Animal production level III

Based on March, 2018, Version 3 OS and January, 2021, V1 Curriculum

Module Title: - Performing Aquaculture and Fishery Production Activities

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East Africa Skills for Transformation and Regional Integration Project (EASTRIP)

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Instruction sheet

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

- Inspecting location of new or existing site
- Assessing topography, adequacy of water and soil type
- Producing construction work plan.

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:

- Inspect location of new or existing site
- Assess topography, adequacy of water and soil type
- Produce construction work plan.

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
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Information Sheet 1- Inspecting location of new or existing site

1.1 Introduction

Fisheries and agricultural farming have evolved rather parallel in the history of human civilization. It is believed that hunting of fish was not uncommon in pre-historic times.

The water area of Ethiopia includes about 7 400 Km² of lakes and reservoirs, and 7 000 Km of rivers. Most of fishing areas are found in natural lakes, of which Lake Tana is the largest one. A hundred local fish species have been identified, while the bulk of the production is made of Tilapia, Lates, Barbus, Bagrus, Clarias and Labeo species. Approximately 80% of the catch is tilapia, although Nile perch is caught in large quantities on Lakes Chamo and Abaya, as well as in major riverine fisheries. Most of the remainder of the lake catches consists of catfish and barbus. Therefore, this learning material is prepared to enable the trainees with knowledge, skill and attitude of implementing feeding plans in an intensive poultry. It includes different units of competence such as:-

- Plan and schedule fish pond operation
- Monitor fish is pond and natural water bodies operation

In order to achieve mentioned competences which are new, frequently occurring and complex words, terms and phrases are defined by taking the module context in to consideration.

Terminology

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

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.

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.

Hygienically: With care to keep free of germs. This will require rodent control, dust management, no rat or bird fecal contamination of feeds or raw ingredients, and feed not being wet.

Occupational health and safety (OHS): actions to be taken to ensure safe operation and maintenance of machinery and equipment

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

Gillnetting is a common fishing method used by commercial fishermen of all the oceans and in some freshwater and estuary areas.

Gillnet, the name of the net employed, illustrates the method used to snare target fish.

1.2 Inspecting location of new or existing site

Selecting a suitable site for pond is important, and preliminary studies are needed before final design and construction. Analysis and selection of pond sites should be based on landscape structure and associated ecological functions and values. Relationship of the site to other ecological features within the landscape is critical to achieving planned objectives. If possible, consider more than one location and study each one to select the most ecologically appropriate, esthetic, and practical site. Weighing both onsite and offsite effects of constructing a pond is essential in site selection. Refer to figure 1 and the glossary to become familiar with the components of a pond and associated dam.

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

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

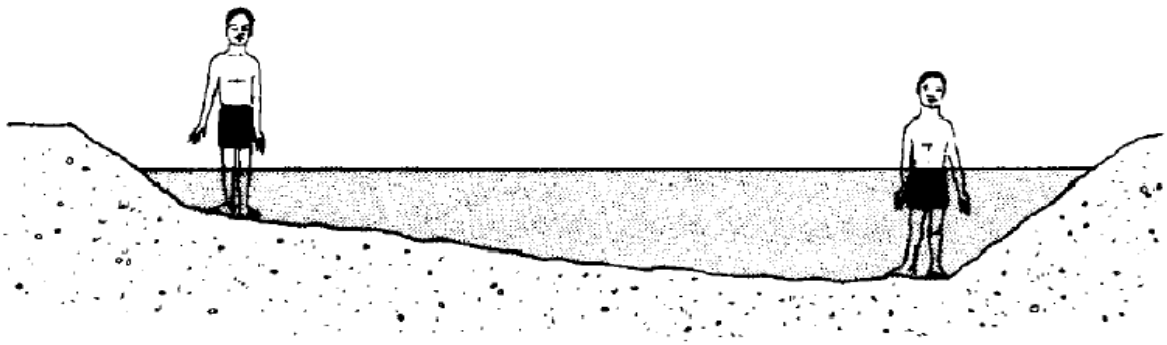

Fig 1: Cross-section of a pond

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

Avoid pollution of pond water by selecting a location where drainage from farmsteads, feedlots, corrals, sewage lines, mine dumps, and similar areas does not reach the pond. Use permanent or temporary measures, such as diversions, to redirect runoff from these sources to an appropriate outlet until the areas can be treated.

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

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

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. **Define Fish?(2pts)**
2. **Define Aquaculture? (3pts)**
3. **Define Gillnetting? (3pts)**

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information Sheet 2- Assessing topography, adequacy of water and soil type

Site selection of fish farm

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

Factors to be considered in site selection

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

A. Water Supply

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

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

B. Soil Type & Quality

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

Types and Characteristics of soils

Sandy soil - this soil can't be used for constructing fishpond, because it can't keep water. Its clay content<12.5%, sand content >87.5%.

Clay soil- This soil can be used for constructing fishpond, but it has much poor aeration. Clay conserves water well. It can be used on the pond bottom; however, because it cracks when dry, it is unsuitable for dike construction.

Clayey soils are preferable because they are superior material for diking and holding water. They have good compaction characteristics and low permeability. A very simple general rule can be followed: As a clay content of the soil decreases, its suitability for fishpond construction also decreases.

Loamy soils are also recommended. They have good organic matter content which favors the culture and growth of natural fish food.

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

- High water retention (holding) capacity
- Good aeration
- Adequate nutrient
- Favorable chemical properties.

Soil Quality Testing

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

I. The ball method

- Dig about 50cm deep pit, take a handful of soil from the bottom of the pit, and moisten
- It with some water. And squeeze it into a ball
- Throw the ball of soil into the air and catch it

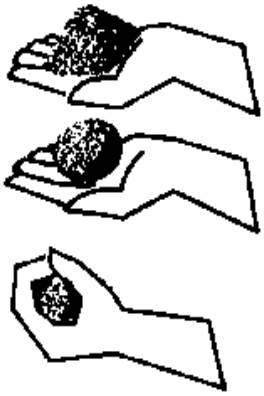

Fig 1 squeeze it into a ball Fig 2 Throw the ball of soil into the air and catch it

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

II. The pit method

a) Dig a hole as deep as wrist early in the morning (Fig 1) fills it with water to the top (Fig 2).
b) By evening some of the water will have sunk into the soil (Fig 3).
c) Then fill the holes with water to the top again (Fig 4). Cover the hole with boards or leafy branches (Fig 5).
d) The next morning if most of water is still in the hole at least 60%, the soil hold enough water, therefore the soil is suitable to build fish pond(Fig 6).If there is some or no water remaining reject the site.

