day	Percent of total fish weight
10	21	2.1
100	17	1.7
300	11.3	1.1
1 000	8	0.8

#### Example

Pond contains 1000 kg of common carp at a water temperature of 25<sup>0</sup>C. Feed these fish with cereal grains. To cover their maintenance needs only, they must be fed the following amounts, according to the average size of the fish:

Examples on calculating the daily feed requirement

i) If an African catfish of 5 grams requires a ration of 8% of its body weight, how much food should it be given per day?

Amount of feed to be fed per day;

$$= 5 \text{ grams} \times 8/100$$

$$= 0.4 \text{ grams feed per fish per day.}$$

If there are 1000 fish in the pond, then;

$$= 0.4 \text{ g} \times 1000 \text{ fish}$$

$$= 400 \text{ g of feed should be weighed out for the day}$$

ii) If a catfish fish of 180 g requires a ration of 2.5% of its body weight, how much food should it be given per day?

Amount of feed to be fed per day;

$$= 180 \text{ grams} \times 2.5/100$$

$$= 4.5 \text{ grams feed to be fed per fish per day.}$$

- 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.

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.

Mixing two or more feedstuffs together may result in several advantages:

- The fish feed is better balanced from the nutritional point of view. This consideration is especially important for brood stock and juveniles.
- Locally available feedstuffs are better used.
- Liquid feedstuffs can be used more efficiently by absorbing them on to dry materials

### **Floating feed**

Provides an added advantage in that the farmer not only knows when the fish have started feeding, but the farmer will know when the fish have stopped feeding. Even though catfish are thought to feed on the pond's bottom, they are easily trained to feed wherever the food is, even at the surface. Therefore, it is much easier for the farmer to evaluate feeding response when using a floating feed. However, floating feed often costs more. It is therefore up to the farmer to decide if floating feed is worth the added expense by evaluating fish performance and feed conversion.



**Figure 3.1: Fish feed**

Example: If there are 1000 young fishes in a pond, and each weighs about 10 grams, then the total amount of food to be given will be:

$10\text{grams} \times 1000 \times 4 / 100 = 400\text{grams}$  of food is required

### 3.2.5. Fish feeding equipment

There are advantages and disadvantages to machine feeding and hand feeding.

#### a. Hand feeding

This is the most common method of feeding stock. Many smaller farms only use hand feeding.

There are many advantages of hand feeding fish stock:

- constantly monitor the feeding behaviour and health of your stock
- feed more or less depending on the behaviour of the stock
- are less likely to overfeed or underfeed stock

Feeding structures: used to feed fish on growing, including feeding machines, feed platforms, barrels, panels.



**Figure 3.2: feeding structures**

However, it can be an expensive method of feeding because you need to employ a someone to feed the stock. The main advantage of mechanical /hand feeding is that it reduces labour requirements connected with hand feeding. Demand feeders and pneumatic feeders are two types of mechanical feeders used on fish farms.

**b. Demand feeders**

- These are started by stock behaviour.
- Some people think that demand feeding can cause a large difference in fish stock sizes. They believe that the large fish stop the smaller fish from feeding.
- You need to check regularly for uneaten feed to stop pest infestations and rancid feed stock.

**c. Pneumatic feeders**

- These are hoppers that use air pressure to deliver feed to the stock. Pneumatic feeding isn't a good option if you have to feed your stock frequently, as it can take a long time to build up air pressure between feeds.
- Pneumatic feeders are very reliable and don't break down often. They're used a lot in pond feeding situations in Australia.

**3.2.6. Time to feed fish**

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 AM and 4 PM., 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.

Always try to feed your fish at the same time every day preferably early in the morning and late in the afternoon when the pond is cooler by dividing the food into two.

### 3.2.7. Ways / methods of feeding fish

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 predetermined 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.

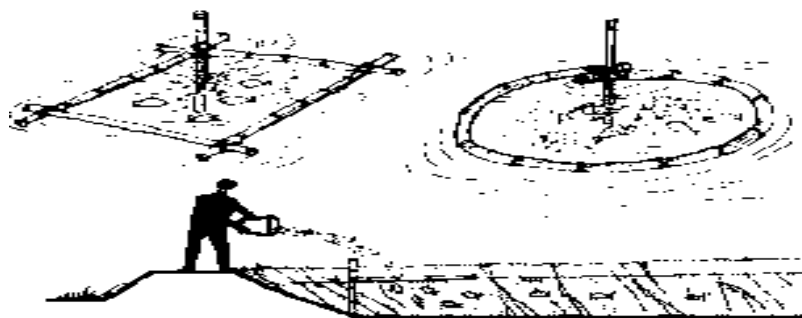
A benefit of feeding by hand is that the feeder has the opportunity to observe how well the fish are feeding, as well as how fast they are growing. Healthy fish usually eat enthusiastically, and any deviation from enthusiastic eating suggests a problem may be developing. The following are some reasons 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

### 3.2.8. Place of providing feed to fish

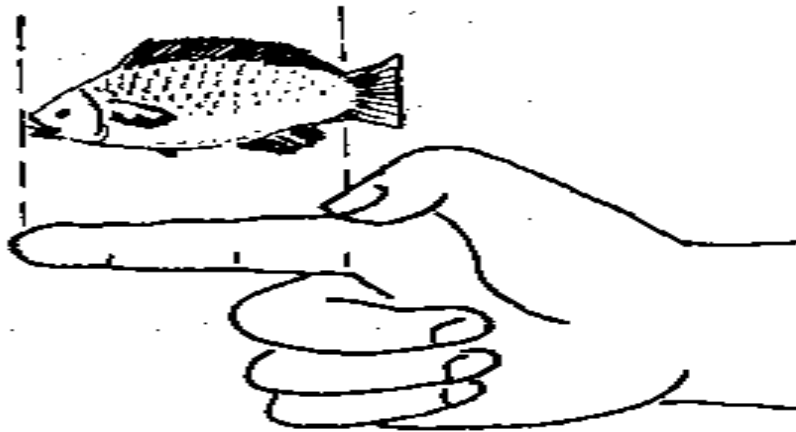
Where do we provide feed to fishes?

The food should not be spread all over the surface of the water, but on a certain side of the pond on feeding platform ( prepared from bamboo by cutting into 4 pieces of 150cm in length and joining each corner and fixing with rope or wire to form a square.



**Figure 3.3: Structure of feeding platform and method of feeding**





**Figure 3.4: A fish at fingerling stage**

### **3.3. Undertaking fish farming activity**

#### **3.3.1. Activities performed in fish farming.**

##### **a) Protect the pond dikes**

When the pond dikes are finished, cover them with the topsoil that was saved when digging the pond. On the dikes, plant grass. Do not use plants with long roots or trees because these will weaken the dikes and may cause leaks. The fertile topsoil will help the new grass to grow, and the grass will help to protect the dikes from erosion.

