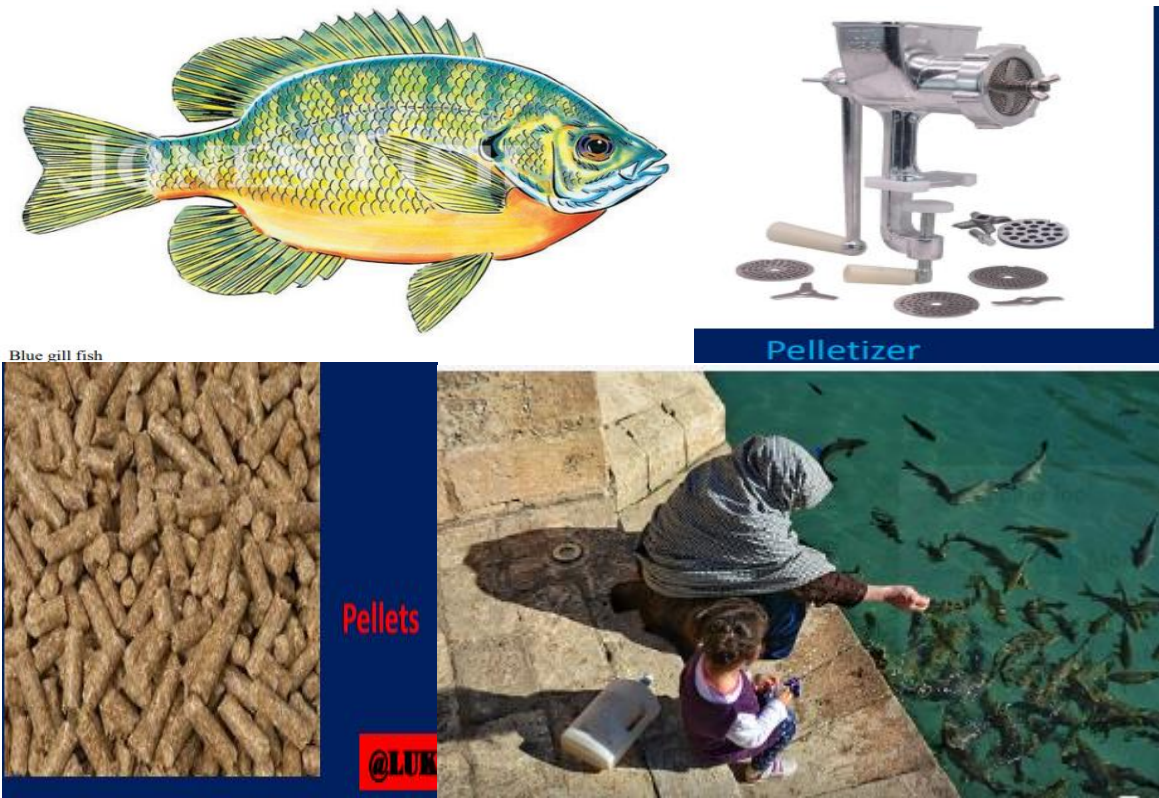


# FISHERY AND AQUACULTURE

## Level – II

Based on July 2022, Version- I Occupational Standard



**Module Title: Performing Fish Feeding**

**LG Code: AGR FAQ2 M02 LO (1-4) LG (7-10)**

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## Introduction to the Module

This module of compliance focus on the required knowledge, skills and attitude to identify sources and types of feeds, prepare for feeding, perform feeding and clean up on accomplishments of the work. Fish is an aquatic-vertebrate cold-blooded animal that breathes oxygen by means of gills and utilizing the dissolved oxygen, moves and keep balance by fins, reproduce by laying eggs and its body covered by skin and scale.

**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.

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

**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.

### Importance of fish farming

- For income generation
- For employment/job creation
- To satisfy nutritional needs
- For food security and health
- To supplement dwindling production of capture fisheries
- For trade (local/global)
- To enhance use and benefits from land and water resources

## LG # 7

## LO # 1 Prepare for feeding

### Instruction sheet

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

- Identifying Tools, materials and equipment
- Types of fish feed
- Occupational health and safety (OHS)
- Fish species and stock

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 Tools, materials and equipment
- Types of fish feed
- Occupational health and safety (OHS)
- Fish species and stock

### 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 Tools, materials and equipment

Fish feeding require some essential materials, tools, equipment and facilities which are used for varies purposes. Such equipment may be used for maintenance and repairs, monitoring and maintaining water quality 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 and feeding.

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

- Automatic feeders/ feeding Machine
- Fertilizer
- Buckets/Basket
- Weighing balance
- Thermometer
- PH meter
- DO<sub>2</sub> meter
- Sack
- Wheelbarrow
- Spades, forks, rakes and hoe
- Spray equipment etc.
- Feed blowers
- Feed dispensers
- Demand feeders
- Wooden ladle with long handle,
- Litmus paper
- Conductivity meter
- Secchi desk
- Ammonia and Nitrate test Kits
- Plankton nets
- Loaders and vehicles
- Barrel

### 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 down how it works;

### 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:**
  - Turn the meter on and inspect the probe for damage.
  - Place the probe in a holder that contains a sponge which has been moistened with distilled water.
  - Allow time for the probe to "warm up" and for the air in the probe holder to become saturated with water vapor.
  - Set the altitude on the meter.
  - The probe will now be calibrated to 100% saturation.
  - Set the salinity of the water sample that you want to measure on the meter.
  - Put the probe into the water sample and gently move it from side to side.
  - 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.
- j) place the probe in the sample to be measured
- k) wait for a stable reading to appear on the meter
- l) Record that reading.

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.

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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:

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- 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:

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

## A) 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 millimeters (mm). It is used to measure the length of fish or crayfish.

## B) 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 1.9. 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 center 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 1.10. Water pump**

## **D. Fish feeding equipment**

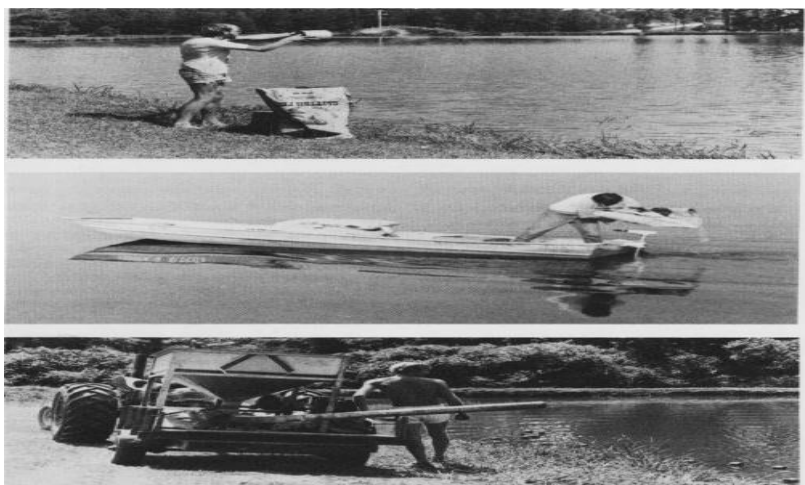
There are advantages and disadvantages to machine feeding and hand feeding.

### **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 behavior and health of your stock
- feed more or less depending on the behavior 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.



**Fig. 1.11. Fish feeding structures**

## **B. Machine feeding**

### **I. Feed blowers**

A feed blower is only a tool to simplify hand feeding (Fig. 1.12). There are different blower types based on the ‘carrier’ used for the feed particles which is normally either air or water. The feed can either be sucked up from a tank or a bag by vacuum, or the feed can be filled into a hopper standing over a pipe with flow of air or water. The hopper can be fixed on a boat or be movable.

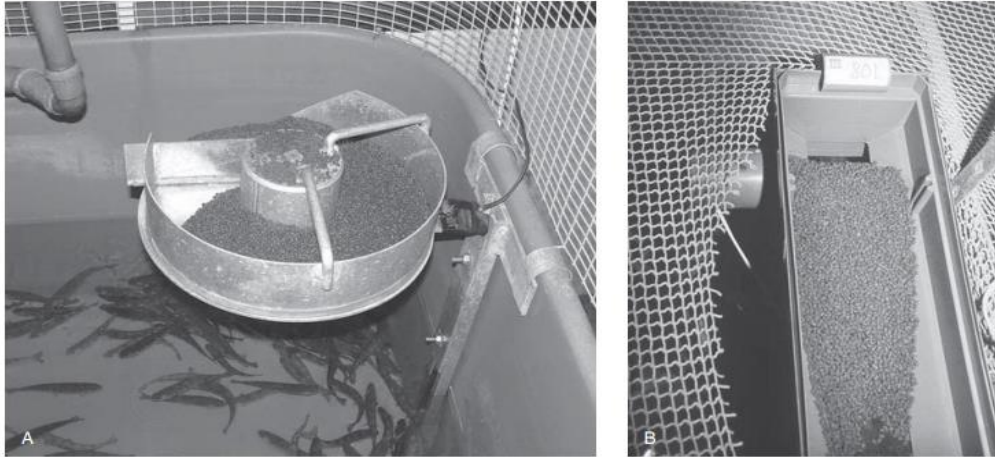


**Fig 1.12. A feed blower being used to simplify hand feeding.**

### **II. Feed dispensers**

A feed dispenser is often confused with a feeding machine, but does not have the distribution unit. Actually it is therefore something between a feed machine and hand feeding. A weighed portion of feed is placed on the dispenser and the dispenser will empty it during a fixed period, normally from one to three days. It either goes continuously or stepwise controlled by a control unit. To get the wanted feed ration, the actual amount of feed must be put in the dispenser. This is normally weighed out.