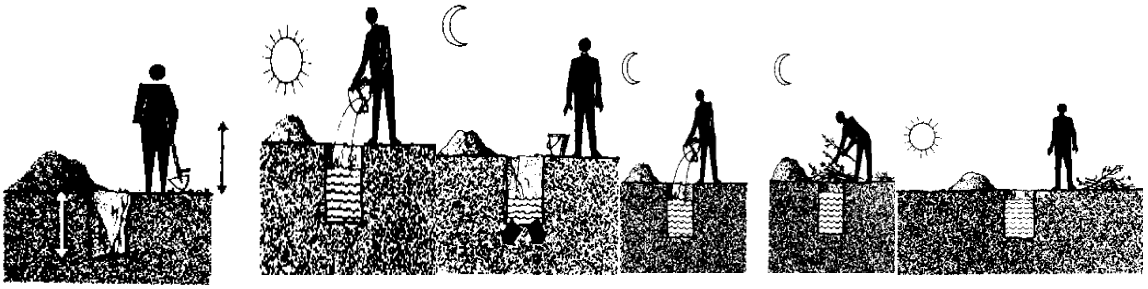

Fig 1 Fig 2 Fig 3 Fig 4 Fig 5 Fig 6

C. Topography of the site

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

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

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

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

D. Other criteria

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

- **Accessibility**. This is important for the transport of construction equipment and material, and for production inputs required for daily operations. Transporting costs can considerably increase if materials are manually carried through long distances. It is better if the site is accessible throughout the year by means of land and water.
- **Availability of labor**. The cheapest sources of labour are those which can be provided by the local residents, or people living within or near the area. It is important that the customs and tradition of local laborers are known. The pattern of labor distribution and utilization should be considered as this is important in preparing the calendar of activities.

- **Availability and cost of material**. In fishpond production, it is important that critical production inputs such as fish seeds, fertilizers, pesticides and other related materials are readily available when needed.
- **Availability of marketing outlets and prices**. Aquaculture products are highly perishable. Immediately upon harvest, products must be disposed of to maintain good quality and for better prices. If marketing outlets are located at a distance, larger quantities must be harvested and transported requiring some post-harvest marketing practices. If so, then the required support facilities especially ice-making plants must be available.
- **Availability of credit and technical assistance**. Fishpond operations require high initial capital investment. In this respect, credit at reasonable terms play a major role in providing the needed cash outlays.
- **Pattern of land and water use.** It is important to assess the pattern of land and water use in the area to determine the impact of this on the project. Activities such as navigation, fishing, industries, public utilities, and recreation and nursery areas must be included in the overall assessment. It is best that a complementary rather than competitive relationship between these various uses and the project be established.
- **Peace and order situation.** Good peace and order conditions at site are favorable for both public and private interests.

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

What are the two methods to test the quality of soil for pond construction?(4pts)

Write at least 6 factors to be considered during site selection? (12pts)

Test 2 multiple choice

1. One is not a good characterized of soil types used for pong construction? (2pts)
   A. poor water retention (holding) capacity
   B. Good aeration
   C. Adequate nutrient
   D. Favorable chemical properties

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

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

Information Sheet 3 - Producing construction work plan

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

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

The Contractor's duties are as follows:

- Review and study all the detailed plans thoroughly.
- Report all questions and comments to the Engineer, particularly those which have a bearing on timely execution of the project.
- Request any additional drawings, calculations or other clarifications from the Engineer.
- Make application for any and all permits required for the construction work from the public authorities.
- Arrange for all necessary sub-contracts.
- Prepare a detailed schedule of requirements for all items of work, materials and equipment.
- Order all equipment required for the construction, e.g., pumps, generators, etc. The Engineer's duties are as follows:
- Provide to the Contractor all permits required before and during the construction work.
- Arrange, if necessary, for provision of adequate water source for construction work.

- Supply any additional drawings, calculations or modifications to the work plan which may be required by the Contractor.

Methods used in organization of construction work

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

Network scheduling

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

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

Analyzing and scheduling: this involves establishment of the relationship between activities in order to determine their interdependency. In this way it can be determined which works can be independently carried out and which depend on some other activity being completed first, thereby allowing for scheduling the flow path of activities. Time duration for each activity is arrived at with reference to general availability of laborers, materials, equipment, etc. The total project time is the summation of the duration times of all activities to be undertaken from the initial start of work to the

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

Controlling: this consists of assessing the progress of work, including comparing the actual performance with the planned performance of each activity. Precise evaluation of actual performance time against that scheduled can provide useful data which may be adopted for another project. The CPM must be revised patch time an assessment is made.

Pay close attention to the layout, design and construction of the ponds. A well-built fishpond means lower costs and better production.

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

Observe and note down the tide levels, especially during the heavy rains. The highest and lowest tide levels will affect the elevation of ponds. Also, find out the levels of flood waters from the people in the locality. This information is important in determining the height of your main dike.

Self-check 3	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. List the duties of Contractor's?(8pts)

2. What are the Methods used in organization of construction work? (6pts)

Note: **Satisfactory rating - 14 points** **Unsatisfactory - below 14 points**

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

LG #85	LO #2- Participate in construction or installation work

Instruction sheet

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

- Determining materials and equipment for construction and preparing work plan
- Undertaking construction tasks
- Determining pond type and size
- Carry out pond lay out.
- Excavating pond
- Assembling and fixing fixtures and fittings
- Cleaning and checking equipment and material
- Disposing waste and debris

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:

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Information sheet – 1 Determining materials and equipment for construction and preparing work plan

1.1. Determining materials and equipment for construction and preparing work plan

In most cases, pond size is limited by topography, availability of inputs and construction costs. Construction costs for ponds less than 100 m^2 in surface area are high relative to the weight of fish.

Construction costs will also be affected by the kind of plants that had been growing or are growing in the fishpond site and by the type of soil. Sandy clay or sandy loam is best for dike construction because it is hard and does not crack when dry.

Cheaper and locally available materials could be used in constructing ponds, especially nursery ponds. Although laborious to prepare, they will cost much lower and are just as durable as the ready-to-use but costly materials.

For instance, PVC materials which are normally used for distribution line can be replaced with a canal system made of bricks and hollow blocks. Wooden pipes or bamboo poles can be used as inlet or outlet pipes instead of PVC materials. Other usable materials are coconut trunks and big bamboo poles.

Use water supply pipe instead of sluice gate

For prawn nursery ponds, use water supply pipe instead of a sluice gate. While a sluice gate is practical and efficient in grow-out ponds or in bigger ponds, its use is impractical in the smaller prawn nursery pond. Because:

- Fit is expensive as it requires bigger and more materials.
- Its maintenance cost is rather high because you'd have to periodically change the flush boards and parts of sidings which rot easily.
- Water seepage is strong in wooden sluice gates. This problem of water seepage can be easily controlled with the use of small pipes.

Materials selected must have enough strength for the dam to remain stable and be tight enough, when properly compacted, to prevent excessive or harmful percolation of water through the dam. Soils described as acceptable for foundation material generally are acceptable for fill material. The exceptions are organic silts and clays.

The best material for an earth fill contains particles ranging from small gravel or coarse sand to fine sand and clay in the desired proportions. This material should contain about 20 percent, by weight, clay particles. Though satisfactory earth fills can be built from soils that vary from the ideal, the greater the variance, the more precautions needed.

Soils containing a high percentage of gravel or coarse sand are pervious and can allow rapid seepage through the dam. When using these soils, place a core of clay material in the center of the fill and flatten the side slopes to keep the line of seepage from emerging on the downstream slope.

Self-check 1	**Written test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What are the factors limiting pond size?(6pts)

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

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

Information sheet 2 – Undertaking construction tasks

Farm Designing and Construction

Farm Designing

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

Important sections of a farm such as:

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

Should be designed in separated areas within the farm

Construction

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

Keep compact

- Keep compact the soil at regular intervals while you are building the dike. After adding each 30 cm of loose soil trample it well while spraying water on the dike.

Then, pound it with your hoe, a heavy log, or a piece of wood attached to the end of a pole. This will make the dike strong.