##### **b) Fence the pond area**

Putting a fence around the pond is for safety to protect from falling into the pond and it can help to keep out thieves and predatory animals. To make a low cost plant a thick hedge around the edge of the pond or build a fence using poles and thorn branches.

##### **c) Lime the pond**

After the ponds have been constructed the pond should be limed. It's very important to lime the pond (bottom and dike) for preventing fish from getting disease and for maintaining high fish productivity.

The main roles/purpose/ function of liming is showed in the following:

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- Lime is disinfectant (anti-parasite) destroying parasites (eggs, larva) living in the water or the intermediate hosts of disease.
- Kill the fry enemies such as insects, frog and their larvae.
- Fertilize the pond because many algae fed by fishes need  $\text{Ca}^{2+}$  as nutrient element.
- Kills the wild fish, because wild fish will consume lots of dissolved oxygen and food, but provide no good taste and low productivity.
- Kills the virus and bacteria in the ooze and in the water.
- Regulate the acid water to slightly alkaline (PH 7-8) which is suitable for fish growth and stabilize the pH.
- Reduces water muddiness, by settling siltation

### I) Types of lime

- The most common liming materials are agricultural limestone ( $\text{CaCO}_3$ ), hydrated or slaked lime and or quick lime.
- Liming materials differ in their ability to neutralize acid.
- Pure agricultural limestone is the standard against which other liming materials are measured.
- The neutralizing value of agricultural limestone is 100%.
- Generally calcium oxide ( $\text{CaO}$ ) called slaked lime or quicklime, and calcium carbonate ( $\text{CaCO}_3$ ) called chalk or limestone is used as the liming material.

### II) Lime application rate and method

- Apply the amount of agricultural limestone shown in Table depending on either the total alkalinity of the pond water or the  $\text{P}^{\text{H}}$  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.
- Apply lime to the pond bottom and dyke slopes.
- Distribute the powder evenly around the pond bottom and on the slopes of the dykes. This can be done using a shovel. If necessary, you can also apply lime by spreading it over the water surface after filling the pond.
- Lime should be applied every month interval.

#### **d) Filling the fish culture with water**

- After renovating and disinfecting fishponds, the freshwater can be filled into the pond.
- The water must be nontoxic.
- In order to prevent the wild fishes and another harmful animals enter the ponds, dense net or filter should be installed in the pond inlet.
- After or before filling the water, base manures should be put into the pond.
- The dosage of base manure is 200 kg/ha for dry cow dung, or 6000kg/ha for fresh grass or another fresh manures.
- One week later, the pond water will be changed into green or brown color and plankton grow well.
- When filling the water into pond, at first one-third of water needed should be filled gently.
- Then other water can be added until the full of pond when the water color has been changed to green or brown.

Water from any source can be used for refilling a pond after passing it through a fine sieve to get rid of predators and insects in any stages.

#### **Quantity of water needed**

- A general rule is that pond water inflow and outflow should equal the pond volume over the period of a month. If inflow is too low, water quality may suffer from oxygen depletion and/or the accumulation of toxicants. However, if the inflow is too high, large amounts of beneficial algae may be flushed from the pond.
- As a rule of thumb, ponds should fill up in less than a week. For small ponds, e.g., ponds smaller than 200m<sup>2</sup>, 1-inch pipe is recommended. A 400m<sup>2</sup> pond needs a 2-inch pipe, while a pond larger than 4000m<sup>2</sup> will require a 4-inch pipe.

#### **Estimating amount of water needed to fill a pond**

To estimate the amount of water available from a specific source, use the simple bucket procedure:

- Measure the capacity of a bucket and measure how long it takes to fill the bucket with water, e.g., a 10-litre bucket filling in 45 seconds. From this, calculate how many litres will be delivered per minute. This is estimated as  $(10 \times 60)/45 = 13.3$  litres/minute.

- ii. Now determine how long it takes to fill a 100-m<sup>2</sup> pond (e.g., 10 m x 10 m). If the pond had a uniform depth of 1 m, it would hold 100 m<sup>3</sup> of water. In actuality the pond does not hold 100 m<sup>3</sup> of water, however. For example, if the pond is 50 cm deep at the shallow end and 90 cm deep at the deep end, its average depth is 70 cm or 0.7 m  $(50 + 90)/2 = 70$  cm) and the volume of water required to fill the pond is 70 m<sup>3</sup> or 70,000 litres (100 m<sup>2</sup> x 0.7 m = 70 m<sup>3</sup>).
- iii. We also know that 1 m<sup>3</sup> = 1000 litres. Since we know that our water supply gives us water at a rate of 13.3 litres per minute, we can now calculate how long it will take to fill the pond. This is calculated as  $(70,000 \text{ litres} / 13.3 \text{ litres per minute} = 5263 \text{ minutes or } 87.7 \text{ hours}$ . This pond will therefore require about three and a half days to fill.
- iv. Remember that with sound management strategies one can successfully culture fish in ponds with inconsistent, undependable, or seasonal water sources.
- v. Ponds lose water through seepage and evaporation. The amount of water lost by evaporation depends on factors such as temperature, wind, vegetation, water surface, and humidity.

Evaporation ranges from 2 to 7 mm per day. Assume 4 mm per day. So for 100 m<sup>2</sup> pond, water loss through evaporation would be  $= 0.004 \text{ m} / 100 \text{ m}^2 = 0.4 \text{ m}^3$  or 400 litres in a day. So get enough water to replace what is lost by evaporation. Water lost by seepage depends on soil and construction factors such as the existence of a suitable clay layer under the pond bottom, whether or not good clay cores were placed under the dykes during construction and the quality of soil used to build the dykes.

Generally nursery ponds are watered 10-15 days before stocking, initially to 60 cm and subsequently raising it up to 100-120cm. Before about 15 days new fishes will be put into the pond, fill the pond with water (1/3, 1/2 or full).

- This helps to check for percolation and any water linkage from the outlet and pond dykes.
- Allowing the conditioned and disinfected pond to stay idle at least 4-5 days even more than 7 days to avoid the disinfectant kill fry or fingerling or put a few fish as indicator.

#### **e) Fertilizer application**

Fertilization supplies the phytoplankton (free floating plants) with the materials essential for photosynthesis. As the phytoplankton photosynthesize and reproduce, zooplankton (floating organisms that is made up of microscopic animals), which feed on phytoplankton, flourishes.

In turn, the fish, which feed on zooplankton, phytoplankton, and benthos, also flourish.

Therefore, the importance of pond fertilization lies in the cultivation and propagation of various

food organisms for the cultural fish.

### **I) Purpose of fertilizing pond**

Fertilizers used in ponds stimulate the growth of microscopic plants called algae or plankton. As primary elements of the food web, algae are eaten by microscopic animals called zooplankton and insects which serve as food for the fish.