A great advantage with the feed dispenser is its simple and robust construction. It is also easy to monitor visually whenever it is functioning and the amount of feed that has been dispensed. The construction is favorable to use in research operations because if you weigh out the feed exactly you can be sure that the dispenser will supply the exact amount to the fish. The great disadvantage, compared to a feeding machine, is that it takes quite a long time to measure and/or weigh the feed that should be placed in the dispenser.



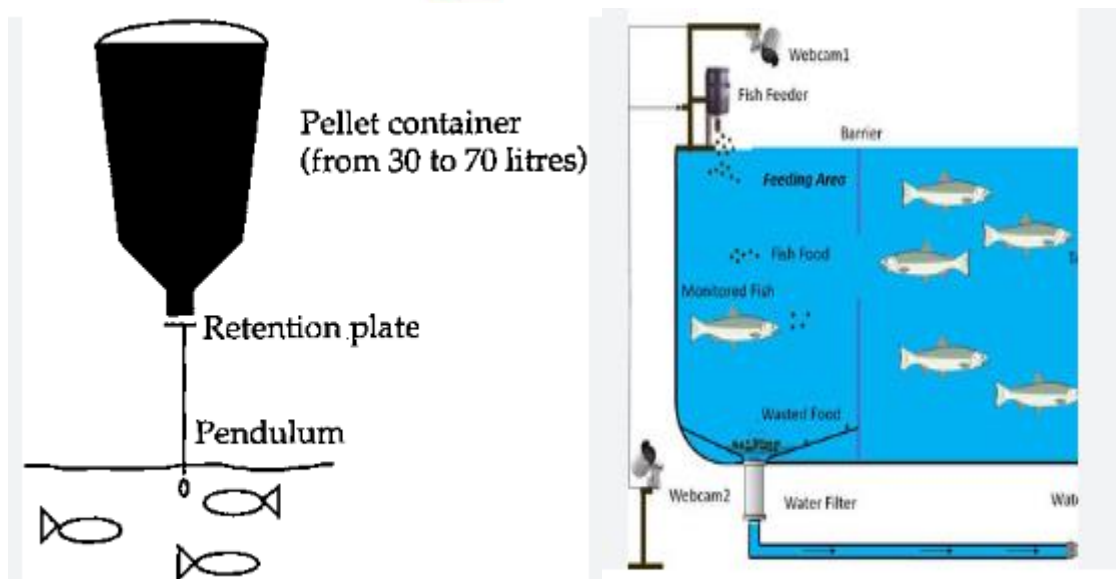
**Fig 1.13. Typical Feed dispensers: (A) Disc feeder (B) Conveyor belt feeder.**

Several designs of feed dispenser are used (Fig. 1.2). In a disc feeder a scraper rotates on a horizontally fixed circular plate, and the feed falls off the edge of the plate and into the fish tank. A disc dispenser needs electricity to run the motor, normally 24 V a.c. The feeder normally goes step-wise, controlled by a unit that regulates the start and stop intervals. Another much used construction is a rubber conveyor belt that is dragged along on rollers. When starting, the belt is dragged back-wards so it creates a surface where feed is supplied. The end of the belt is fixed to rollers; when these rotate the belt will be dragged up and the surface where the feed is lying will gradually be decreased so that the feed falls off and into the fish tank. This type is either powered by electricity or by clockwork. An advantage with this type of feed dispenser is the possibility of running it without electricity. Feed is either dispensed continuously or stepwise.

## **II. Demand feeders**

A demand feeder is normally a mechanical construction. A stick is attached to a slightly bowed plate sitting under a feed hopper (Fig. 16.3). The stick goes from the feeder down into the water. When the fish touch the stick, feed will be dispensed from the hopper. At the end of the stick is a knob, or something similar, which the fish touch. A great advantage with using demand feeders is that there is no need for an electricity supply. Furthermore, the design is simple with few moveable parts.





**Figure 1.14. The fish operate a demand feeder when they move the stick hanging down in the water.**

The fish operate the demand feeder themselves, and can therefore theoretically be fed according to appetite (*ad libitum*). However, some feed loss has been registered. The fish may use the demand stick as a toy and feed may be lost; demand feeders are also sensitive to movements in the water, such as waves; wind may also affect the demand feeder so shielding may be included. Demand feeders are used for almost all species, even if some species, such as Atlantic salmon, are slow to learn the system. The fish need a training period to learn how to operate the system. Compared to hand feeding, both improved and less good growth results have been shown.

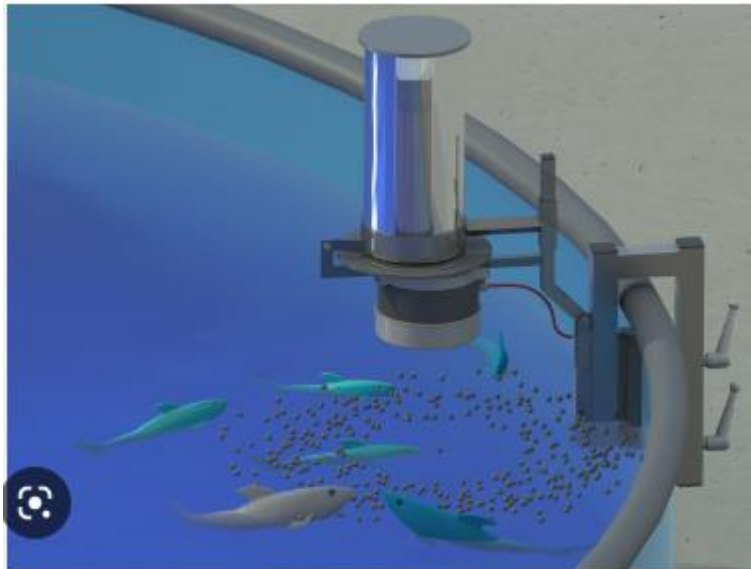
In electronic demand feeders feeding is triggered by electric signals. The mechanical stick is replaced by an electric cable with a pressure sensor at the end. When the fish touch this sensor a signal is given to the feeder which starts. This system allows extra control over the demand feeding, for instance by setting fixed interval for the operation of the feeder or by setting a maximum limit of distributed feed per portion or per day. A more advanced control system is, however, required in this type of feeder.

### III. Automatic feeders

A feeding machine or an automatic feeder consists of four major components (Fig. 1.4): a feed container (hopper), a mechanism for feed distribution, an electrical power supply for the distribution mechanism and a control unit for starting and stopping the distribution mechanism.



The feed distribution mechanism is the main component in an automatic feeder and distinguishes it from a feed dispenser. The feeders are fixed in a rack on the tank or on the cage, but may also be included in a buoy. When using an automatic feeder, the amount of feed that has to be distributed over a period of time is known and the distribution unit runs for the period that satisfies this requirement.



**Figure 1.15. An automatic feeder**

Feed is distributed by volume. In specially designed and more expensive feeders, the systems may also use feed mass. When using volume for distribution, the volume: mass ratio (litre/kg), i.e. the density, of the feed must be known. The density of the feed varies with formulation, from producer to producer, and also depends on the size of the feed particles. Because volume distribution feeders only distribute a certain volume of feed, and the in mass feed is of interest, calibration of the feeders is necessary. To calibrate the feeder, it is run for a known time period; then the exact amount of feed that has been dispensed is weighed so that the feed distributed per unit time can be calculated. This information is then used to find the necessary time that the feeder has to run to distribute a certain mass of feed.

### **Example**

A fish tank requires 3 kg feed per day. For how long must the feeder be run to deliver this amount? First the amount of feed delivered from the feeder per unit time must be found. The feeder is run continuously for 1 min and the amount of feed delivered is weighed and found to be 1 kg. The feeder is there-fore delivering 1 kg/min; to deliver 3 kg to the fish tank, the feeder must be run for a total of 3 min per day.

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If the feeder starts every 30 min throughout the day and night, it starts 48 times in total. Each time it must therefore run for:  $3 \text{ min} (= 180 \text{ s})/48 = 3.75 \text{ s}$ .

#### IV. Fish feed pelletizer

Twin screw fish feed extruder, also called floating fish feed machine, is widely used for producing high grade aquatic feed pellets for fish, catfish shrimp crab lobsters ... etc. we have two types of fish feed extruder, dry and wet type model fish feed machine, through feeding materials extruding forming, filling, and cutting drying oil spraying packaging to produce floating and sinking fish feeds pellets automatically.

This production line can greatly improve the production efficiency and quality of fish feed, promote the growth of fish and the best choice for farm breeding.



**Figure 1.16. Fish feed pelletizer**

##### 1.2. Types of fish feed

**Food:** is any substance consumed to provide nutritional support for the body.

**Feed:** - feed is defined as the mixture or compound of various ingredients which accomplish the nutritional requirement of any organism.

**Moist feed:** - These feed contains the level of moisture is 35 – 75 % Semi moist feed: - This type of feed contains 12 – 35 % moisture level.

**Dry feed:** - The moisture level in this type of feed 4 – 12 % but not zero.

**Food habits** mean the type of food which the fish eat.

**Feeding habits** means the behavior of nutrition, or the way by which the fish obtain the food.

**Phytoplankton's** are microscopic marine algae. Phytoplankton provides food for a wide range of sea creatures. They contain chlorophyll and require sunlight in order to live and grow

**Zooplankton** is very small animals that float near the surface of water and on which other sea creatures feed.

Feeding 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 feeds 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 fertilizers.