Fig 1: Compacting the dike

Pond dikes should be about 30 cm above the water level in the pond. If catfish are to be farmed in the pond, build the dike to 50 cm higher than the water level to prevent the catfish from jumping out. Once have reached this height, add a little more soil to allow for settling and then refrain from adding any more soil on top of the dikes.

Bottom Soils

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

Bottom Seals

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

Another increasingly popular method of pond sealing involves lining the bottom with a flexible plastic or rubber sheeting of polyethylene, vinyl, or butyl at least 2 mm thick. To protect against punctures and tears, the pond liners should be covered by at least 6 inches of sand or fine soil.

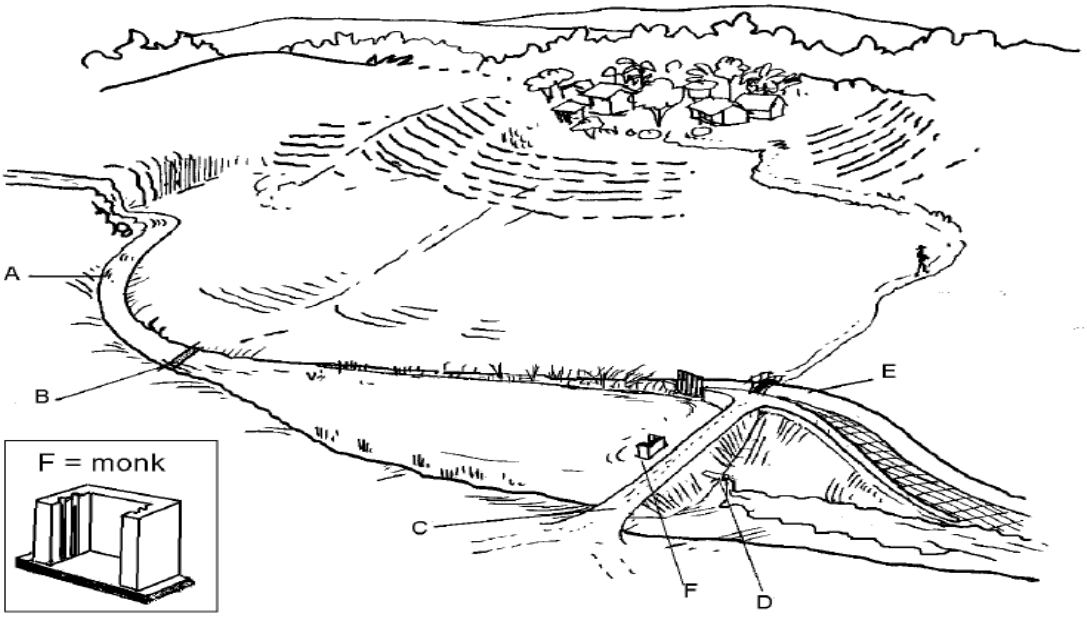


Fig 2: Barrage pond. A: stream, B: inlet, C: dam, D: outlet pipe, E: spillway and overflow, F: monk (One of the most common pond draining structures. It consists of a vertical tower with boards to regulate the water level; a pipeline to discharge the water; and a screen to prevent farmed fish from escaping the pond).

Cement pond Construction

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

Self-check 1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What are the Important sections of a farm?(10pts)
2. Write the criteria of Cement pond Construction?(10pts)

Note: **Satisfactory rating - 20 points** **Unsatisfactory - below 20 points**

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

Information sheet 3 – Determining pond type and size

3.1. Determining pond type and size

Types of fish pond

A. Earthen ponds

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

B. Cages

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

C. Reservoirs

Reservoirs that are used as source water for agriculture may be acceptable sites for aquaculture. However, reservoirs used as source water for drinking water should be avoided, as wastes, antibiotics, and other chemicals used in fish farming will render water unfit for human consumption. Normally, fish fry are stocked in the reservoir and then harvested once grown. This often resembles a natural fishery and requires some of the same management considerations. Unfortunately, this form of aquaculture rarely allows the operator to manage the culture well, which may lead to losses and slower growth rates. For this reason, the use of cages or pens may be a more appropriate alternative.

D. Recirculation systems

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

Pond size and shape

Pond shape: the easiest and perhaps best shape is the rectangular with a length twice the width. However, the shape could be modified based on the topography of the area.

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

Pond depth: pond should be deeper near the outlet for easy drainage. The average depth of fish pond could be 1m to 1.5m.

Self-check 3	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What are the Types of fish pond? (6pts)
2. What are the size and shape of Pond (4pts?)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

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

Information sheet 4 – Carry out pond lay out

4.1 Carry out pond lay out

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

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

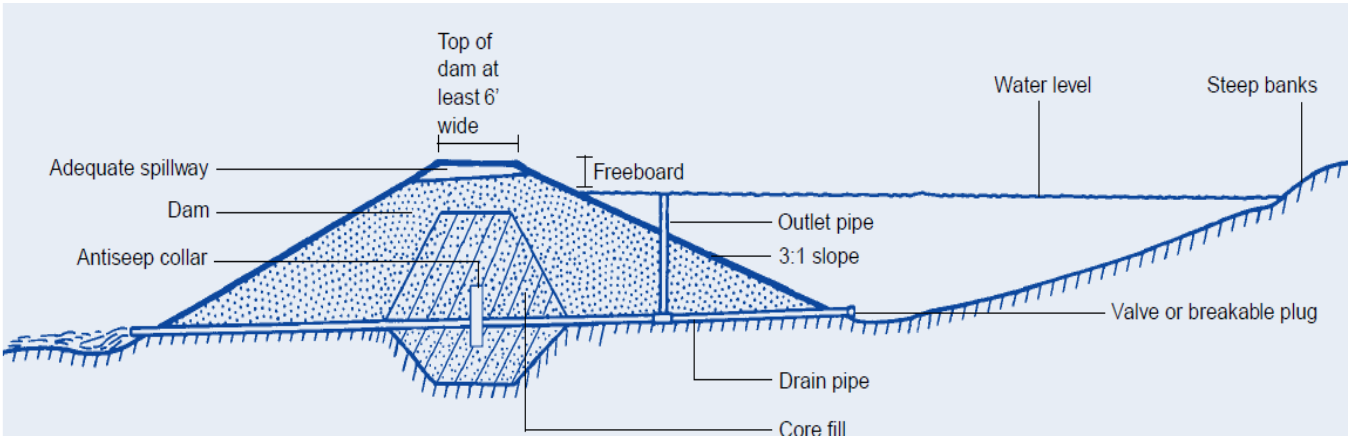


Fig1. Pond construction

Top Width and Side Slopes of Dam

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

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

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

Emergency Spillway

An emergency spillway is necessary to provide a safe overflow outlet for floodwater. Be sure that your pond has one. The spillway should be constructed in the undisturbed bank at one end of the dam. It should have a flat-bottomed channel large enough to handle the overflow caused by a 10- to 50-year rainstorm, depending on the size and watershed area.

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

Freeboard

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

Outlet Pipe

A drop- or hood-inlet pipe should be installed through the dam to provide an outlet for the normal flow of water. The pipe, which governs the depth of water in the pond, should be positioned at a level about 12 inches below the bottom of the emergency spillway. The pipe should be large enough to drain the full pond down to normal water level within 24 hours after the flow through the emergency spillway ends. These pipe sizes vary with drainage area and pond storage characteristics and should be determined by an engineering professional.

Drain

A combination outlet pipe and drainpipe is highly desirable for pond management. It can be used to drain the pond for various fish management practices, pond repairs, or emergency situations.