Well fertilized pond make the water turn green because of the Algae.

- The aim of fertilizing the pond is to maintain high pond productivity, and improving fish (growth) production by increasing the amount of natural food of fish in the pond.
- The fertilizing substances in the fertilizers provide the necessary nutrient substances, which are either lacking in the pond water or are insufficient. The supply, supplement or increase of these nutrient substances, is responsible for increased production of phytoplankton and vegetation.
- The addition of the fertilizers to pond is immediately absorbed by the bottom muddiness which later releases the nutrients in minimal quantities into the water for long periods. This is the reason for the prolonged action of fertilizers on the pond.

### **II) Types of Fertilizers**

- **Chemical/ Inorganic fertilizers**

According to composition, chemical fertilizers can be divided into three groups: nitrogenous, phosphoric, and potash fertilizers. Common examples are UREA and DAP (Diammonium Phosphate)

- **Organic fertilizers**

The most cheap and locally available source of fertilizer is the organic fertilizer such as; Animal manure or waste (cattle manure, poultry waste, sheep and goat manure), Vegetable and household wastes, Grasses, legumes and plant leaves and Compost made from plant and/or animal wastes.

Importance of Organic Fertilizer;

- It improves the bottom muddiness.
- It encourages phytoplankton growth, which in turn favours better production of the zooplankton.

- It increases the effectiveness of many inorganic fertilizers by providing the necessary organic manures.
- It is a highly valuable and the most economical organic fertilizer. But less effective as compared with inorganic fertilizer.

Organic manures;

- Organic manures are mainly farm animal excrement.
- Faeces and urine of livestock and poultry, green manure, night soil, compost, and silkworm dregs are some of the organic matters.
- Fertility of ponds, therefore, is achieved by application of inorganic and organic fertilizers or a combination of both.
- Fertilization supplies the phytoplankton (free floating plants) with the materials essential for photosynthesis.
- As the phytoplankton photosynthesize and reproduce, zooplankton (floating organisms that is made up of microscopic animals), which feed on phytoplankton, flourishes.
- In turn, the fish, which feed on zooplankton, phytoplankton, and benthos, also flourish.
- Therefore, the importance of pond fertilization lies in the cultivation and propagation of various food organisms for the cultural fish.



**Figure 3.5: Compost bin in the pond**

#### Standard Fertilization Schedule

The following standard fertilization schedule can be used with any of the fertilizers and rates recommended in the fertilization table.

- Make the first application of fertilizer one week after first liming.

- b. Make three more applications at three-week intervals.
- c. Continue applications at monthly intervals or whenever the water clears enough that a white disk attached to a yardstick is visible to a depth of 18 inches.
- d. Stop applications when there is excessive growth of plankton.

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.

- Apply available animal manure to your fishpond at a rate of 50 g of dry matter per m<sup>2</sup> per week. This is equivalent to 5 kg/100 m<sup>2</sup>/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.
  - ✓ Set sacks filled with manure to float within the pond and shake them daily to allow nutrients to leach out and enhance water fertility.
- 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.
  - ✓ Apply DAP (di-ammonium phosphate) and UREA to your fishpond at the following rates:
    - DAP: 2 g/m<sup>2</sup>/week (or weekly applications of 15 tablespoons DAP for every 100 m<sup>2</sup>)
    - UREA: 3 g/m<sup>2</sup>/week (or weekly applications of 30 tablespoons urea for every 100 m<sup>2</sup>)
  - ✓ 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.

- Avoid applying too much fertilizer to your pond, however, as this can lead to water quality problems as well as higher costs for you.

Once the pond is fertilized with animal compost, or animal manure or inorganic fertilizer the water will start turn green within a week. If the pond is fertilized with plant material it will take one week or more.

#### **f) Disinfecting the pond**

It's very important to disinfect the pond for preventing fish from getting diseases and getting high fish productivity.

Besides the limestone, some another materials can also be used for disinfecting the fishponds.

There are three methods of pond disinfection: -

- Using quick lime to sterilize the pond without water.
- Using quick lime to disinfect the pond with water.
- Using bleaching powder to sterilize the pond with water.

After deciding on the site or location and design of fish pond the pond's shape size and depth has to be determined

### **3.3.2. General principles of undertaking fish farm**

Good management Equals Successful culture and High yields of Fish, therefore:

- It is a good idea to pay at least one visit a day to the ponds in the morning if possible another visit to be made in the late afternoon to have full control. Hence, the following points should be checked every day.
  - ✓ Check the water level and see that no water is running through the outlet. If there is any leakage repair it.
  - ✓ Carry out necessary daily feeding after checking the food is eaten.
  - ✓ Watch them carefully to see that they are healthy & swimming strongly.
  - ✓ If you find any dead fish floating in the pond, take them out, and investigate the causing factors and change some of the water with new water, this is the first measure to be taken. Again if the fishes are coming to the surface and gasping for air, these is due to shortage of oxygen then add some water.
  - ✓ Avoid if any weeds are growing in the pond.

There are certain management aspects that are undertaken weekly or monthly

- Add some manure as fertilizer every month to maintain high fish productivity by growing natural food of fish.
- Add some amount of Limestone every month to reduce disease incidence and to kill parasites of fish.
- Weekly release some water and let water into the pond slowly, never make like a fall.
- When the fishes reach market size about one year of age drain some of the water and harvest them with the appropriate net.
  - ✓ Generally speaking, strictly following appropriate management
  - ✓ Practices help the fish farm run profitably by raising (growing) large amount of fish by the most economical means.

### **3.3.3. Reason of farming fish**

Why fish are farmed?

Nowadays there is an increasing population pressure throughout the world with a steadily increasing demand for protein. This forced people to exploit the natural resources of the aquatic environment, mainly fish which is the largest single source of animal protein and the fastest growing food commodity from natural or artificial water bodies. Thus, the reason why fish are farmed is summarized as follows;

- Fish are a high-value, marketable product used to generate high income even at the subsistence level.
- Fish is primarily used as food. From fish one can get abundant nutrients such as proteins, fats, vitamins and minerals, for this reason. Fish protein is described as first class protein.
- Fish farming could be integrated with livestock and crop production sectors that can help for efficient utilization of our resources.
- Part of the fish is used for the preparation of fish meal which is the best source of animal protein for ruminants & poultry.
- Fish farming is the best alternative because the exploitation of fish from natural water bodies is becoming less and less profitable.

### **3.3.4. Type and size of fish culture**

Culture systems found in Africa include semi-intensive and intensive culture of Nile tilapia (*Oreochromis niloticus*), African catfish (*Clarias gariepinus*), and common carp (*Cyprinus*

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*carpio*). The species used at any given site are commonly found in the region and more or less appropriate to the agro-climatic zone. They are warm water fish species and are mainly cultured in a freshwater environment.