#### 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 e.g. 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

### 1.3. Occupational health and safety (OHS)

The Occupational Health and Safety Program is designed to inform individuals who work with animals about potential zoonoses (diseases of animals transmissible to humans), personal hygiene, and other potential hazards associated with animal exposure.

Hazards in the work environment need to be removed or mitigated to prevent unfavorable health exposures. Conflicting objectives in the production process may lead to work pressure for workers. Organizational factors that could improve individual work conditions are avoidance of long working hours and ensuring adequate rest between shifts. Workplace risk levels may be influenced by the design of fish farms and equipment, and hence occupational health and end user needs should be properly considered in technology development.

#### 1.3.1. 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

### b) 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 1.17: 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.

### c) 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 1.18: Gloves**

**d) 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 1.19: Boots**

**e) 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 1.20: Goggles**

#### f. Respirator

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



**Figure 1.21: Respirator**

#### There are two main types of filters:

Charcoal filters that remove dangerous odors.

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.

#### g. Overalls

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 1.22: Overalls**

f) **Life jacket:** are designed to **keep you afloat in water**. They will automatically turn you into a face-up position, keeping your mouth and nostrils clear of the water to prevent the risk of drowning.



**Figure 1.23: Life jackets**

### 1.3.2. 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.

### 1.3.3. Providing work support to OHS requirements

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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:

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

## 1.4. Fish species and stock

### 1.4.1. Stocking

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.

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.

#### 1.4.2. Fish species

##### Common fish species

The Nile tilapia (sc. Name *Oreochromis niloticus*), African catfish (*Clarias gariepinus*), Labeobarbus species (*Barbus* species), the common carp (*Cyprinus carpio*) and the crucian carp (*Carassius carassius*) are the most commercially important fishes in Ethiopian water bodies. Ethiopia's rivers and lakes are filled with many endemic species of barbels, catfish, loaches, and other fish.

##### 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.
- Nile tilapia is omnivorous, where phytoplankton, macrophytes, insects, detritus and zooplankton were the most important food items. The plant origin foods were the most dominant food item and the seasonal variation in the diet composition is not found in the water



Figure 1.24: Tilapia

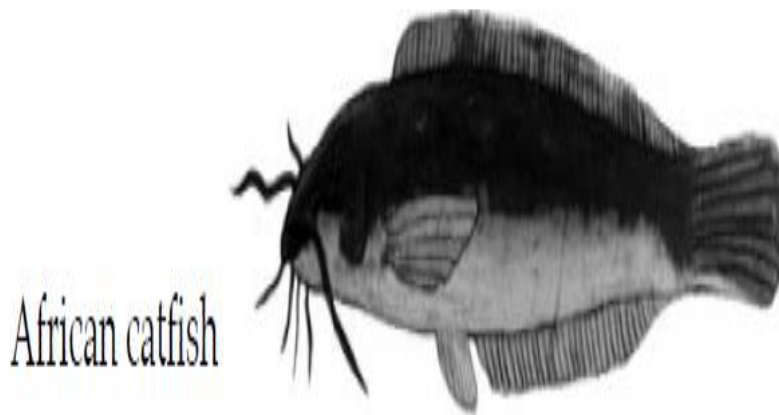
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- Tilapia grows best in waters with a temperature range of 20-35°C.
- They can grow up to 500 g in eight months if breeding is controlled and food supply is adequate.
- Tilapia can reach sexual maturity at less in length two months of age or at 10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

## B) African Catfish

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



**Figure 1.25: 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.
- During the dry month, fish, zooplankton, insects and detritus were important food categories, while during the wet month detritus, macrophytes, insects and gastropods were important. Smaller catfish diets were dominated by detritus, macrophytes and insects, whereas larger catfish shifted to fish and zooplankton.
- 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*. This kind of fish is found in a flaming gorge reservoir, Lake Mohave, Aral Sea, and more places.
- 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.
- Carp are omnivorous but feed primarily on plants. Adult carp feed on a variety of organisms including aquatic plants and seeds, insects, crustaceans, mollusks and fish eggs. Carp feed by sucking up mud from the bottom, spitting it back out and feeding on particles while they are suspended.



**Figure 1.26: 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.
- It is classified under Cyprinus. The body mass of this fish is about 2-14 kilograms. These are grown in freshwater lakes. Mostly found in water bodies in Asia and Europe. They can tolerate low oxygen levels.

- These are omnivorous. It can lay up to 300,000 eggs in a single spawn. This fish is taken as food by humans all over the world. The lifespan of common carp is until 47 years.

#### D. Goldfish (*Sc.name Carassius auratus*)

- The scientific name of goldfish is. It is classified under the higher classification of Carassius. It is mostly found in Utah Lake.
- It is an aquarium fish. This fish native is in East Asia. It was domesticated in China and later breeds have developed. Size of this fish is 19 inches.
- Goldfish has an ability of strong learning, social learning skills. Goldfishes are gregarious. They feed on insects and plants. Goldfish eggs hatch within 48-72 hours.
- Feeding behavior of goldfish includes a suctorial intake of food particles, a sorting stage where food is separated from nonfood within the oropharyngeal cavity, and a final stage involving either acceptance or rejection of the particles.
- Goldfish are gregarious, displaying schooling behavior, as well as displaying the same types of feeding behaviors.



**Figure 1.27:** Goldfish

#### E. The crucian carp (*Sc.name Carassius carassius*)

They are generally distinguished from crucian carp by their body color and shape, and the appearance of the back, tail, anal fin, head, eyes, scales, opercula, and nares film. One of the more recognizable features of the goldfish is the bifurcated tail. In contrast, crucian carp have an undivided tail.

This fish is considered to have a mainly omnivorous feeding habit. The major food items ingested were insects when the size of the fish is increase. However, the importance of phytoplankton and zooplankton tended to decrease where as that of insect tended to increase with the length of *C. carassius*.



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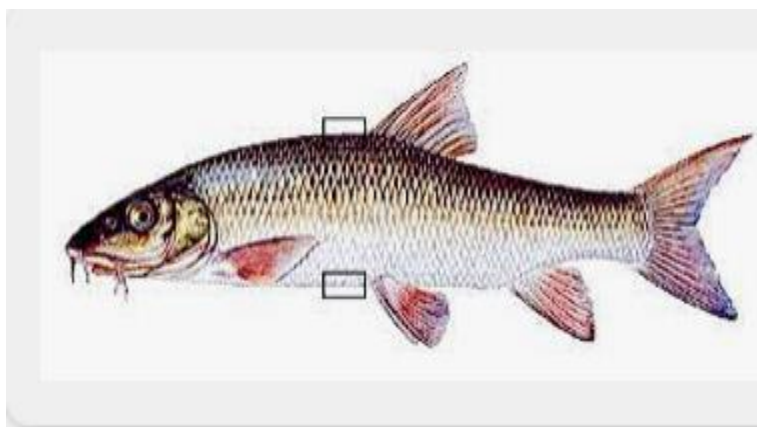
The Crucian Carp (Carassius Carassius) Is A Me...

**Figure 1.28: The crucian carp**

**F. Labeobarbus species** (*Sc.name Barbus species*)

Barbus is a genus of ray-finned fish in the family Cyprinidae. The type species of Barbus is the common barbel, first described as *Cyprinus barbus* and now named *Barbus barbus*.

Commonly called as Minnow or carp. Body of the fish is covered with large scales and is divided into head, trunk and tail. Head has an upward mouth without inner fold, small barbels, large eyes without adipose eye lid and devoid of scales.



**Figure 1.29: The Barbus fish**

Detritus, macrophytes and insects were found to be the dominant food items in all size classes, whereas the contributions of ostracods, fish scales, zooplankton and phytoplankton were low.

Based on the results it can be concluded that *L. intermedius* was omnivorous in its feeding habits in Lake Koka.

|                |              |
|----------------|--------------|
| Self-check – 1 | Written test |
|----------------|--------------|

Name..... ID..... Date.....

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

### Test I: Multiple choices

- Which one of the following factor/s is/are Importance of fish farming?
  - For income generation
  - To satisfy nutritional needs
  - To enhance use and benefits from land and water resources
  - All
- Which one is used to measure the turbidity of water in aquaculture?
  - Thermometer
  - Secchi disk
  - PH meter
  - Ammonia test kit
- Which is natural feed sources for fish feed
  - Zooplankton
  - Phytoplankton
  - Aquatic plants and fish
  - Insects
  - All

### Test II: Short Answer Questions

- Write the functions of pH meter and Dissolved oxygen meter?
- What is the purpose of putting hazard sign in work places?
- Write the reasons for artificial feeds suitability in fish farming
- Write the most common fish species in Ethiopian water bodies.

## Operation Sheet -1

### • Techniques of calibrating dissolved oxygen meter

#### a. Materials, Tools and equipment's

- ✓ Do2 meter
- ✓ Probe and its holder
- ✓ All necessary PPEs
- ✓ Water

#### b. Procedures/Steps

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

## Operation Sheet -2

### • Techniques of calibrating a pH meter:

#### a. Materials, Tools and equipment's

- ✓ Do2 meter
- ✓ Probe and its holder
- ✓ All necessary PPEs
- ✓ Water

#### b. Procedures/Steps

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

|                   |                         |
|-------------------|-------------------------|
| <b>LAP Test-1</b> | <b>Performance Test</b> |
|-------------------|-------------------------|

Name..... ID.....

Date.....

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

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within **2 hour**. The project is expected from each student to do it.