The drainpipe can be closed with a valve or plugged with a bell-end clay tile partially filled with cement. Even a glass jug will work. The plug should be sealed in the inlet end of the pipe with asphalt cement or cement mortar. If a breakable plug is used, the pond can be drained whenever it becomes necessary, but it will be difficult to stop the flow without draining the pond completely.

Anti-seep collars or drainage diaphragms should be placed around the drainpipe to prevent water from seeping along the outside of the pipe and eroding a channel through the dam. When steel pipe is used, the collars should be metal plates welded to the pipe. Prefabricated drains with anti-seep collars and drain valves may be available where culverts and large corrugated pipes are sold. A drainage diaphragm consists of sand and gravel surrounding the downstream sections of the outlet pipe.

Self-check 4	**Written test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What are the structure of fish pond?(8pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 5 - Excavating pond

5.1. Excavating pond

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

The construction site should be cleared of all large rocks, trees, brush, roots, and other debris. The topsoil should be removed and stockpiled for later use.

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

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

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

If the material can be formed into a firm ball that sticks together, the moisture content is adequate for compaction. Laboratory tests of the fill material and field testing of the soil for moisture and compaction may be necessary for large ponds or special conditions. If the material varies in texture and gradation, use the more impervious (clay) material in the core trench, center, and upstream parts of the dam. Construction equipment can be used to compact earth fill in an ordinary pond dam. Equipment that has rubber tires can be routed so each layer is sufficiently covered by tire tracks. For dams over 20 feet high, special equipment, such as sheepsfoot rollers should be used.

Fig22. The sod and topsoil in a pond construction area can be stockpiled for later use

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

Self-check 5	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Why leave the channel bottom transversely level?(4pts)

2. Why topsoil should be removed?(4pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

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 and so on.

A. Dissolved oxygen meter

Description-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.

1. Dissolved oxygen meter

Fig1. Dissolved oxygen meter

Calibration and use

Follow these 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 should always check the user manual for the specific dissolved oxygen meter you are using for the correct way to calibrate it.

B. P^H meter

Description-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.

Fig12. PH meter

Calibration-Follow these steps to calibrate a pH meter:

- Turn the meter on.
- Connect the probe to the meter.
- Place the probe in buffer 7 solution and wait for the reading to stabilize.
- Press the "Cal" button to enter the calibrate mode.
- Press the "Con" button to set the meter to pH 7.
- This method can be repeated for a buffer 4 and/or a buffer 10 solution.
- Press the "Means" 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.

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.

C. **Salinity meter**

Description-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 sample thousand.

Calibration-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.

Fig13. Salinity meter

D. **Ammonia test kit**

Description and use-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.

Fig15. Ammonia test kit

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.

E. 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.

Fig16. 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.

F. 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.

Fig17. Secchi disk

To use a Secchi disk:

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

Self-Check 6	*Written Test*

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the functions of Ammonia test kit, thermometer, and Dissolved oxygen meter? (6pts.)

Test 2 multiple choice

1. Which one of the following equipment is measure the hydrogen ion in the water? (6pts.)

A. Dissolved oxygen meter C. Salinity meter
B. PH meter D. Thermometer

2. Which one of the following equipment is measure the salt content in the water? (6pts.)

A. Dissolved oxygen meter C. Salinity meter
B. PH meter D. Thermometer

Note: Satisfactory rating - 15 points Unsatisfactory - below 15points

Information sheet 7 - Cleaning and checking equipment and material

Cleaning and sanitizing procedures

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 voter, 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, scrabbling 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.

Sanitizing of well cleaned surfaces provides a safeguard against the build-up and spread of pathogenic and spoilage micro-organisms. As sanitizers lose most of their effectiveness when used on dirty surface; the sanitizing procedure must not be employed as a substitute for thorough cleaning. Steam or hot water over 82 °C can be

used for sanitizing only if the temperature at the surface of the object being treated is maintained above 82 °C for at least 2 minutes and preferably longer. Where conditions cannot be met consistently in practice the use of sanitizer rinses is recommended. Sanitizers shall be non-corrosive, non-perfume, non-tainting and shall be used in the contact time available.

Self-Check 7	***Written Test***

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the steps of cleaning and sanitizing of plant and equipment? (10pts.)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10points

Information sheet 8 - Disposing waste and debris

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.

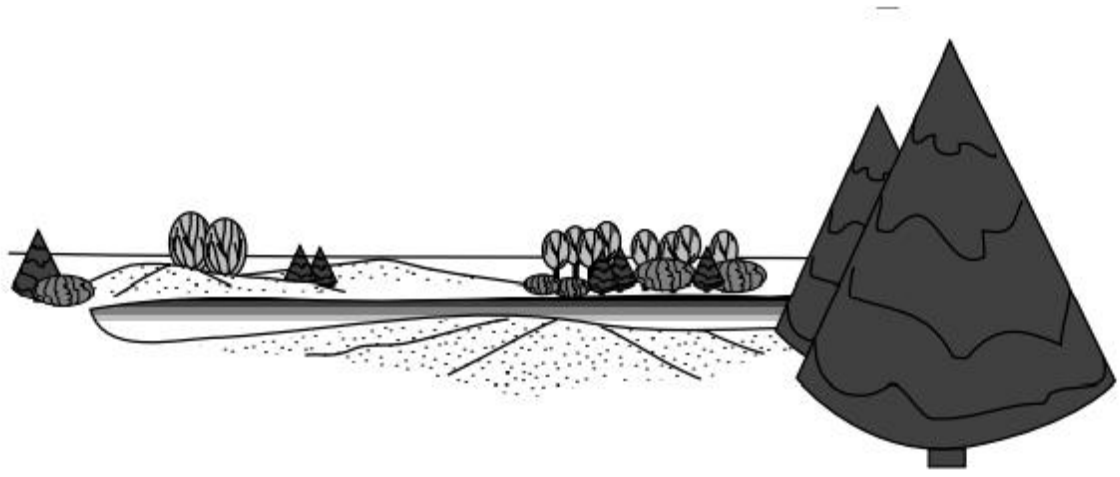


Fig23. Correct disposal of waste material, Waste material properly shaped, graded, and vegetated blends into surrounding landscape.

Waste material can also be located and designed to be functional. It can screen undesirable views, buffer noise and wind, or improve the site's suitability for recreation. In shaping the material, the toe of the fill must be at least 12 feet from the edge of the pond. In the Great Plains you can place the waste material on the windward side of the pond to serve as a snow fence for collecting drifts in the pond. These banks can also reduce evaporation losses by breaking the force of prevailing winds across the pond.

Perhaps the most satisfactory method of handling waste material is to remove it from the site. Complete removal, however, is expensive and can seldom be justified unless the material is needed nearby. Waste material can sometimes be used advantageously for filling nearby low areas in a field or in building farm roads. If state or county highway maintenance crews need such material, you may be able to have them remove it.

Clear the foundation area and excavated earth spillway site of trees and brush. In some states this is required by statute. Cut trees and brush as nearly flush with the ground as practicable and remove them and any other debris from the dam site. Should you or your contractor elect to uproot the trees with a bulldozer, you must determine if the tree roots extend into pervious material and if the resultant holes will cause excessive seepage. If so, fill the holes by placing suitable material in layers and compact each layer by compacting or tamping.

All material cleared and grubbed from the pond site, from the earth spillway and borrows areas, and from the site of the dam itself should be disposed of. This can be done by burning, burying under 2 feet of soil, or burying in a disposal area, such as a sanitary landfill.