Desirable characteristics for cultured fish species include:

- Ease of reproduction
- Attainment of market size prior to reaching sexual maturity
- Acceptance of supplemental and/or manufactured feeds
- Feeds low on the food chain, i.e., eats plant material
- Rapid growth
- Efficient feed conversion
- Resistance to diseases
- Tolerance to relatively high stocking density and poor environmental conditions
- Is highly desired in the marketplace.

There are two options in the production of fish in artificial ponds. These are starting with parent fishes and fish seed collection method

### **3.3.5. Stocking**

Stocking fish seed should be 120 seeds/m<sup>2</sup> until 20 gram weighs each fish then reduce the stocking rate to 30 young fish/ m<sup>2</sup> for growing from 20-60 grams usually this is at the age of 3 month. After this reduce the stocking rate 4 fish/ m<sup>2</sup> until marketable size is attained.

- It is usually expressed as the number of weight of fish per ha.
- The stocking density must be reasonable because it is inversely proportional to the quality of marketable fish under the same pond condition and culturing measures.
- The optimum stocking density for silver carp and bighead carp is 150000-180000 fry per 1000 m<sup>2</sup>; for grass carp and black carp 120 000-150 000 fry per 1000 m<sup>2</sup>; for tilapia 200 000-300 000 fry per 1000 m<sup>2</sup>.
- Lower stocking density rate will decrease yield and increase production costs though fry grows faster. Stocking density can be optimized with skillful farming and careful management.

## Common fish species

### A) Tilapia

- locally called '**koroso**' scientific name is *Tilapia nilotica* or *Oreochromis niloticus*
- It is the most common fish species in Ethiopia and has greatest commercial value in the market.
- Naturally found in Rift valley lakes such as Lake Ziway, Abiyata, Awassa, Abaya and Chamo and also in Lake Tana, Baro River cultured in small dams and reservoir of Wollo and Tigray.

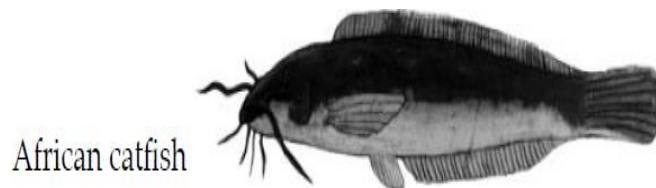


**Figure 3.6: Tilapia**

- Tilapia grows best in waters with a temperature range of 20-35°C.
- They can grow up to 500 g in eight months if breeding is controlled and food supply is adequate.
- Tilapia can reach sexual maturity at less in length two months of age or at 10 cm

### B) African Catfish

- Locally called '*Ambaza*' and scientific name is *Clarias gariepinus*
- Found in most Ethiopian Lakes and Rivers. Have good growth, and can survive poor quality water.
- Demand for African catfish (*Clarias gariepinus*), both for food and as bait in capture fisheries, has been increasing substantially.



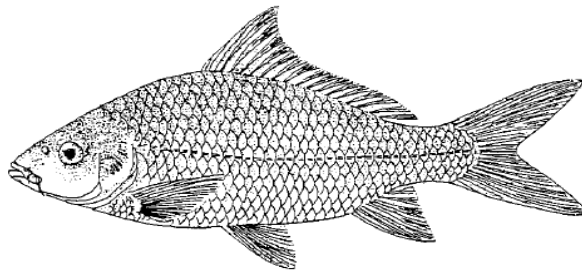
**Figure 3.7: Catfish**

- Catfish generally reach maturity at two years of age at a weight of 200-500 g.

- Females can produce between 10,000 and 150,000 eggs, depending on the size and age of the female. The main first foods are zooplankton and small aquatic insect larvae.
- Catfish are omnivorous or predatory, feeding mainly on aquatic insects, fish, crustaceans, worms, molluscs, aquatic plants, and algae.
- They find food by probing through the mud on the bottom of the ponds

### C) Common Carp

- locally called '*Duba Assa*' scientific name *Cyprinus carpio*
- It is the most cultured fish worldwide also found in Ethiopia and has greatest commercial value. Found in Lake Koka and Aba Samuel dam in Akaki imported and cultured in the above lake and dam.
- The common carp is a widely cultured strictly freshwater fish which can reach a length of about 80 cm and weight of about 10 to 15 kg.
- The temperature range is from 1 to 40°C while the fish starts growing at water temperatures above 13°C and reproduces at temperatures above 18°C when the water flow is increased suddenly.



**Figure 3.8: Common carp**

- Carp are usually mature after about 2 years and a weight of 2 to 3 kg. The female carp can produce 100,000 to 150,000 eggs per kg body weight.
- Growth rate is high in the tropics where the fish can reach a weight of 400 to 500 g in 6 months.
- The common carp is a hardy fish species and thus resistant to most diseases when environmental conditions are maintained properly.

### 3.3.6. Predator and disease control

Various animals including fish are harmful to fish cultivation so far as they either live upon the cultivated fish species or their eggs and fry, even compete them for food. To this category of fish enemies belong all groups of vertebrates as well as insects.

Depending upon the population of any of these a control becomes necessary as part of pond management. Some measures taken are as follows:

- Periodical drainage of pond
- Use of quicklime treatment to pond
- Destruction with quicklime or removal with scoop net of eggs keeps a control on multiplication of harmful amphibians.
- Use of traps is an effective measure against harmful amphibians, birds and mammals.
- Shooting when permitted is especially effective against harmful birds.
- Use of toxic substances is quite effective in certain cases. Notonectids (back swimmers) can be easily controlled by spraying an emulsion of various oils (mustard, castor, etc.) in washing soap with the ratio of 3:7 and at the rate of 66 pounds per acre of water surface.

#### Control of fish diseases in farm ponds

Diseases are caused by parasites and infectious pathogens. Disease can significantly decrease the productivity of fish farm by:

- Minimizing the productive & reproductive performance of fish
- Marketing is delayed due to slowed growth
- Increasing cost of production incurred for treatment. Due to the above effect of disease to the fish and fish farm. It is much better to prevent disease. “Prevention is cheaper than disease treatment”, and avoids lose due to poor growth and death.

#### Factors Affecting Fish Health

1. **Nutrition**- proper nutrition (feeding) is required for fast growth and to avoid nutritional deficiencies. Adequate nutrition enable the fish defend itself against diseases.
2. **Physical & environmental stress** – this increase susceptibility of the fish to diseases.

Some of physical & environmental stress includes:

- Very high or low environmental temperature
- Low dissolved oxygen content of the water
- Increase in acidity or alkalinity of the water
- High stocking rate (overcrowding)

- Very turbid water due to silt and/or waste from the fishes.
- Rough handling (poor management practice)

### **3.3.7. Harvesting and measuring fish**

As in any other type of farming the final phase in the fish farming cycle is the catching /harvesting and use or sale of the product. There are two ways that a farmer can harvest his product, he can either take out the whole population from a pond at the same time or he can selectively catch fish from the pond throughout the year. For this, different capturing techniques have been employed.