**Task 1:** Conduct calibration of dissolved oxygen meter.

**Task 2:** Conduct calibration of a pH meter.



## LG #8

## LO # 2 Identify Sources and Types of feeds

### Instruction sheet

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

- Fish feed sources
- Fish species feeding habits
- Artificial feeds
- Natural feed

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:

- Fish feed sources
- Fish species feeding habits
- Artificial feeds
- Natural feed

### 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. Fish feed sources

Fish feed is a major expenditure for fish farmers. Good fish feed management can reduce overall culture cost, improve fish farm environment and ensure healthy growth of fish stock. Fish feed management includes choosing the right feed, using a correct feeding method, calculating the feeding cost and ensuring the cost effectiveness of fish farm.

Fish need feed to survive, grow and reproduce, fish need to feed on organic materials such as plants, other animals, or prepared feeds containing plant and/or animal material. It is therefore most important for you to ensure that your fish get the food they require, both in quality and in quantity.

Natural food 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. The most common sources of feed ingredients for aquaculture feeds.

Some feedstuffs for aqua feeds includes;-

- Fish offal
- Shrimp meal
- Animal meat waste
- Meat and bone meal
- Soybean meal
- Yeast

Some sources of dietary energy are corn, rice, bran, cassava and binders. Aside from carbohydrates, lipids are also used as sources of energy.

Most of the raw materials used in fish feed industry are plant based; corn, corn gluten meal, rice bran, wheat bran, sunflower seed meal, groundnut meal, cottonseed meal, linseed meal, copra meal and DORB (de-oiled rice bran).

#### Non-conventional fish feed resources

Non-conventional feed resources (NCFRs) are feeds that are not usually common in markets and are not the traditional ingredients used for commercial fish feed production. NCFRs are credited for being non-competitive in terms of human consumption and also cheap to purchase. They come in the form of by-products or waste products from agriculture, farm-made feeds and processing industries, and they serve as a form of waste management for enhancing proper sanitation.

**NCFRs** include all types of feedstuffs, from animal and plant origin as well as waste products:

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- Animal sources, such as silkworms, maggots, termites, earthworms, snails, tadpoles, poultry by-products and feather meal
- Plant sources, such as jack bean, cottonseed meal, soybean meal, cajanus, duckweed, maize bran, rice bran, palm kernel cake, groundnut cake and brewers waste
- Animal wastes from animal sources and processing of food for human consumption, such as animal dung, offal, visceral, feathers, fish silage, bone and blood.

They are usually cheaper than conventional feeds and can be recycled to improve their value if there are economically justifiable and technological means (such as fermentation) for converting them into useable products. It must be noted that when using non-conventional feed, fish can be predisposed to toxic substances and even infections, so it is important to ensure proper treatments before feeding it to fish.

### **The right choice of feed**

The right choice of feed can increase culture productivity so there are things that need to be considered, including:

#### **a. High nutritional value and feed quality**

The nutritional value must be adapted to the needs of the culture. Feed must fulfill nutritional needs such as protein, fat, carbohydrates, and vitamins and minerals.

#### **b. Feed characteristics**

The shape of feed must be customized to the type, size, age, and mouth opening of the fish or shrimp. The feed should be easy to digest and not contain toxins that can cause illness or death in culture animals.

#### **c. Economic value**

The biggest cost in culture is the cost of feed. The easier the feed is to obtain, the less costs will be incurred, and vice versa.

## **2.2. Fish species feeding habits**

Feeds are used to increase fish yields and are especially beneficial when

- Maximum fertilization is not practiced;
- A pond does not respond well to fertilization
- Fish are stocked at high density in a pond
- Fish are confined in a cage, pen or other culture facility and

- Fish are held in tanks.

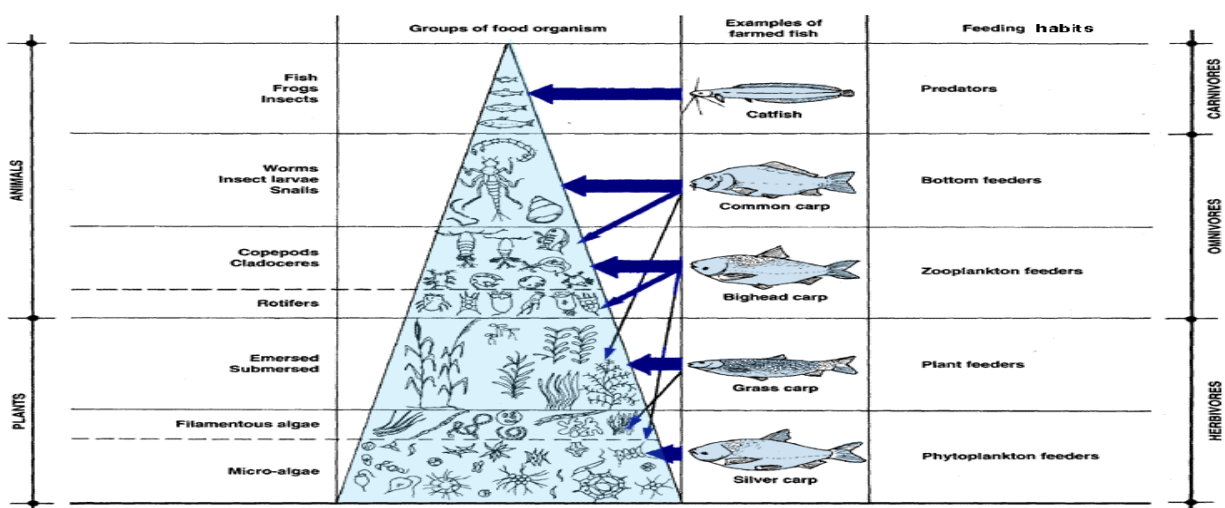
Generally, fish species have different feeding habits.

**Carnivores**, such as catfish, feed mainly on flesh foods, like fingerlings, crustaceans and worms in the water environment.

**Omnivores**, such as tilapia, feed on both plant and animal foods.

**Herbivores**, such as grass carp, feed mostly on plant materials.

**Limnivores**, also known as mud eaters, which feed mainly on algae and microorganisms in the pond bottom. These kinds of fish are constantly eating and can be fed both pellets and algae-based foods.



**Figure. 2.1. Groups of fish food organisms and feeding habit of fish.**

Most fish under culture are able to eat plant and animal food materials as well as supplementary feeds. In a poly-culture system, fish species can feed at different levels of the food chain in the pond. Tilapia is an example of a surface feeder and catfish an example of a mid-water feeder, while African bony tongue an example of a typical bottom feeder.

A fish culturist should take these feeding habits into consideration when planning pond stocking and feeding practices.

### 2.3. Artificial feeds

Artificial feed is made from a mixture of natural ingredients and artificial ingredients that contain nutrients which are then processed and shaped. Artificial feed has an important factor in fish culture, especially in the nursery and rearing process.

In artificial feed, the nutritional content can be adjusted to the needs, easily obtained or found and can reduce the risk of disease transmission because the feed is confirmed to have passed the test at the production site. Just like natural feed, artificial feed also has drawbacks such as

relatively higher costs compared to natural feed and lower water quality because it is more difficult to decompose. Forms of artificial feeds in fish feeding likes pellets, food flakes, crumbles, granular food and tablets.

**A. Fish Flakes** - The most common commercially available food comes in the form of flakes. The advantage of using flakes is that they float for a while (which helps the surface feeders) and then sink slowly as they get soft and saturated (which benefits the mid-water feeders). Eventually, flakes sink to where they can be eaten by the bottom feeders. Fish flakes are being manufactured in various compositions that address different fish requirements. Some flakes actually enhance the color of the fish while others flakes promote breeding. You can even buy flakes that are made to help sick fish. Flakes will probably always be the best food form for small fish and picky eaters.

**Feeding Tip:** Drop a pinch or two of fish flakes and observe the consumption rate of the feeders. You can then add a little more if it appears necessary. You may even need to reduce the amount in the next feeding if too much is left uneaten.



**Figure. 2.2. Flakes**

**B. Pellets** - Much like fish flakes, pellets are geared more towards surface feeders because they remain afloat longer than flakes.

**Feeding Tip:** Remember not to overfeed. Scoop up pellets that have sunk and remained uneaten.



**Figure 2.3. Pellets**



C. **Tablets** - Most tablet preparations can be stuck to the wall of the aquarium at any desired level. This makes it possible for you to address the special needs of all of the various fish in the aquarium.



**Figure 2.4 Tablet form of fish feed**

D. **Granular Food** – This type is best used for bottom dwellers because it sinks quickly.

Feeding Tip: Use granular food only when bottom feeders are not getting enough sunken flakes or other types of food. Granular foods are also ideal for nocturnal bottom dwellers since they need to be fed separately.

D. **Frozen and Freeze-dried Fish Food** – It is obviously much more convenient and safer to use this type of food than live food. Frozen or freeze-dried tubifex worms, brine shrimp, bloodworms (midge larvae), mosquito larvae, and water fleas (daphnia) are nutritious (they have the same nutrients as their live counterparts) and disease-free.

Feeding Tip: Fish do not always enjoy eating freeze-dried foods as much as live, frozen or natural foods. Give your fish time to get used to them. Be sure to use a weighted container when feeding bottom dwellers.



**Plate 3.** Fish feed pellets of 2 mm, 3 mm, 4 mm sizes.

**Figure 2.5. Forms of artificial feeds in fish feeding**



## 2.4. Natural feed

A variety of natural fish food organisms are found in a water body, which depends on the productivity of the water body. Natural feeds have high protein and fat content, which promote the growth of fish. Hence, it is necessary to increase the live food in the aquatic ecosystem to improve the growth of fish.