Minimal clearing conserves site character and minimizes the difficulty and expense of reestablishing vegetation. Confine clearing limits to the immediate construction areas to avoid unnecessary disturbance

Self-check 8	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

4. How dispose material cleared and grubbed from the pond site?(6pts)

5. What are the Seven Steps of wet sanitation process?

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

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

Operation Sheet- 1	**Water quality measurement using pH**

Direction: Perform the following the Procedure given below.

1. Put PPE
2. Arrange all necessary materials tools and equipment

***Calibration*-**Follow these 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. Measure the pH of the pond

LAP TEST	Performance Test

Name…… ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **4** hour. The project is expected from each student to do it.

Task 1

Identify ingredients and equipment for Water quality measurement using pH

Preform successfully Water quality measurement using pH

LG #86	LO #3- Prepare facilities and Undertake fish stock selection

Instruction sheet

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

- Undertaking stock selection criteria
- Preparing ponds, pens, cages and tanks
- Acclimatizing fish fingerlings for PH, temperature and salinity
- Weighing stock samples.
- Selecting, sampling, analyzing, computing and recording feeds

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:

- Undertake stock selection criteria
- Prepare ponds, pens, cages and tanks
- Acclimatize fish fingerlings for PH, temperature and salinity
- Weigh stock samples.
- Select, sample, analyzing, compute and record feeds

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, ask your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1 - Undertaking stock selection criteria

Selecting Appropriate Species and Culture Systems

Selecting appropriate species and culture systems is fundamental to successful aquaculture development. As a general principle, species that possess the following characteristics are preferred:

- Native species
- Species that require little or minimal feeding during all or part of their life cycles (e.g., seaweed, filter-feeding bi-valves, extensively farmed shrimp)
- Species that can utilize feeds with lower protein contents or feeds that use local components
- Species proven to be easily cultured in tested systems that are low-cost, low-technology and within the technical capacity of local stakeholders
- Species with potential to be scaled-up to mid- size family farms or national industries
- Species for which larvae and juveniles are available in the wild without damaging local fisheries
- Species that can be cheaply and easily produced in local hatcheries
- Species that have a demonstrated market, are locally accepted, and are in demand as a food source
- Ease of reproduction
- Attainment of market size prior to reaching sexual maturity
- Acceptance of supplemental and/or manufactured feeds
- Feeds low on the food chain, i.e., eats plant material
- Rapid growth
- Efficient feed conversion
- Resistance to diseases
- Tolerance to relatively high stocking density and poor environmental conditions
- Is highly desired in the marketplace.

Major Aquaculture Species Groups

I. Fish

A. Carps

They accounted for over 40 percent of world aquaculture by volume. The main species of carp are silver carp (Hypophthalmichthys molitrix), grass carp (Ctenopharyngodon idellus), and common carp (Cyprinus carpio) which are widely cultured globally and feed some of the world's poorest populations.

B. Tilapias (Cichlid family)

Cichlids are perch-like tropical and semi-tropical fish widely distributed throughout the world. Due to evolutionary divergence, thousands of species have evolved, some with highly specialized and useful traits. Tilapias are freshwater cichlids that are native throughout Africa. Various tilapias are among the most successful aquaculture species. The most common species used for culture are Oreochromis niloticus (Nile tilapia), O. aurea (Blue tilapia), O. mossambicus (Mossambique tilapia) and O. hornoru (Redeyed tilapia). Hybrid forms also exist, being bred for traits such as improved color and growth. Tilapias usually require temperatures over 80º F (27º C) to thrive. They have good culture characteristics including rapid growth, good flesh quality, rapid reproduction, and the ability to consume plant materials and utilize natural pond production as a food source.

C. Other freshwater fishes

A wide range of freshwater fishes, other from tilapias and carps, are grown throughout the world. These include catfishes, perch, pike, trout, barramundi, gouramis, sturgeon, paddlefish, and many others. Aside from food fish, culture of ornamental and baitfish is also an important economic contributor in many areas. Freshwater fishes are perhaps among the most vulnerable to environmental changes that affect water quality, volume, or regularity of supply.

D. Other marine fish

There are dozens of species of marine finfish that are established culture species and many more are being developed. In part, this rapid development is driven by the

decline in wild fisheries and recognition of the need to conserve wild stocks. The most common species groups under aquaculture production are groupers, snappers, and sea bass, with most culture taking place in Asia. Pelagic aquaculture species include cobia, and blue fin and yellowtail tuna and although these forms are newer and less well-developed. Rabbit fish, milkfish, mullet, eel, and dozens of other species are also widely cultured. Marine finfish culture is projected to grow rapidly in the near future. Most culture is done in cages, pens, and nets in near shore or offshore settings.

II. Mollusks

A. Gastropods (snails)

Gastropods are snails and are generally more difficult to culture than their cousins, the bivalves. The most commonly cultured gastropod is the abalone, for which there is a high-value global industry. The recent development of more reliable reproductive and feeding methods should lead to an expansion in the culture of abalones and other snails.

B. Bivalves (oysters, clams, cockles, scallops)

Bivalves are mollusks with two shells that generally feed themselves by filtering water and extracting algae. As such, they do not require artificial feed and have the advantage of generally being sedentary, thus eliminating the need for cages. Bivalves also perform a valuable ecosystem function by helping maintain good water quality.

III. Crustaceans

Shrimp and prawns

The term “shrimp” usually refers to marine species while “prawn” refers to certain larger marine species and freshwater species. Shrimp and prawn culture produce some of the highest value products in aquaculture. Shrimp culture has been widely criticized for causing environmental impacts. This is not universally true, however, as many shrimp ponds have been built without cutting mangroves and have successfully operated with few, if any, impacts. Shrimp are also an ideal culture species for other reasons. They have good feed conversion ratios (sometimes less than 1:1), they derive some of their nutrition from natural pond productivity, they grow rapidly, and they have a high market price.

Self-check 1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Write the Major Aquaculture Species Groups?(4pts)
2. What are the appropriate criteria Species and Culture Systems?(4pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 2 - Preparing ponds, pens, cages and tanks

Preparing the pond

Building a pond can be the most difficult and most expensive part of fish farming. A well-built pond is a good investment that can be used for many years.

Prepare the site

First remove trees, bush and rocks, then cut the grass in the area where the pond will be made. Measure and stake out the length and width of the pond

Plough the pond and build the dikes

Use the soil that you dug out when making the trench for the clay core to build up the dike on top of the core trench. Try not to use sandy/rocky soil or soil that contains any roots, grass, sticks or leaves. These will decay later and leave a weak spot in the dike through which the water can leak out.

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

Liming

The importance of Liming:

- The last aim of fertilizing in pond is maintaining pond productivity, and improving fish production where the pond is already productive. The indirectly aim is increasing the amount of the natural feed for fish in the pond and thereby encourage higher production.
- The action of fertilizer is rather indirect. The fertilizing substances in the fertilizers provide the necessary nutrient substances, which are either lacking in the pond water or are insufficient.
- The supply, supplement or increase of these nutrient substances, is responsible for increased production of producers of the first trophic level, the plants (the phytoplankton and vegetation). This is the basis of improvement in first production, as the stocked fish profits the increased food depending on its

position in the food chain.

- The addition of the fertilizers to pond is immediately absorbed by the bottom mud which later releases the nutrients in minimal quantities into the water for every long period. This is the reason for the prolonged action of fertilizers on the pond.