#### **A) Passive Fish Capturing Methods**

In these fish capturing methods catching is dependent on the movement of the fish. The fishes should move into the trap or net by themselves.

- **Fishing with Traps:** Fishes can be caught with simple locally made traps such as basket from bamboo made in conical shape. In this method it allows the fish to enter easily but prevent its escape by means of a valve net. Farmers put food inside to attract fish in the non- return valve trap .It is common in lake and rivers the fish are used for home consumption.
- **Gill Net:** The principle in this method is that if a net is hung in a pond or lake the fish will attempt to swim through the net by selecting the appropriate mesh size the farmer can make sure that any fish smaller than he wishes to harvest will swim through the net while the larger fish will get stuck. Fish are caught by the operculum (gill cover), and because of this the net is called a gill net, which rank first in tropical small scale fisheries.
- **Hook and Line (Angling):** The principle used in hook and line fishing is to offer the fish bait (food) fixed to hook and at the end of a line (rope) Which is attacked to a short bamboo or wooden pole. The fish while trying to bite the bait (food) swallows the hook and then gets caught. The bait may be small animals as earthworms, insects, small fish, and pieces of bread. With this method several hooks could be attached to a long rope fitted with float to catch more fish at one time.

#### **B) Active Fishing Methods**

In these methods the catching process involves the movement of the net than the fish. The net is moved by manpower to encircle a group of fish and bring it on the shore.

- **Seine Nets:** Seine nets are the most common and effective to collect all the fish in ponds. During Operation, one end of the net is fixed either by means of a stick or by anchoring to the bottom. The free end of the net is moved or pulled along to surround a certain area making a semicircle and finally brought to the fixed stick end( i.e. the starting point) the net is then dragged or pulled into the bank( dyke) enclosing the fish. This can be used in lakes one standing on the shore and other person standing on boat holding the other end and making a circle and then collect them.( This is the method mostly used in different Ethiopian lakes such as lake Ziway, Lake Tana, Lake Awassa.
- **Cast Nets** The cast net is thrown over a group of fish either from land as in ponds or from a boat. The net encircles the fish. The hand line (rope) fatted with lead (weight) and then slowly pulled closing the net, which is then lifted up with the fish.
- **Hand (scoop) Net:** This net consists of bag of netting materials with the mouth of the bag kept open by circular framing with iron fixed to wooden pole or stick. This method usually used to take out alive fish for sample from the pond.

Basically main methods used to harvest fish from pond are Seining and drain harvest;

#### a) Seining

Seining is a great way to harvest a large number of fish. It involves dragging a net through the pond, restricting the fish to a small area of the pond, and then taking the fish out of the pond into holding containers or tanks. Seining is normally done when the pond is going to be fully harvested or partially harvested.



**Figure 3.9: A Seining a small scale pond**

#### b) Drain harvest

You'd only do a drain harvest if you wanted to harvest the entire pond. Some ponds are specially built for drain harvesting. These ponds have an outlet valve and an outlet pipe. Opening the

outlet valve causes the water in the pond to drain out through the outlet pipe. In other ponds, the water is pumped out.

These ponds have harvesting basin at the bottom of the pond. The water drains away and leaves the fish in the harvest basin where they can be carefully netted or harvested. Drain harvesting is good for harvesting fingerlings.



**Figure 3.10: Harvesting a large pond with drag net operated from work boats. The net is provided with a mud line.**

Harvesting by complete and partial draining of the pond if the ponds are small and have convenient inlet and draining system and enough water resource, it is the best measures for harvesting by complete draining of the pond. The correct harvesting time should be determined according to marketable requirement and size and age of fish.

The following times are the best for harvesting:

- i. Good marketable price of fish
- ii. Size of fish just meets consumer's need (e.g. over 200g for tilapia; 0.5—0.6kg for common carp).
- iii. Age of fish has reached or surpassed the one of biggest growth speed or sexual mature.
- iv. Pond's other need.

Pond management after harvesting;

- Dry the pond bottom until the cracks
- Plough the bottom of pond
- Put lime on the bottom, wall and dyke of the pond
- Wait two weeks
- Add water
- Check the water quality

Handling fish after harvest

- Fish that have been harvested need to be transferred to holding containers or tanks as quickly as possible.
- Don't leave fish out of water for long or they will become distressed.
- Holding tanks must always be placed in a cool, shady area to prevent the water heating up.
- The water in the holding tank must have the same *pH*, *salinity* and temperature as the water in the pond that the fish came from. Otherwise, the change of water conditions will cause the fish to stress. Use pH test kit, oxygen meter, and thermometer during harvesting, so that you can check the quality of water in the holding tanks.
- Make sure there is always enough dissolved oxygen in the water inside tanks and other holding containers where you put the fish after harvest. Check the level of dissolved oxygen and *aerate* the water if necessary. Use oxygen cylinders during harvesting to aerate the water in holding tanks.

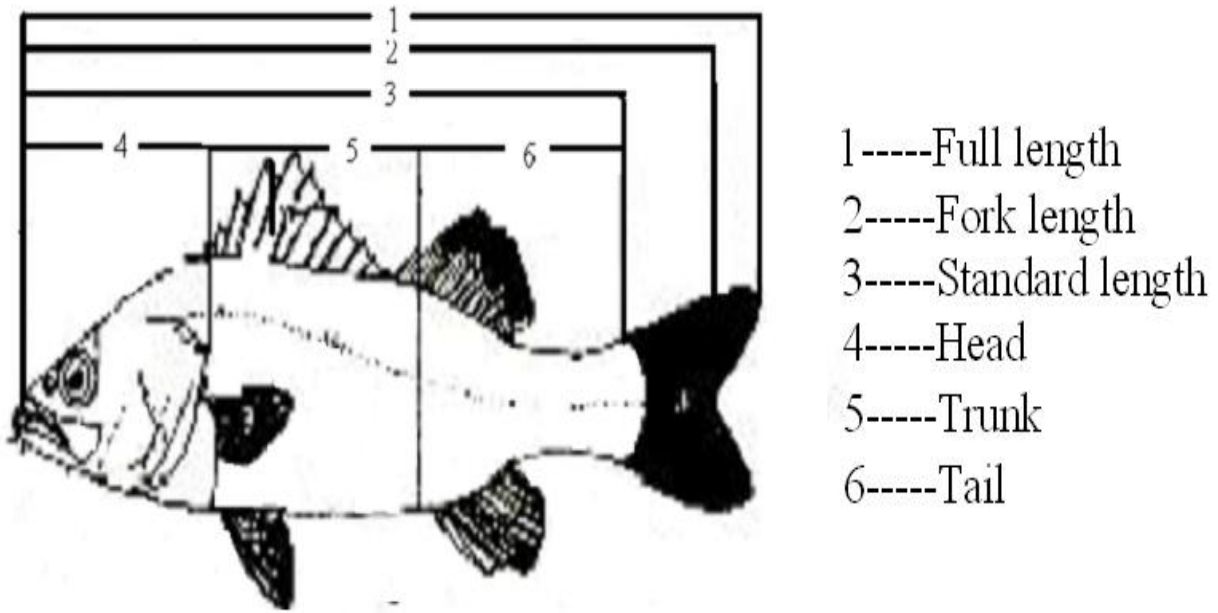
Mesh size of the net—means the size of each square parts of the net, usually for Tilapia species the recommended size is 10cmx10cm mesh size for larger species such as Nile perch the size could be increased