Natural feed has a high fiber content which is generally good for the digestion of fish/shrimp. Natural feed has an important role in the fish farming chain, especially in hatcheries.

Some of the fish natural food organisms include phytoplankton, zooplankton, annelids, worms, insects, molluscs etc. The natural food provides the constituents of a complete and balanced diet.

The demand of natural food varies from species to species and between age group of individuals. For example catla prefers zooplankton and silver carp prefers phytoplankton. At a younger stage; the fish may feed on plankton, and the same fish may prefer animal food.

Natural feed has the advantage that it is easier to digest, the price is relatively cheaper, it has more complete and high nutrition and the level of pollution in culture water is lower. However, natural feed also has drawbacks, namely it takes a longer time to prepare it according to needs, besides that natural feed is more at risk of disease transmission so that it can interfere with the culture process carried out.

### Some of the fish natural foods includes:-

d. **Live Food** – Most fish like to eat live food that's been harvested from ponds or homegrown in cultures. In fact, your fish will enjoy pursuing these natural, wriggling, elusive prey that are so similar to what they would hunt if living in more natural or wild habitats. Live food is also the most nutritious kind available. Starter kits can be purchased if you desire to breed your own white worms and grindal worms. Brine shrimp eggs are also available for hatching and feeding young fish.

Feeding Tip: When gathering live food from ponds and streams, be sure to rinse them free of dirt, predators, and dead specimens. Always be sure to scoop out uneaten live food before they die and contaminate the water.

b. **Vegetables** - Herbivores and omnivores will appreciate hand-chopped fresh vegetables. They prefer potatoes, peas, spinach, lettuce, chard, and zucchini.

Feeding Tip: Chop the vegetables into bite-sized pieces. Remove uneaten pieces promptly.

During meal time, try planting lettuce leaves as a special feast for your herbivores.

- c. **Food Scraps** - Human food scraps - such as bits of crumbled cheese, oat flakes, fish roe, wheat germ, raw (lean) meat, cow liver, cooked chicken breast, and hard-boiled egg - can be nutritious additions to the diet of your fish.

Feeding Tip: Remember to feed conservatively. Feeding kitchen scraps to your fish is just a novel way of adding variety to your fish community's feeding requirements.



**Figure 2.6. Types of natural feed of fish**

|                |              |
|----------------|--------------|
| Self-Check – 2 | Written test |
|----------------|--------------|

Name..... ID..... Date.....

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

**Part I Choice the Correct Answers**

- Which one of the following is a man-made source of fish feed?
  - Plankton
  - Artificial feed
  - Worms
  - Vegetable
- One of the following feeds are not usually common in markets and are not the traditional ingredients used for commercial fish feed production.
  - Pellets
  - Crumbles
  - Flakes
  - Non-conventional feed resources (NCFRs)
- Which one is best type of feed used for bottom dwellers because it sinks quickly?
  - Granular Food
  - Pellets
  - Tablets
  - All.

**Test II: Short Answer Questions**

- Write the consideration for right feed choice for aquaculture.
- Describe the feeding habits of fish.

| LG #9  | LO # 3 - Perform feeding |
|--|--------------------------|
| Instruction sheet  |                          |
| <p>This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:</p> <ul style="list-style-type: none"> <li>• Feeding requirements of stock species</li> <li>• Methods of Fish Feeding</li> <li>• Feeding schedule</li> <li>• Factors and condition affecting feeding</li> <li>• Optimum stocking density</li> <li>• Monitoring feeding activities</li> <li>• Condition of feeding operation</li> <li>• Feed storage</li> </ul> <p>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:</p> <ul style="list-style-type: none"> <li>• Feed requirements of stock species</li> <li>• Methods of Fish Feeding</li> <li>• Feed schedule</li> <li>• Factors and condition affecting feeding</li> <li>• Optimum stocking density</li> <li>• Monitor feeding activities</li> <li>• Condition of feeding operation</li> <li>• Feed storage</li> </ul> |                          |
| <b>Learning Instructions:</b>  |                          |
| <ol style="list-style-type: none"> <li>1. Read the specific objectives of this Learning Guide.</li> <li>2. Follow the instructions described below.</li> <li>3. Read the information written in the information Sheets</li> <li>4. Accomplish the Self-checks</li> <li>5. Perform Operation Sheets</li> <li>6. Do the “LAP test”</li> </ol>  |                          |

### Information Sheet-3

#### 3.1. Feeding requirements of stock species

Feed is one of the most important external signals in fish that stimulates its feeding behavior and growth. The intake of feed is the main factor determining efficiency and cost, maximizing production efficiency in a fish farming firm.

Fish usually feed to satisfy their energy requirements. The quantity of feed fish consume depends on various factors, such as appetite, feed quantity and palatability. All these factors being equal, a well-fed fish will grow well while a poorly fed fish will have slower growth and be prone to diseases. Farmers must supply fish under culture with a nutritious diet daily at the recommended rates.

In general, farming aquatic organisms is divided into intensive, semi-intensive and extensive. The difference depends on the degree of human intervention in their management, which gradually increases from extensive to intensive farming. This intervention can be quantified with the amount and quality of feeds provided the elimination of catabolites (substances produced by the process of catabolism) and the supply of oxygen in the farmed water. In recent decades, the nutritional requirements of farmed fish species, formulation of animal feed and management of animal feed have been the subject of much research. Standard nutritional requirements for fish are based on the lowest amount of nutrients necessary for good growth and health. These requirements vary with species and age.

**Table 3.1: Feed requirement of fish based on their body weight.**

| Fish wt<br>(grams) | Feeding rate<br>(%) | Fish wt<br>(grams) | Feeding rate<br>(%) |
|--------------------|---------------------|--------------------|---------------------|
| 1                  | 11.0                | 30                 | 3.6                 |
| 2                  | 9.0                 | 60                 | 3.0                 |
| 5                  | 6.5                 | 100                | 2.5                 |
| 10                 | 5.2                 | 175                | 2.5                 |
| 15                 | 4.6                 | 300                | 2.1                 |
| 20                 | 4.2                 | 400 +              | 1.5                 |

To achieve optimal growth and production, fish must be fed a diet that meets all their nutritional requirements. These are divided into six classes, carbohydrates, protein, fats, minerals, vitamins and water.

1. **Carbohydrates:** These serve as a source of energy in fish feed, but they are also used as binders. Carnivorous fish require fewer carbohydrates than omnivorous fish.
2. **Protein:** This provides limited energy, but it is important for synthesizing and building body tissues, growth maintenance, reproduction, enzymes and hormones, egg production, etc.

Table 3.2. Protein requirement of fish in different age groups.

| Protein requirement in freshwater |            |                 |
|-----------------------------------|------------|-----------------|
| Life stage                        | Weight (g) | Requirement (%) |
| First feeding larvae              |            | 45-50           |
| Fry                               | 0.02-1.0   | 40              |
| Fingerlings                       | 1.0-10.0   | 35-40           |
| Juveniles                         | 10.0-25.0  | 30-35           |
| Adults                            | 25-200     | 30-32           |
|                                   | >200       | 28-30           |
| Broodstock                        |            | 40-45           |

3. **Fats:** These provide fish with a large amount of energy, and they contain essential fatty acids needed for physiological processes.
4. **Minerals:** These are inorganic chemicals required for normal health and growth, and for controlling physiological processes.
5. **Vitamins:** These are organic chemicals needed in small amounts for normal health and growth, and for controlling body enzymatic processes.
6. **Water:** This is the universal solvent needed for all bodily functions.

The quantity of feed is important in aquaculture, as overfeeding has a lot of disadvantages. In the wild, fish hunt for food, but in the culture system farmers control the feeding frequency, feed composition and feed quantity to meet a desired production target.

Overfeeding leads to economic loss. Since feeding represents about 70% of the variable cost for a fish farm, it is not economically wise to allow feed wastage from overfeeding. Overfeeding predisposes the culture system to pollution and water quality problems. It can also predispose the fish to infection due to accumulated waste from uneaten feed and increased waste produced by fish that eat more than they need.



The amount of feed necessary in a pond, also called the feeding level or feeding rate, is usually the proportion of the biomass of fish in the pond. This amount is usually given in a percentage of biomass. For instance, see table below for their daily requirements

**Table 3.3. Feeding rate of fishes in different growth stage**

| Stage of fish | Rate of feeding/body wt. | Remark |
|---------------|--------------------------|--------|
| Larvae        | 8-10%                    |        |
| Fry           | 5%–7%,                   |        |
| Juveniles     | 3%–5%                    |        |
| grow-out fish | 2%–3%.                   |        |

It is important for farmers to estimate the volume of fish contained in their pond on a regular basis, either biweekly or monthly. This can be done through periodic sampling of anywhere from two to 50 fish to adjust the feeding level.

As an illustration, if a pond contains 200 kg of fish at the grow-out phase and the farmer feeds them 3% of their weight per day that amounts to 6 kg ( $200 \text{ kg} \times 3\%$ ) of feed in the pond per day. However, daily feed should be distributed across several meals, ideally three per day, though two is also acceptable.

### **Feed formulation and preparation of artificial diets using Pearson square**

Selection of food sources and preparation of pelleted fish feed:

- After procurement of raw materials, formulation of feed is essential.
- As per the nutritive requirement of the specific species, ingredients are mixed for preparing feed.
- To formulate a good feed, one must select commonly available good quality ingredients so as to make it palatable.
- The initial stage in feed formulation is balancing crude protein and energy levels by using Pearson Square Method (PSM)
- Besides protein and carbohydrates if fish requires additional vitamin-mineral mixture or any feed additive, then it can be included in the diet by reducing carbohydrate rich ingredients.