Available liming materials

- The amounts of liming material needed when compared to 1 kg of agricultural lime (CaCO3) are: 700 g slaked lime ($Ca(OH)_2$) 550 g quicklime (CaO) 2.25 kg basic slag (CaCO3 + P2O5) This means, for example, that 550 g quicklime has the same liming effect as 1,000 g agricultural lime.
- The liming effect is better when the particle size of the liming material is decreased, so crushing the liming material before application gives better results. Best results with liming are obtained if the lime is equally distributed on a dry pond bottom. Quicklime, as disinfectant, however, needs moisture.
- Liquid and powdered limes are common choices for liming fish ponds. Pay attention to the acid-neutralizing value when selecting a lime product. This value represents the ability of a liming material to neutralize acid when compared with standard agricultural lime with a 90% calcium carbonate equivalency. Hydrated or slaked lime and calcium oxide should not be used to lime fish ponds. These products could drastically raise water pH, thereby killing fish.

Method of liming

- Distribute lime as evenly as possible over the entire surface of a dry or full pond. For dry ponds, apply lime with a spreader and mix it into the bottom with a disc-harrow. For small, full ponds, spread bagged lime from a boat or broadcast it from the shore.
- For large ponds, bulk quantities of lime may be necessary. A boat 18-feet long by 6-feet wide can carry 1500 lb of agricultural limestone. Load the lime onto a ½-inch plywood platform placed over the bow of a large boat or between two small boats. Shovel the material or wash it off the platform using a water pump, while moving the boat slowly across the pond.

Filling the pond with water

- Before filling the pond, put rocks on the pond bottom at the spot where the water lands when coming in from the inlet pipe. This will keep the incoming water from making a hole and eroding the pond bottom. Then open the inlet canal and fill the pond.
- Fill the pond slowly so that the dikes do not subside due to uneven wetting. While the pond is filling, the water depth can be measured with a stick. Stop filling the pond when the required depth is reached.
- To prevent overflowing, do not fill the pond too full. Water in the pond should not flow through (and should thus be stagnant), because water flowing through the pond will slow down fish growth by flushing away the naturally produced fish food.
- The only water added to the pond should be to compensate for water loss through evaporation and seepage. New ponds often seep when they are filled with water for the first time as the soil partly takes up the water. Keep adding new water for several weeks and gradually the pond should start to hold water.

Fertilizing the pond

- Fertilization supplies the phytoplankton (free floating plants) with the materials essential for photosynthesis.
- As the phytoplankton photosynthesize and reproduce, zooplankton (floating organisms that is made up of microscopic animals), which feed on phytoplankton, flourishes.
- In turn, the fish, which feed on zooplankton, phytoplankton, and benthos, also flourish.
- Therefore, the importance of pond fertilization lies in the cultivation and propagation of various food organisms for the cultural fish.

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. **What is the importance of pond Fertilizing**?(4pts)
2. Write the main roles of liming during pond conditioning?(4pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 3 - Acclimatizing fish fingerlings for PH, temperature and salinity

Prawn fry must be acclimated before stocking to minimize stress.

The water condition in the fry transport containers is usually different from that of the pond water. Acclimation will make the transport container water and the pond water conditions closely similar, at least in terms of temperature and salinity.

The steps in acclimation

For fry transported in plastic bag:

- Remove the plastic bags from the Styrofoam containers.
- Allow the bags to float on the pond water for at least 30 minutes.
- Open the bag and take the water temperature with a thermometer or by dipping the hand inside the bag.
- Then take the pond water temperature.
- If no difference is felt or if the thermometer reading differs only within one to two degrees Centigrade, proceed with the next step; otherwise, introduce pond water into the plastic bag gradually.
- If the salinity of the transport water and the pond water is known beforehand to be equal or less than 5 ppt. differences between them, the fry can be released immediately once the temperature is equalized.
- If the salinity difference is great, enough pond water should be introduced very gradually until the salinity difference is reduced to less than 5 ppt. In the absence of a salinity measuring device, gradually diluting the transport water with pond water up to four times its original volume should be sufficient to bring the salinity difference down to acceptance limits.
- Directly stock the fry from the hatchery into the earthen nursery pond. Stocking in temporary net enclosures such as hapa net causes stress in fry due to overcrowding.

For fry transported in live tanks:

- A shed is necessary for acclimatizing a large number of fry when transported in live tanks. The shed should have aeration facilities, a one-ton fiberglass or marine plywood tank, 20-liter plastic pails, and one centimeter plastic hoses.
- Transfer fry and water in the transport tank to the empty one-ton tank. Allow the fry and water to settle for a few minutes.
- Then adjust the final volume to one-half the total tank capacity by siphoning through the screen.
- Allow filtered pond water to flow from an elevated storage tank into the acclimation tank by gravity and through a one-centimeter plastic hose. When the acclimation tank is almost full, the amount of water should already be double the original volume.
- Install a screened siphon and allow the water to flow at the same rate as the incoming water. Allow the water to flow continuously in and out of the tank.
- Check temperature and salinity. Fry stocking can be done when the physical conditions have stabilized.

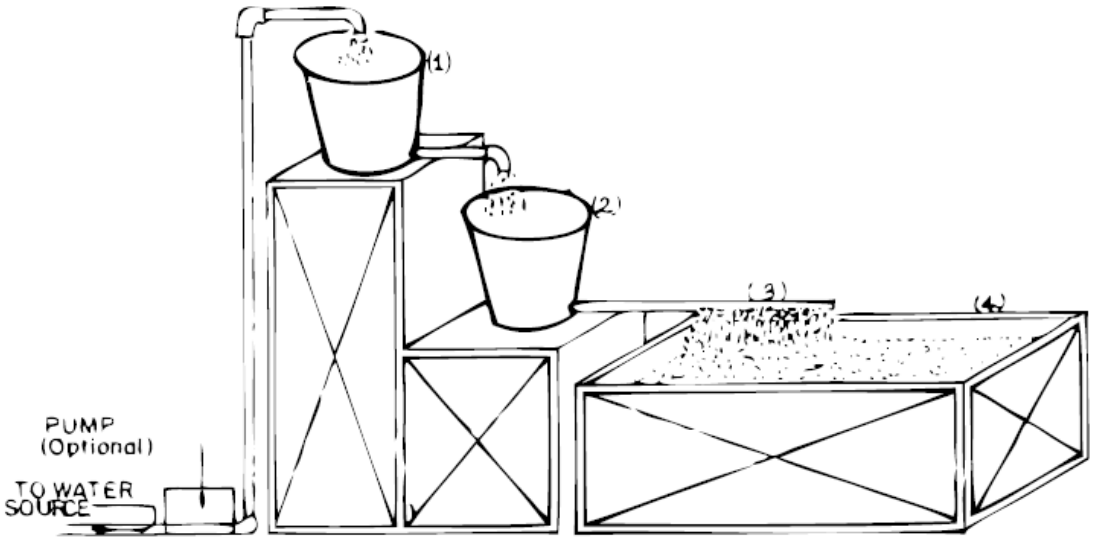


Fig10. Acclimation facilities

Self-check 3	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Why acclimating prawn fry before stocking?(4pts)

2. Write the steps acclimating for fry transported in plastic bag?(8pts)

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

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

Information sheet 4 - Measuring Length of stock samples

Accurate weight-length data for fish (and other aquatic organisms) are essential for many aspects of fisheries management, including stock assessment modeling, evaluating fish condition and health, geographic comparisons of life histories and morphometric, and resource allocation.