### 3.3.8. Measuring fish length

- **Total length:** This length represents the maximum elongation of the body from end to end.. For this measurement, mouth is kept closed and caudal fin squeezed/compressed. For forked fin, tip of the longer lobe is used.
- **Fork length or Ac length:** It represents the length of fish from the anterior terminal to the notch of the forked caudal fin i.e., the tip of the media fin rays. It is regarded as the most convenient length.
- **Standard length or A.D length:** It represents the length of the body from the tip of snout to the base of the caudal fin. This is the commonest length used for fishery work, head length, trunk length and tail length.

Standard length = head length + trunk length + tail length





**Figure 3.11: External feature of a perch**

### **3.4. Reporting problems or difficulties in completing work**

This title of content is similar with that of under LO4 of number 4.6 content, so please refer information that discussed under 4.6 for that of 3.4.

<b>Self-Check - 3</b>	<b>Written test</b>
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Name..... ID..... Date.....

**Directions:** Answer all the questions listed below.

**Test I: Short Answer Questions**

- What is the Select criterion of supplementary feeds?(2pts)
  - Of good nutritional values
  - Easy to handle and store
  - Cheap in price
  - Well accepted by the fish plan to feed
  - All
- What is the objective of feeding fish?(2pts)
  - To provide the nutritional requirements for good health
  - To optimize growth
  - To optimize yield
  - To optimize profits
  - All

**Test II: Short Answer Questions**

- What is the difference between liming and fertilization of pond? (2 points)
- What is the role of lime in fish culture? (3 points)
- Write some pond management activity after harvesting? (5 points)
- How do you control fish from disease and predator? (4point)

**Note:** Satisfactory rating – 9 points

Unsatisfactory - below 9 points

You can ask you teacher for the copy of the correct answers

### Operation Sheet -3

#### 3.1. Techniques in liming of fish pond

##### 1. Tools and equipment's

- Limestone
- Grinder
- Bucket
- Soap
- pH meter/strips
- Recording book
- Weigh balance

##### 2. Procedures/Steps/

- Select and wear personal protective clothing's.
- Arrange all necessary materials tools and equipment
- Use calcium oxide (CaO) called slaked lime or quicklime, and calcium carbonate (CaCO<sub>3</sub>) called chalk or limestone is used as the liming material
- Calculate the quantity of lime required.
- Weigh the liming material and convert it into powder.
- Take the powdered lime in a bucket and spread it evenly in the pond.
- Wash your hand thoroughly.
- Using quick lime to disinfect the pond with water.
- Add the lime until the pH of acid water to slightly alkaline (pH 7-8.5)
- Check the result of disinfecting pond with indicator fish or other aquatic creature after 7 days.
- Find out the pH value of the pond with the help of litmus paper or pH strips
- Clean work areas and dispose wastes

### **3.2. Techniques in fertilizing of pond with organic fertilizer**

#### **1. Tools and equipment's**

- Animal dung
- Urine
- Soil
- Green leaves
- Bucket
- Soap
- Weigh balance

#### **2. Procedures/steps**

- Wear PPE
- Arrange all necessary materials tools and equipment
- Use Faeces and urine of livestock and poultry, green manure, night soil, compost, and silkworm dregs.
- prepare compost bin inside the pond around the corner of the pond so as to pour the compost
- Apply this fertilizer with the proportional amount of the pond water
- Apply 10 -15kg/ 100m<sup>2</sup> for dry cow dung or 2-3 kg/m<sup>2</sup> poultry manure around the corner of fish pond
- Leave it at least a week
- Check and report changes on the pond

### 3.3. Procedures in filling of pond with water

#### 1. Tools and equipment's

- **Animal** dung or inorganic fertilizer
- Urine
- Green leaves
- Bucket

#### 2. Procedures/ steps

- Wear PPE
- Arrange all necessary materials tools and equipment
- Renovating and disinfecting fishponds
- Fill the freshwater into the pond.
- The water must be nontoxic.
- Base manures should be put into the pond.
- The dosage of base manure is 200 kg/ha for dry cow dung, or 6000kg/ha for fresh grass or another fresh manures.
- One week later, the pond water will be changed into green or brown color and plankton grow well.
- When filling the water into pond, at first one-third of water needed should be filled gently.
- Then other water can be added until the full of pond when the water color has been changed to green or brown.

### 3.4. Techniques in water quality measurement using pH

#### 1. Tools and equipment's

- pH meter

#### 2. Procedure/steps

- Wear PPE
- Arrange all necessary materials tools and equipment
- **Calibration**-Follow these steps to calibrate a pH meter:
  - ✓ Turn the meter on.
  - ✓ Connect the probe to the meter.
  - ✓ Place the probe in *buffer 7* solution and wait for the reading to stabilize.
  - ✓ Press the "Cal" button to enter the calibrate mode.
  - ✓ Press the "Con" button to set the meter to pH 7.
  - ✓ This method can be repeated for a buffer 4 and/or a buffer 10 solution.
  - ✓ Press the "Meas" button and Measure will appear on the display screen.
  - ✓ Rinse the probe with distilled water.
  - ✓ The pH meter is now calibrated and ready for use.
  - ✓ Measure the pH of the pond

<b>LAP TEST-3</b>	<b>Performance Test</b>
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Name: \_\_\_\_\_ Date: \_\_\_\_\_

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within 2 hours.

**Task 1-** Undertake liming fish pond

**Task 2-** Fertilize fish pond with organic fertilizer

**Task 3-** Undertake Water filling of fish pond

**Task 4-** Carryout water quality measurement using pH

<b>LG # 28</b>	<b>LO # 4 - Handle and clean material and equipment</b>
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**Instruction sheet**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Handling waste material
- Handling and transporting materials, tools and equipment
- Disposing disposable materials
- Cleaning maintaining and storing tools and equipment
- Maintaining clean and safe work site
- Reporting work outcomes and difficulties

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Handle waste material
- Handle and transport materials, tools and equipment
- Dispose disposable materials
- Clean maintaining and store tools and equipment
- Maintain clean and safe work site
- Report work outcomes and difficulties

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”



## Information Sheet- 4

### 4.1 Handling waste material

Waste materials produced during fish work may include;

- Waste water, chemicals, dead fish., aquatic weeds, pond mud and broken components
- Plant debris
- Plastic, metal and paper-based materials
- All these wastes will be either disposed according to industry work procedures or recycled or re-used or returned to manufacturer.