What is Pearson Square Method?

- It was first formulated by a British scientist Karl Pearson
- It is a useful tool for simplifying and balancing of rations.

- It shows the proportion or percentage or parts of two feeds to be mixed together to give a percentage of the needed nutrient or source of Protein, Carbohydrates etc.
- The amount or quantity of the crude protein or carbohydrates sources should be known first before mixing or formulation.
- Finally we have to set the target percentage of protein for the feed to be formulated.

How much amount of protein sources you need to mix together for making 25%, 30% 35%, 45% etc for 1kg or 200kg of feed for your fish?

# depending of the feeding nature of fish whether carnivore or omnivore or herbivore we should know the target protein concentration of the feed to be prepared according to the need of fish.

# Ornamental fish feed normally are prepared between 25-35% Protein concentration.

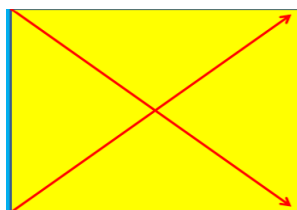
Let us do feed formulation by using Pearson Square Method by using two food sources of protein wheat flour (WF) and Fish Meal (FM).

Wheat flour (WF)= 13-14 % protein concentration (13%)

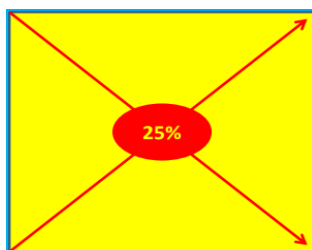
Fish meal (FM) = 40-50% protein concentration (50%)

Let us put 25% protein concentration as the target protein for the feed to be prepared. Let us say we are going to make 1kg of fish feed containing 30% of protein from the wheat flour and fish meal as main food sources of protein.

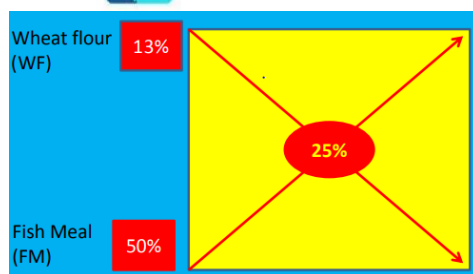
Step 1. Draw a 1 to 2 inches square place diagonal line across the square.



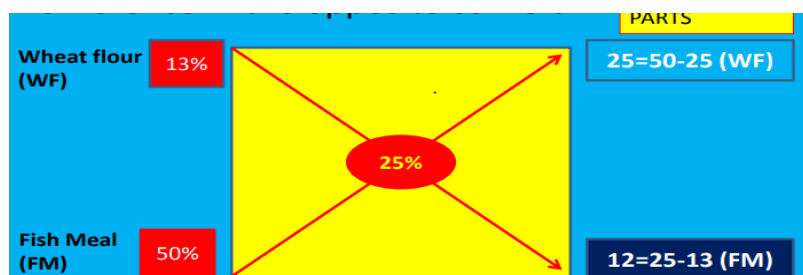
Step 2 Write the percentage of crude protein needed by the fish in the center of the square where the Diagonal lines cross.



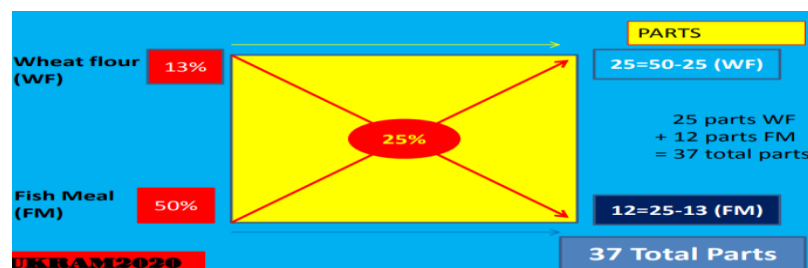
Step 3: Write the feeds to be used at each corner, and place the percentage of crude protein in the feeds after the name of feed.



Step 4: Subtract the smaller of the numbers from the larger numbers (this involves crude protein needed by the fish and that provided by the feed source) write the difference in the opposite corners.



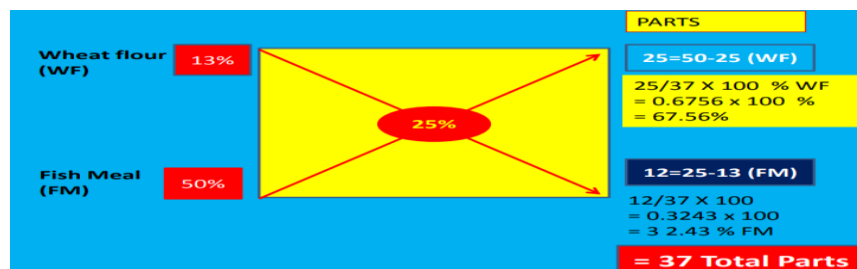
STEP 5 the numbers at the two corners are parts of the feed ingredients that are needed, do the calculation



STEP 6. The percentage of each feed needed in the diet can be calculated by dividing the number of parts by the total parts, then multiply by 100

- Do the calculation
- $25/37 = 0.6756 \times 100 = 67.56\%$  of WF
- $12/37 = 0.3243 \times 100 = 32.43\%$  of FM

STEP: 7



Step 8: The amount of each feed ingredients for a large batch or feed is determined by multiplying the percentage of each by the total amount of the feed desired.

- For example let us say 10 kg of feed.
- $10\text{kg} / 0.6756 = 6.756 \text{ kg}$  of Wheat flour (WF).
- $10\text{kg} / 0.3243 = 3.243 \text{ Kg}$  of Fish Meal (FM).

**Finally** the food is formulated and now we can say that the formulated feed.

As 10kg of fish feed containing @ 30% Crude Protein

### **Feed Preparation Process**

- After ensuring different nutritive values of the ingredients and the composition of the feed mixture, each ingredient is finally powdered in a pulverizer of a mixer separately and kept in trays.
- Some additives like vitamin mineral mixture, probiotic's supplements and enzymes at required levels are also added to this mixture. For essential fatty acids 1% each of vegetable oil and fish oil/ cod liver oil can be added.
- After mixing thoroughly different powdered ingredients including binder, water is added at 400ml for every 1kg of feed to make dough.
- Feed additives are added after sterilization or cooking to improve feed quality.
- The dough is then cooked for 10-15 minutes in pressure cooker or autoclave for sterilization that improves digestibility.
- The moist substances are cooled to attain normal temperature. Then feed additives are added by spraying over them.
- The dough is passed through a hand pelletizer to make nodules for different size group of fishes different sizes of sieves can be used (1-3 mm diameter is used for large size fish).
- After making moist pellets they should be dried at 40-45°C to avoid fat oxidation and protein denaturation at high temperature.
- Pellets can be dried in fully ventilated place, may be under shade. Solar drier may also be used.
- After drying pellets can be broken into different granular forms for different smaller size groups of fishes through mesh/ sieves.

**SIZE OF PELLET OR GRANULE RECOMENDATED  
ACCORDING TO BODY SIZE**

| Body weight (g) | Specification      | Feeding at body wt (%) | Diameter (mm) | Length (mm) |
|-----------------|--------------------|------------------------|---------------|-------------|
| 0.4-0.1         | Granules/ crumbles | 10-15                  | 0.8-1.5       | -           |
| 1.0-3.0         | Granules/ crumbles | 10-15                  | 1.5-2.0       | -           |
| 3.0-5.0         | Fine pellet        | 8-10                   | 2.0           | 3.0-4.0     |
| 5.0-15.0        | Pellet             | 5-8                    | 2.0-3.0       | 4.0-5.0     |
| 15.0-25.0       | Pellet             | 3-5                    | 3             | 5.0-6.0     |

The following percentage can be considered as comprising a good fish food.

| Fish Group                | Protein  | FAT MIN | MAX | RAW FIBER MIN | MAX |
|---------------------------|----------|---------|-----|---------------|-----|
| Carnivore                 | Over 45% | 3%      | 6%  | 2%            | 4%  |
| Herbivore                 | 15-30%   | 1%      | 3%  | 5%            | 10% |
| Limnivore (mud consumers) | 30-40 %  | 2%      | 5%  | 2%            | 6%  |
| Omnivore                  | 35-42%   | 2%      | 5%  | 3%            | 8%  |

1% of fat (Feed with minimum level of lipid is good)  
1% of Vitamin and minerals

### 3.2. Methods of Fish Feeding

There are four main methods used to feed fish: broadcasting, point feeding, automatic feeding and demand feeding.

- **Broadcasting:** - spreads the feed throughout the pond.
- **Point feeding:** - has designated feeding points and must be done regularly.
- **Automatic feeding:** - is a programming system that feeds the fish at specified time and quantity.
- **Demand feeding:** - is usually a mechanical system that uses a stick applied to a slightly bowed plate sitting under a feed hopper. The stick goes straight into the water, and the feed is dispensed from the hopper when touched by the fish.

### 3.3. Feeding schedules

#### Feeding frequency of fish

If possible, feed adult fish two small meals per day. Halve the portion and feed them in the morning and afternoon. With that in mind, how often you feed depends on the type of fish in your tank. For example, juvenile fish need meals more often to ensure they grow properly.