Measurements of total length (TL), fork length (FL) and weight (W) are metrics that are not only important, but are also easy to understand, and require little training to collect in an accurate manner. However, in practicality, the collection of weight data can be difficult.

Measuring Length

The fish length will be determined on a measuring board with a linear scale (mm) with a rigid head piece. The board will be calibrated with a second measuring device prior to the fish collection. Before taking measurements of each fish, the measuring board will be visually inspected to ensure that the board is in good working order. The board will be rinsed with salt water between fish.

Procedures

- Place a fish on the measuring board on its right side, with its head facing the recorder's left.
- Hold the head of the fish firmly against the head piece before measuring the fish.
- Measure the total length to the nearest millimeter. Total length is defined as the length from the most anterior part of the fish to the tip of the longest caudal fin ray. (Exhibit 2 demonstrates the different fish measurements.)
- Measure the standard length to the nearest millimeter. Standard length is defined as the length of a fish from the front of the upper lip to the posterior end of the vertebral column.
- Note the fish length on the data sheet in the next fish number of that species.

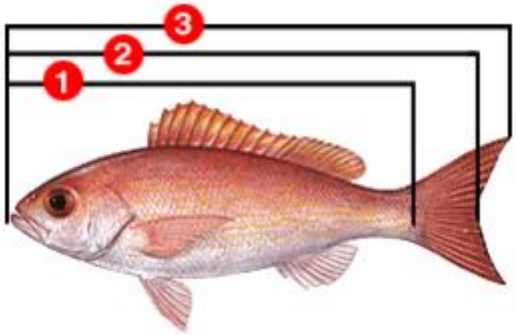


Fig2. Description of Different Length Measurements (1) Standard Length (2) Fork Length (3) Total Length

Self-check 4	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What are the 3 description of Different Length Measurements?(6pts)
2. Write the Procedures Measuring Length of fish?(8pts)

Note: **Satisfactory rating - 14 points** **Unsatisfactory - below 14 points**

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

Information sheet 5 - Selecting, sampling, analyzing, computing and recording feeds

Selecting fish feeds

There are three types of feed used in fish ponds:

- natural feed;
- supplementary feeds;
- complete feeds

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.

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.

Complete 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.

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

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

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.

Supplementary feeds: qualitative aspects

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.

Selecting supplementary feeds

When deciding on the use of supplementary feeds on the farm and their selection, look for feedstuffs that are:

- Of good nutritional values: with high protein and carbohydrate content and low fiber content
- Well accepted by the fish plan to feed;
- Cheap in price: for a given food quality, the lower the cost, the better;
- Available most of the fish-growing season;
- Of minimum additional cost for transport, handling and processing;
- Easy to handle and store.

Many kinds of materials may be used as supplementary feeds for the fish such as:

- Terrestrial plants: grasses, legumes, leaves and seeds of leguminous shrubs and trees, fruits, vegetables;
- Aquatic plants: water hyacinth, water lettuce, duckweed;
- Small terrestrial animals: earthworms, termites, snails;
- Aquatic animals: worms, tadpoles, frogs, trash fish;
- Rice: broken, polishing, bran, hulls;
- Wheat: middling, bran;
- Maize: gluten feed, gluten meal;
- Oil/cakes after extraction of oil from seeds of mustard, coconut, groundnut, African palm, cotton, sunflower, soybean;

- Sugar cane: molasses, filter-press cake, bagasse;
- Coffee pulp;
- Cottonseeds;
- Brewery wastes and yeast;
- Kitchen wastes;
- Slaughterhouse wastes: offal, blood, rumen contents;
- Silkworm pupae;
- Manure: chicken droppings, pig manure

Quantities to use

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

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

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

Example

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

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

Mixing several feedstuffs together

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

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

Self-check 8	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Write at least 5 ingredients of supplementary feeds for the fish?(5pts)
2. What are the production systems of fish farm? And explain it?(6pts)
3. What are types of feed used in fish ponds?(6pts)
4. why should supplement the natural feed available within the pond with artificial feedstuffs originating from outside the pond?(4pts)

Test 2 multiple choice

1. **What is the Select criterion of supplementary feeds**?(2pts)
   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
2. What is the objective of feeding fish?(2pts)
   A. To provide the nutritional requirements for good health
   B. To optimize growth
   C. To optimize yield
   D. To optimize profits
   E. All

Note: **Satisfactory rating – 25 oints** **Unsatisfactory - below 25 points**

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

Operation Sheet 1	Liming

Pond liming

Procedures: procedures of pond liming.

1. Select and fulfill personal protective clothing's.
2. Arrange all necessary materials tools and equipment
3. use calcium oxide (CaO) called slaked lime or quicklime, and calcium carbonate ($CaCO_3$) called chalk or limestone is used as the liming material
4. Calculate the quantity of lime required.
5. Weigh the liming material and convert it into powder.
6. Take the powdered lime in a bucket and spread it evenly in the pond.
7. Wash your hand thoroughly.
8. Using quick lime to disinfect the pond with water.
9. add the lime until the pH of acid water to slightly alkaline (pH 7-8.5)
10. Check the result of disinfecting pond with indicator fish or other aquatic creature after 7 days.
11. Find out the pH value of the pond with the help of litmus paper or pH strips
12. Clean work areas and dispose wastes

Operation Sheet- 2	measuring the length of fish

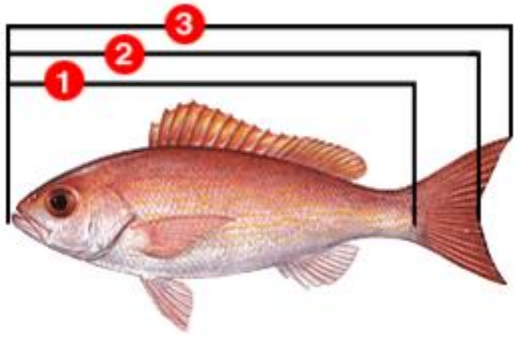
Direction: Perform the following the Procedure given below.

3. Put PPE
4. Arrange all necessary materials tools and equipment

Procedures

- Place a fish on the measuring board on its right side, with its head facing the recorder's left.

- Hold the head of the fish firmly against the head piece before measuring the fish.
- Measure the total length to the nearest millimeter. Total length is defined as the length from the most anterior part of the fish to the tip of the longest caudal fin ray. (Exhibit 2 demonstrates the different fish measurements.)
- Measure the standard length to the nearest millimeter. Standard length is defined as the length of a fish from the front of the upper lip to the posterior end of the vertebral column.
- Note the fish length on the



data sheet in the next fish number of that species.

LAP TEST 1	Performance Test

Name……. ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **4** hour. The project is expected from each student to do it.