The proper handling of the things we throw away in a manner that does not harm anyone or anything, be it human, animals or the environment. Proper handling includes the collection, transport, processing, recycling or disposal of waste materials produced by human activity in order to reduce their negative effect on the environment. Unwanted materials or substances produced by human activity, which is usually referred to as rubbish, trash, garbage or junk i.e. waste.

Fish Waste - Large amounts of fish guts deposited in an enclosed area can produce foul odors and impair water quality through decreased dissolved oxygen and increased bacteria levels.

Waste handling techniques

- Provide facilities for fish cleaning and carcass disposal.
- Provide a stainless steel sink equipped with a garbage disposal that is connected to a sanitary sewer. (Note: fish heads, large carcasses, and fish skin will clog up the disposal.)
- Provide garbage containers for fish carcasses.
- Empty garbage containers regularly (especially on hot days).
- Prohibit fish cleaning outside of designated areas.
- Implement fish composting where appropriate.
- Use a grinder to make chum out of fish carcasses. Sell the chum at your store.
- Arrange for crabbers to take fish carcasses.
- Prohibit fish cleaning at your marina.
- Educate people on the water quality problems associated with excess fish waste in lake waters.

## **4.2 Handling and transporting materials, tools and equipment**

All the materials and equipment used in fish farming should be handled and transported according.

Good handling measurements are:-

- Provide sanitation services to the working devices after and before work
- Maintaining identification and selection of functional equipment from non-functional ones.
- Use safe and well organized storage for tools, equipment and materials.
- Use recommended transportation system as the transported materials nature.
- Make of care during loading and unloading of materials, equipment and tools
- Materials, tools and equipment's required to handle and transported properly.
- It requires using guidance for proper handlings and transporting.
- During transporting career should necessary for some fragile and toxic materials and equipment.
- Whenever we are going to our work area we have to handle and transport our equipment materials and tools safely. And also after completing our task we have to take them back to their place (store) safely without any damage on the equipment and ourselves by cleaning and maintaining if necessary.
- materials should handle in a good manner
- put the same material on the same area don't mix with other
- transport carefully for fragile and toxic material

## **4.3 Disposing disposable materials**

Materials should be returned to store or disposed according to the condition. After the accomplishment of task all necessary materials, tools and equipment must be stored properly or if there is need to be disposed should be done accordingly.

Remove waste from living area and dispose of according to facility policy and procedures (Note: Toxic gases such as carbon dioxide, hydrogen sulfide and ammonia may build up to lethal levels. Never enter storage tank unless absolutely necessary and then with professional assistance on site.) Utilize PPE. Select equipment appropriate for size and type of area to be cleaned.

Review safety procedures with supervisor and follow all safety guidelines. Provide maximum ventilation when store perishable materials.

## **Types of wastes and disposal methods**

The correct management of waste material such as waste water (also called effluent), stock feed and chemicals is an important part of successful ESD in aquaculture. Waste management should focus on: Managing and controlling waste water, Minimizing waste, Disposing of construction waste and Disposing of dead stock.

### **A. Managing and controlling waste water**

Waste water from aquaculture can come from ponds that have been drained, or from tanks and containers used to hold or keep stock. This water is usually rich in nutrients and chemicals that can have a negative effect on the environment, especially when it manages to drain into creeks and rivers. This can pollute natural waterways and wetlands, and may lead to the growth of poisonous blue-green algae.

### **B. Minimizing waste**

A good strategy for managing waste products is to minimize the amount of waste produced by stock. Use a high-quality diet and avoid overfeeding stock. Maintain correct stocking densities in all your ponds. Finally, if fertilizing ponds, avoid adding too much fertilizer as this can cause high nutrient levels in the effluent from ponds.

### **C. Disposing Dead stock**

The recommended method of disposing of dead stock is to bury the stock. Cover the dead stock with lime before you fill in the hole. Lime helps decompose the stock and prevent diseases from spreading. Make sure that any tools such as shovels, rakes, gloves, buckets, bins and nets that come in contact with the dead stock are washed and disinfected thoroughly.

Dead stock must be disposed of by either

- bagging it up and sending it to an authorized rubbish site
- burying it on site
- Incinerating it.

We have an area at the east of the farm for burying dead stock. All dead stock must be buried in this area.

When burying stock:

- dig a hole deep enough to allow a good covering of soil over the dead stock

- place the dead stock in the hole
- Spread lime over the dead stock before the dead stock is covered over with soil.

#### **D. Diseased stock**

Diseased stock that has died should be disposed of in a way that prevents the disease from spreading to other ponds and to the environment.

Remove diseased stock from ponds and place it in a suitable disinfectant such as chlorine, bag it and then bury it in the same area for burying dead stock. If the resources are available, incinerate the dead diseased stock on site.

Diseased stock may be buried in a suitable area that is away from the ponds, and the addition of lime to the stock will help prevent the spread of disease.

#### **E. Solid waste**

Solid waste from fish ponds will accumulate unless it is removed from time to time. Store the waste for use as fertilizer. When fertilizing crops, care must be taken to prevent excessive nutrients from *leaching* into the environment.

#### **F. Disposing of construction waste**

Any waste materials from construction work need to be disposed of properly or they can become both environmental and health hazards. A good strategy to control and dispose of construction waste is to collect all waste materials in one area, put them in a skip bin and have them removed.

#### **G. Disposing of poor quality (Spoiled) feed**

Never feed poor-quality food to stock. Where possible, poor-quality food should be bagged and removed from the site by a waste company. Alternatively, large quantities of poor-quality food can be buried. Never place large quantities of food in household bins.

Fish food that has gone off should not be fed to stock, as this may increase the chances of disease, due to nutritional problems or from toxins that may have accumulated. Waste feed should be bagged for disposal off-site or buried in a suitable area away from ponds.

Methods of disposing waste;

- recycling
- burning
- fermentation ( used as bio fuel)

Plan the placement or disposal of the material excavated from the pond in advance of construction operations. Adequate placement prolongs the useful life of the pond, improves its appearance, and facilitates maintenance and establishment of vegetation. The waste material can be stacked, spread, or removed from the site as conditions, nature of the material, and other circumstances warrant.

If do not remove the waste material from the site, place it so that its weight does not endanger the stability of the side slopes and rainfall does not wash the material back into the pond. If you stack the material, place it with side slopes no steeper than the natural angle of repose of the soil. Do not stack waste material in a geometric mound, but shape and spread it to blend with natural landforms in the area. Because many excavated ponds are in flat terrain, the waste material may be the most conspicuous feature in the landscape. Avoid interrupting the existing horizon line with the top of the waste mound.