#### Create a Schedule to Feed the Right Amount

Certain types of fish need a special schedule for mealtime. Remember that your fish's stomach isn't larger than an eye. The general rule is to feed only what your fish can eat in a period of three to five minutes per feeding. You don't need a stopwatch, but fish keepers need to keep an eye out as all the food should disappear in a few minutes. There are always exceptions to the schedule.

#### The Type of Eater Dictates the Schedule

The fish species dictates how often they need meals. Take the time to research each fish in your tank, as some fish have a high metabolism. Heavy eaters include tiger barb fish, swordtail fish, and Oscar fish. Balloon mollies are known to be light eaters.

#### Most fish fall into three groups.

**Herbivores:-**Herbivores have smaller stomachs and need the opportunity to graze.

**Omnivores:-**This type of fish eats meat, vegetables, algae, and even debris found in the aquarium.

**Carnivores:-**Shrimp is always on the menu. Carnivores prefer a diet high in protein.

### 3.4. Factors and condition affecting feeding

Many factors affect the feeding rates of fish. Some factors are listed below:-

- Reproductive state (physiological state of fishes)
- Genetics
- Age
- Presence and activity of predators
- Tides
- Strong winds and rough water
- Stock health
- Algal blooms
- Water quality
- Dissolving oxygen
- Quality of feeds
- Feed additives
- Rainfall
- Time of day
- Moulting or breeding cycle



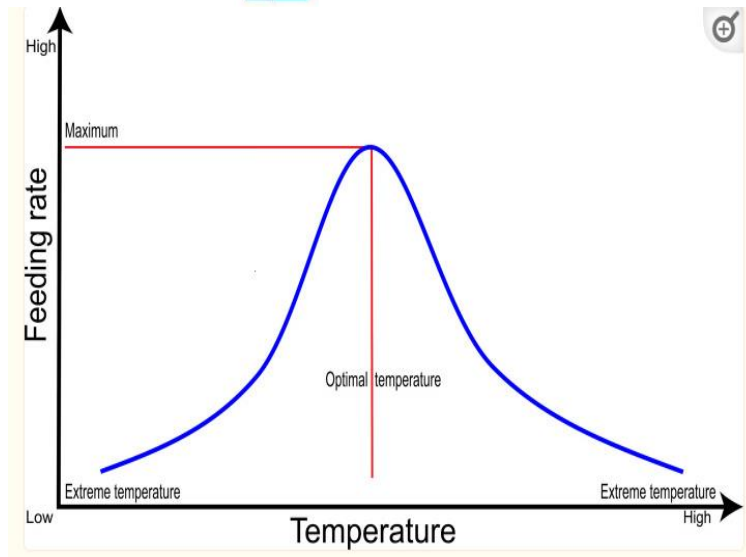
- weather condition (temperature)
- Stock density
- Water temperature

For example, feeding fish grown in ponds early in the morning when the lowest dissolved oxygen levels occur is not advisable. In contrast, in recirculating aquaculture systems where oxygen is continuously supplied, fish can be fed at nearly any time.

During the winter and at low water temperatures, feeding rates of warm-water fish in ponds decline and should decrease proportionally. Feed acceptability, palatability, and digestibility vary with the ingredients and feed quality. These are herbivores, detritus feeders, carnivores, and omnivores. Herbivores feed directly on the green plants which are the primary source of all food energy.

**The following are factors that affect the nutritional requirements of fish:**

- **Genetics:** Variation in species might also mean variation in nutritional requirements. The potential growth rate and the efficiency of absorbing and using nutrients in fish feed will determine which nutrients are included.
- **Life stage or age:** Nutritional requirements are related to the stage of maturity of fish and its weight.
- **Reproductive state:** Physiological condition of the fish (Female brood fish producing eggs and male brood fish) producing milt will need different nutrients compared to fry. Nutrients that meet the current anabolic needs of the fish are important.
- **Temperature of the environment:** Nutritional requirements can also depend on the ambient temperature of the water derived from the climate where the farm is located. When digested, some feed can produce heat, which could be desirable for fish raised in cold regions. Others factors include management practices and feed quality. When the optimal temperature of a particular fish species reaches and/or exceeds, it results in a gradual decline in feeding behavior. The feeding rate decrease and subsequently stops at higher or lower temperatures (extreme temperatures).



**Figure 3.1. A general relative relation between feeding rate and temperature of fish species.**

### 3.5. Optimum stocking density

Stocking density (kg fish/m<sup>3</sup>) describes the biomass of fish per unit of water in the cultivation system; it is one of the main characteristics that determine whether a cultivation system is extensive or intensive. Stocking density can have a major impact on fish welfare, as it influences not only water quality but also growth, stress status and social interactions – such as aggression – among the fish.

Optimal stocking densities that support good fish welfare depend on biological factors such as species or life stage and also on technical factors such as water flow rates. Stocking density is limited by water quality and thus has to be adjusted to maintain optimal water quality.

For species like rainbow trout, other salmonids, eel, tilapia and catfish, successful rearing is, in general, only possible at densities in which all fish of the rearing unit form a community. If, for instance, the stocking density is too low, single fish may develop dominant behavior, becoming aggressive to the other fish in the tank.

On the basis of intensity of input and stocking density aquaculture is categorized as follows.

- Extensive fish farming system
- Semi-intensive fish farming system
- Intensive fish farming system
- Integrated aquaculture system

#### **a. Extensive fish farming system**

The extensive fish farming system is the least managed form of fish farming, in which little care is taken. This system involves large ponds measuring 1 to 5 ha in area with stocking density limited to only less than 5000 fishes/ha. No supplemental feeding or fertilization is provided. Fish depends only on natural foods. Yield is poor (500 to 2 ton/ha), and survival is low. The labour and investment costs are low, and this system results in minimum income.

#### **e. Semi-intensive fish farming system**

Semi-intensive fish culture system is more prevalent and involves rather small ponds (0.5 to 1 hectare in an area) with higher stocking density (10000 to 15000 fish/ha). In this system, care is taken to develop natural foods by fertilization with/without supplemental feeding. However, the major food source is natural food. Yield is moderate (3 to 10 ton/ha), and survival is high.

#### **f. Intensive fish farming system**

An intensive fish farming system is the well-managed form of fish farming, in which all attempts are made to achieve maximum production of fish from a minimum quantity of water. This system involves small ponds/tanks/raceways with very high stocking density (10-50 fish/m<sup>3</sup> of water). Fish are fed wholly formulated feed. Proper management is undertaken to control water quality by use of aerators and nutrition by use of highly nutritious feed. The yield obtained ranges from 15 to 100 ton/ha or more. Although the cost of investment is high, the return from the yield of fish exceeds to ensure the profit.

#### **g. Integrated aquaculture system (Fish farming with agriculture)**

In the fish integrated agriculture system, fish culture is integrated with agricultural crops such as rice, banana and coconut, thereby producing fish and agricultural crops. Agriculture based integrated systems include rice-fish integration, horticulture-fish system, mushroom-fish system, Seri-fish system.

### **3.6. Monitoring feeding activities**

Fish feed management involves choosing the right feed, using correct feeding methods, calculating the feed cost and ensuring feed effectiveness. It is important because it reduces overall costs, ensures fish grow healthy and improves the water or culture environment by managing the water quality.

Fish farmers pay careful attention to feeding activity in order to help determine feed acceptance, calculate feed conversion ratios and feed efficiencies, monitor feed costs, and track feed demand throughout the year.

### **3.7. Condition of feeding operation**

#### **Rules for feeding fish**

For the most part, feeding your fish once or twice a day is sufficient. Some hobbyists even fast their fish one or two days a week to allow them to clear their digestive systems. Larger, more sedentary fish can go longer between meals than smaller, more active fish.

#### **Factors that you must consider when choosing the right fish feed**

The following identifies various factors to consider when deciding on the purchase and use of alternative feed ingredients.

- Composition and quality of fish feed.
- Nutrient digestibility/availability.
- Suitability or form of material.
- Palatability.
- Handling and storage.
- Inclusion rates.
- Impact on pellet quality and final Feed.

### **3.8. Feed storage**

Commercial fish feed is usually purchased by large farms as bulk feed in truckloads and stored in outside bins. Smaller farms often buy prepared feed in 50-pound bags. Bagged feed should be kept out of direct sunlight and as cool as possible. Vitamins, proteins, and lipids are especially heat-sensitive and can be readily denatured by high storage temperatures. High moisture stimulates mold growth and feed decomposition. Avoid unnecessary handling and damage to the feed bags that could break the pellets and create fines (powder) that will not be consumed by fish.

Feed should not be stored longer than 90 to 100 days and should be inventoried regularly. Feed must be stored in a cool and dry place away from pests, like rodents. The moisture content must be low enough to be stored without spoilage from mold. Bags should not be stacked more than

10 high because the excessive weight from the upper bags will crush pellets in lower bags, creating excess fines (dust).

Older feed should be used first, and all feed should be regularly inspected for mold prior to feeding. All moldy feed should be discarded immediately. Mice, rats, roaches, and other pests should be strictly controlled in the feed storage area because they consume and contaminate feed and transmit diseases.

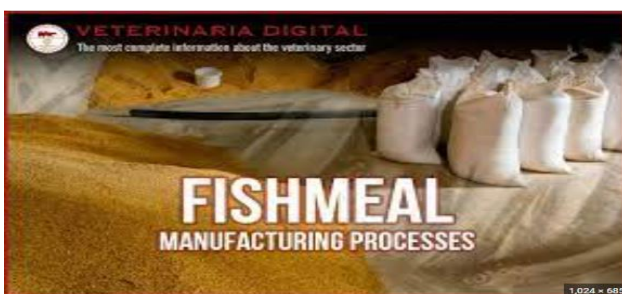
It must be noted that trash feed, which has about 70% moisture content, is made of irregular ingredients and is more likely to pollute the water. Moist pellets must be stored frozen, otherwise spoilage sets in. If there is no storage facility for moist pellets, they must be used immediately in production. Dry pellet feeds are more stable and should be stored in a cool dry place. They can last about 3 months.

### Storage guidelines

- **Bagged feed**

1. Store feed in a cool, dry, well-ventilated area.
2. Rotate stock to use old feed first. “First in, first out” principle.
3. Keep bags stacked neatly on pallets to prevent feed from being in direct contact with damp floors.
4. Bags should be stacked to allow at least 18 inches between walls and upright supports. This allows for cleaning and placement of traps/bait boxes. This also prevents condensation on walls from damaging feed and permits necessary air flow around the bags.
5. Keep different types of feed separate and clearly marked. Be particularly careful not to mix bags of medicated and non-medicated feed together.
6. If receiving skids of feed in plastic wrap, remove wrap before storing feed in warehouse. This allows better air flow around the product and helps prevent mold problems.
7. Rodent/insect control:
  - Keep exterior doors closed when not in use.
  - Position bait boxes/traps around interior and exterior walls. Glue boards or automatic traps on either side of warehouse doors are effective for preventing entry of rodents.
  - Clean up spilled feed immediately and remove torn bags as soon as possible. A continuous good housekeeping policy is the basis of any pest control program.
  - Regularly fog warehouse area with approved insecticide during warm months.

- Regularly spray problem areas with good residual crack and crevice type insecticide.
  - Periodic fumigation of entire storage area may be required for severe problems, but is expensive and requires a qualified applicator.
  - Keep weeds and brush away from exterior of storage area.
  - Eliminate poor drainage areas which serve as breeding grounds for most insects.
8. Do not handle bags more than necessary and handle with care. Pelleted diets are designed to be durable, but they are not indestructible. Abusive handling will increase the dust level in the feed which results in poor water quality and loss to the farmer.
- **Bulk feed**
    - ✓ Bin design: bins should be designed to empty out completely and maintain air flow through the bin, preventing condensation.
    - ✓ Inspect bins regularly for leaks and repair immediately.
    - ✓ Allow bins to empty out completely between loads. Many bins have “dead” areas where old feed and dust can accumulate and spoil if new feed is continually put in on top of old.
    - ✓ Clean inside of bins regularly, removing encrusted material which acts as mold and insect growth areas.
    - ✓ Bins can be sealed and fumigated to kill insects, but be sure to use a qualified fumigant applicator.



**Figure 3.1. Fish feed storage condition**

|                       |                     |
|-----------------------|---------------------|
| <b>Self-Check - 3</b> | <b>Written test</b> |
|-----------------------|---------------------|

Name..... ID..... Date.....

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

**Test I: Short Answer Questions**

9. What is the Select criterion of supplementary feeds?

- A. Of good nutritional values
- B. Easy to handle and store
- C. Cheap in price
- D. Well accepted by the fish plan to feed
- E. All

10. What is the objective of feeding fish?

- A. To provide the nutritional requirements for good health
- B. To optimize growth
- C. To optimize yield
- D. To optimize profits
- E. All

3. ----- describes the biomass of fish per unit of water in the cultivation system.

- A. Stocking density B. Integration C. Feeding D. All.

**Test II: Short Answer Questions**

1. Write the main method of aquaculture feeding?

2. Write the Factors and condition affecting feeding of fish.

**Test III: Calculate**

- 1. Prepare 200 kg of artificial feed for ornamental fish containing 35 % of crude protein from wheat flour (12% Protein) and fish meal (50% protein).



### Operation Sheet -3

- **Techniques of Artificial Fish Feed Preparation:**

A. Material tools and equipment's

- ✓ Necessary PPEs
- ✓ Feed ingredient's
- ✓ Weighing balance
- ✓ Bucket
- ✓ Pelletizer
- ✓ Sieve

B. Procedures of steps of feed preparation

- ✓ Take correct amount kg of fish meal
- ✓ Take correct amount kg of Wheat flour
- ✓ 1% of Cod liver oil
- ✓ 1% multivitamins
- ✓ Mixed properly
- ✓ Fish meal ( ) + Wheat flour ( )
- ✓ Add water (200-400 for 1 kg)
- ✓ Boil or sterilized the mixed dough
- ✓ Cold down add oil and vitamins
- ✓ By using pelletizer make pellet of (1-3mm) depending on the mouth size of the fish
- ✓ Dry at 45degree in cold dark room
- ✓ Break the pellets into small pieces
- ✓ Sieve the food to separate out between layers and small food size.

## Operation Sheet -3

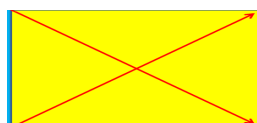
### Techniques of feed formulation a

#### a. Material tools and equipment's

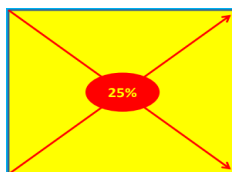
- ✓ Necessary PPEs
- ✓ Note book
- ✓ Calculator
- ✓ Weighing balance

#### b. Procedures/steps of feed formulation

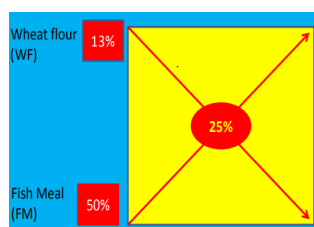
Step 1. Draw a 1 to 2 inches square place diagonal line across the square.



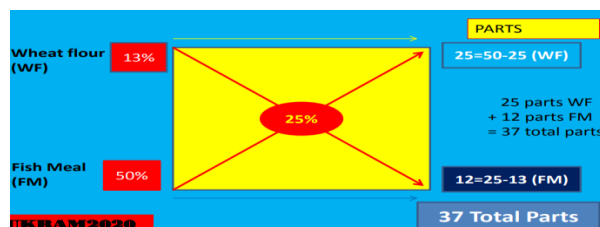
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Step 3: Write the feeds to be used at each corner, and place the percentage of crude protein in the feeds after the name of feed.

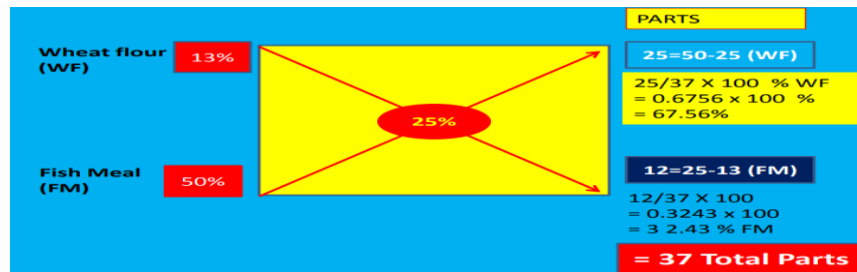


Step 5 the numbers at the two corners are parts of the feed ingredients that are needed, do the calculation



Step 6. The percentage of each feed needed in the diet can be calculated by dividing the number of parts by the total parts, then multiply by 100

Step: 7



Step 8: The amount of each feed ingredients for a large batch or feed is determined by multiplying the percentage of each by the total amount of the feed desired.

Step 9. Finally the food is formulated and now we can say that the formulated feed.

|                   |                         |
|-------------------|-------------------------|
| <b>LAP Test-3</b> | <b>Performance Test</b> |
|-------------------|-------------------------|

Name..... ID.....

Date.....

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

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within **2 hour**. The project is expected from each student to do it.

**Task 1.** Prepare artificial feed fish

**Task 2.** Conduct fish feed formulation

|                |   |
|----------------|---|
| <b>LG # 10</b> | <b>LO # 4 -: Clean up on completion of work</b> |
|----------------|---|

|                          |
|--------------------------|
| <b>Instruction sheet</b> |
|--------------------------|

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

- Identifying usable and disposable materials
- Handling Material, Tools, equipment and machinery
- Reporting organized documents

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 usable and disposable materials
- Handle Material, Tools, equipment and machinery
- Report organized documents

|                               |
|-------------------------------|
| <b>Learning Instructions:</b> |
|-------------------------------|

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. Identifying usable and disposable materials

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 Material, Tools, equipment and machinery

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.

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## 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. Returning 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.

#### 4.4.3. 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.

### 4.3. Reporting organized documents

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

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- 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.

**Table 1. Fish feed management record format**

| Date | Feed Qty<br>(catty/kg) | Observations      |    |                                |  |
|------|------------------------|-------------------|----|--------------------------------|--|
|      |                        | Water temperature | pH | Level of DO <sub>2</sub> (ppm) | Condition of fish(such as diseased, treatment and number of dead fish) |
|      |                        |                   |    |                                |  |
|      |                        |                   |    |                                |  |
|      |                        |                   |    |                                |  |
|      |                        |                   |    |                                |  |



|                |              |
|----------------|--------------|
| Self-Check – 4 | Written test |
|----------------|--------------|

Name..... ID..... Date.....

- Which one is a method of waste disposing.
  - Recycling
  - Burning
  - Fermentation
  - All.
- refers to removal of matter from a surface on which it is not acceptable.
  - Cleaning
  - Sanitizing
  - Washing
  - All

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

**Test I: Short Answer Questions**

- Write waste handling techniques?
- Write two steps of cleaning?
- Write the purposes of recording?

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