#### **4.4 Cleaning maintaining and storing tools and equipment**

##### **4.4.1. Cleaning and sanitizing procedures**

Before and after work each materials, tools and equipment should be clean for the sake of the work and it is important maintain and store the material in a well manner.

In the cleaning and sanitizing of plant and equipment, the following 5 distinct operations shall be employed;

- Dry-clean
- Rinse with cold water to remove gross dirt and contamination.
- Rinse with warm water containing a detergent, preferably heated from 40°C to 50°C.  
Rinse off with warm water.
- Sanitize by steaming, immersion in hot water, or rinsing with a sanitizer preferably heated from 40°C to 50°C.
- Rinse off with warm water before processing recommences.

Standard cleaning procedures shall be developed for use in the various stages of the catching and processing line. Where practicable the effectiveness of routine cleaning shall be checked by periodic bacteriological sampling.

Cold water, preferably under pressure, shall be used for the preliminary rinse

Cleaning is the most important stage in the whole operation. All possible aids including warm water 40°C to 50°C, soap or synthetic detergents, scrubbing or high-pressure sprays shall be used. The choice of detergent depends on the type of dirt, the nature of the surface, and the degree of hardness of the water being used. Such detergent shall be of an approved non-tainting type. After scrubbing, hot water shall be used to rinse off remaining dirt and excess detergent. This is necessary as detergent neutralizes any sanitizers.

- Cleaning refers to removal of matter from a surface on which it is not acceptable. Soil surface should be contact with a cleaning agent for adequate time and sufficient pressure should be applied, if required, to remove the soil.
- Cleaning involves two steps: wash step and rinse step. Equipment should be carefully selected and, washed, and maintained before they can be sanitized
- Use kaizen principles

#### **4.4.2. Return Materials to store**

Working materials, equipment and tools are necessarily give proper service up to their service has not affect the fish production potential negatively according to supervisor instructions.

Materials have to be described by:

- Specification level (for equipment, tools and materials)
- Ingredient composition (for lime, fertilizers, feed, chemicals...etc.)
- Date of production and expired date
- Usage and storage instructions
- Disposal instructions; therefore, users should be use the materials and devices according to guidelines that described manufacturers as well as supervisor's instructions. So that functional equipment and tools should be cleaned, return to storage place and dispose non-functional ones properly after each activities accomplishment.

#### **4.5 Maintaining clean and safe work site**

Whatever the work, the working environment should be free of hazards that make problems both on workers and the products getting from the farms. Fish farming area should be free from sharp materials, dry and wet wastes, rusted metals, rusted and damaged equipment, unwanted bushes, wild fire, suspected flood, dangerous reptiles (snakes, crocodiles, etc.) and other enemies of both workers and fishes.

The major waste that makes difficulty in and around fish pond is the cut of harvested fish and feed remaining. Therefore, fish producers give great concentration for waste management program by thinking over the workers as well as the dwellers surrounding the fish ponds.

A good workplace housekeeping system will provide for proper inspection, maintenance, upkeep and repair of tools, equipment, machines and processes. Tasks and the equipment required to carry them out should also be set up in a fashion that minimizes the number of times items have to be handled.

Poor workplace housekeeping can often lead to workplace injuries from:

- being hit by falling objects
- tripping over objects on the floor, stairs and platforms
- slipping on wet, greasy, dirty or icy surfaces
- hitting projecting items and stacked materials
- cutting, puncturing or tearing the skin on projecting nails, wire, etc.

General guidelines in maintaining the work area;

- All dead stock must be removed from ponds and buried as soon as possible.
- Fuel must be stored away from other chemicals, food and holding tanks.
- Always tighten the caps and tops of chemical containers after use.
- Mop up all spills immediately.
- Store oxygen containers in their racks. Always keep oxygen containers away from fuel and chemicals.
- Check baits and traps regularly and dispose of any kills properly.
- Waste water is transported to the settling pond.
- Waste must be handled properly; otherwise the environment may be damaged.

## **4.6 Reporting work outcomes and difficulties**

Reporting of work outcome started from recording. As a fish farmer, your main objective is to earn money by selling fish at a profit. To understand why you are getting good or poor results, you will need to keep complete and accurate records of everything that goes on at your farm.

As a commercial fish farmer, your main objective is to earn money by selling fish at a profit. To understand why you are getting good or poor results, and more importantly whether or not you are making a profit, you will need to keep complete and accurate records of everything that goes on at your farm.

### **i. Record**

Records are sets of information that have been systematically and carefully collected and appropriately stored for a specific purpose. To be able to run any economic enterprise successfully, carefully thought out and properly collected records are a must. Comprehensive record keeping will assist both in tracking farm activities and expenses and in assessing the level of investment, the motivation of the investor, and the management skills of the farmer.

### **ii. Importance of record keeping**

Maintaining good records helps you with the following:

- Tracking the activities of your enterprise
- Tracking the expenses of the enterprise
- Monitoring the performance of the enterprise
- Evaluating the performance and operations of the enterprise
- Making decisions about improving operations
- Keeping institutional memory of the enterprise

Good records will, for example:

- Be useful in projection of expected production
- Help in determining the amount of inputs required for specific ponds at various stages of fish production
- Help determine the expected harvesting time
- Determine the economic health of the enterprise

Important aquaculture parameters for record keeping

- Pond identity
- Total area under culture
- Fish species stocked



- Sources of seed
- Stocking densities and time
- Kinds, quantities, and costs of inputs
- Daily events
- Fish production in amounts and values
- Production of other farm crops and their values

### **iii. Classification of fish farming records**

Fish farming records can be classified into:

- Fish farming biological management records, e.g.:
  - ✓ Specific pond production (quantity and value), by species
  - ✓ Stocking details for each pond (species and numbers)
  - ✓ Harvest details for each pond (species, numbers, and weights)
- Financial management records such as:
  - ✓ Purchase of inputs, including quantities and costs
  - ✓ Records of input usage, e.g., feeds and labour
  - ✓ Costs of labour, including the type and duration
  - ✓ Costs of new construction or repairs
  - ✓ Salaries, both in cash and in kind
  - ✓ Sales records, including what was sold, quantities, and prices
  - ✓ Inventory of equipment
  - ✓ Costs of renting or hiring equipment, machinery, services, etc.

<b>Self-Check – 4</b>	<b>Written test</b>
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Name..... ID..... Date.....

**Directions:** Answer all the questions listed below.

**Test I: Short Answer Questions**

1. Write waste handling techniques? (5 points)
2. Write some toxic gases. (5 points)
3. Write methods of disposing waste. (4 points)
4. Write two steps of cleaning? (2 points)

**Note:** Satisfactory rating – 8 points

Unsatisfactory - below 8 points

You can ask you teacher for the copy of the correct answers

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