Task 1
Identify ingredients and equipment for Liming

Preform successfully liming

Task 2
Identify ingredients and equipment for measuring the length of fish

Preform successfully measuring the length of fish

LG #87	LO #4- Undertake management and monitoring activity

Instruction sheet

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

- Identifying advanced water quality, routine water quality and environmental parameters.
- Determining and arranging equipment and suitable PPE
- Making repairs and calibrations
- Collecting data or record sheets/books
- Taking and analyzing samples
- Confirming labor and resource requirements.
- Selecting and checking suitable PPE.
- Identifying health factors of stock and Making plans
- Identifying and discarding Infected fish
- Identifying and following treatment
- Planning and communicating operational guidelines

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 advanced water quality, routine water quality and environmental parameters.
- Determine and arrange equipment and suitable PPE
- Make repairs and calibrations
- Collect data or record sheets/books
- Take and analyze samples
- Confirm labor and resource requirements.
- Select and check suitable PPE.
- Identify health factors of stock and Make plans
- Identify and discard Infected fish
- Identify and follow treatment
- Plan and communicate operational guidelines

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work..
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, ask your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1 - Identifying advanced water quality, routine water quality and environmental

Understanding the pond ecosystem better

Fish farming, especially prawn farming, requires good knowledge of some basic information on how and why changes occur in the pond's conditions. These changes are mainly the result of interactions among the water, soil, air and the various organisms in the pond. Those include:

A. Soil, water, air and the various organisms in the pond constantly interact. How good or bad the interaction is due largely to available sunlight and weather condition.
B. Water takes in almost all substances such as soils, gases and other pollutants and biological wastes.
C. Salt makes water denser or heavier. The amount of salt is known as salinity and is expressed in parts per thousand or ppt. Seawater's salinity ranges from 32 to 34 ppt. while freshwater has zero ppt., Thus, freshwater will float over seawater. During dry months, it is fairly common for fishpond water to reach a salinity of 60 ppt. or more.
D. Temperature also affects water density. As temperature rises, the density goes down. Warm water will float over cold water.
E. The ability of water to take in (dissolve) oxygen and other gases is reduced by temperature and salinity. Warmer waters hold less oxygen, as do saltier waters. Although water is composed of hydrogen and oxygen, it is not this form of oxygen which is used by aquatic organisms for breathing.
F. Organic matter in the pond such as decaying plants; animals and uneaten food also use up oxygen and produce harmful products such as ammonia and hydrogen sulfide.
G. Dissolved oxygen in the water can be increased by wind action on the surface, by stirring the water with paddle, or by bubbling air in the water. Letting in new water also increases dissolved oxygen content.

H. Water, to a certain extent, contains free hydrogen and hydroxyl ions. The amount of free hydrogen ions is measured in a scale from 1 to 14 known as pH value. Pure water has equal amounts of hydrogen and hydroxyl ions and has a neutral pH of 7. With a pH below 7, water is acidic. Above 7, it is alkaline. For maintenance of plant and animal life, the pH value should be from 7 to 9.

I. Plants in the pond produce oxygen but just like animals, they breathe and use up oxygen. In the process, plants produce carbon dioxide. In the daytime, plants produce more oxygen than they can consume. At night, they stop producing oxygen but continue to use it up and produce carbon dioxide. In so doing, plants lower the dissolved oxygen content in the pond sometimes to the point of depletion.

J. Water pH is affected by soil pH and the amount of carbon dioxide in the water. Some pond soils are by nature acidic. Highly acidic soil is usually reddish. Such soil is not favorable for fish fanning and therefore has to be treated to lower its acidity.

K. Salinity, temperature, dissolved oxygen and pH varies from one pond to another as well as from time to time. A fish farmer must be able to distinguish short-term changes from long-term changes. Short-term changes are those which occur hour by hour within a day while long-term changes are brought about by seasonal variation and sudden changes such as those brought about by a heavy rainfall.

L. During a 24-hour period the most pronounced change which can drastically affect the fish is the rise and fall of dissolved oxygen content. It is generally at its lowest an hour or two before sunrise. Then it slowly rises to its maximum in the early afternoon and declines as the sun sets until it goes down to the minimum level in the early morning hours before sunrise.

M. Temperature also fluctuates during the day but such changes are not usually serious except in very shallow, less than knee-deep ponds. The rise and fall of pH and salinity during a 24- hour period are also not serious.

N. In a one-year period, however, the most significant change occurs in salinity, particularly in regions with pronounced wet and dry seasons. Salinity will rise to 60 or 70 ppt. during the dry season unless freshwater is constantly supplied. On the

other hand, during the rainy season, salinity could become as low as to make water almost fresh.

O. The most serious changes are those brought about by heavy rainfall. Such changes could be disastrous. A big flood can suddenly lower pond water's salinity. Run-off from the dikes in ponds with acidic soil could drastically lower the water's pH from 8 to 3 in a short time. After a heavy rainfall, a layer of freshwater is formed over saltwater thus blocking the interchange of gases between air and water. This will easily deplete the oxygen content in the pond water especially when the air is perfectly still.

Self-check 1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Discus on the effect of Salinity, temperature, dissolved oxygen and pH of water on fish and fish environment (12pts)

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

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

Information sheet 2 - Determining and arranging equipment and suitable PPE

Fish Farming Materials and Resources

Ponds require specific soil types and slopes; so many properties are not suited for building a pond. It's best to consult with aquaculture experts on the viability of any property on which you're hoping to install a pond.

Existing ponds on your property may be easy to stock with fish, but it is recommended that you still consult with local experts to find out what the best fish stocks would be for your region, climate and even your particular pond's ecology.

B. Electrical supply and reliability are critical to most fish farming enterprises. Other supplies needed include:

- Feed appropriate to the fish stock
- Fuel for running the operations
- Medicines because the odds of illness spreading through stock are higher than may expect
- Diagnostics equipment and supplies for measuring pH balance and other needed maintenance

C. Building a Pond

To create a pond, need:

- A digger (hired, rented or borrowed works just fine, of course)
- Sand for lining the pond to reduce tarp tears
- A tarp liner on top of the pond that is compatible and nontoxic for fisheries
- Geotextile fabric to lay over the tarp to protect it from damage since it will secure the water for the pond and reduce the need to refill the water
- For some soil types, it may be possible to use sodium bentonite clay instead of liners, which is more sustainable and more affordable

A. Fish Farming Equipment

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

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

The list of materials and equipment may require is vast and far more comprehensive than what can be listed simply, but it's also specific to the situation in which will work. Some requirements can anticipate include:

- Pipes and plumbing requirements are extensive for anything above ground, and you'll need a surplus on hand for repairs because of pipes failing or clogging, meaning fish will die.
- Back-up generators are critical because power failures mean aeration systems fail, which can be fatal in minutes for crowded tanks.
- For hobby farms looking to stock a pond, cage culture can be good, as a single cage measuring just 3 by 1.5 by 1.5 feet can accommodate up to 100 pounds of fish. Submersible nets may work for pond aspirations as well.
- For tanks or stagnant water, aerators and diffusers are needed to circulate oxygen and diffuse air as bubbles for better dispersion for the fish.
- Filtration is critical for tanks, unnatural bodies of water and any other above-ground method of fish farming since it regulates the quantities of things like ammonia and nitrites and nitrates in the water.

PPE

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

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. List fish Farming Equipment?(6pts)

2. What is the importance of PPE(2pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 3 - Making repairs and calibrations

There are a whole bunch of people who might be in and around equipment on a daily basis who could have a significant impact on its overall operating condition.

Equipment operators are one such group. They typically receive in-depth training on appropriate operating procedures, basic troubleshooting, and best practices for safe equipment use relevant to the machines they'll be working with. However, the day might come when an operator ends up working on a machine they haven't been adequately trained for. Sometimes this situation arises as a result of short staffing or unexpected absences. Other times emergencies come up that require quick remediation with available staff that might not necessarily have the level of expertise that most experienced operators have.

One solution to these problems is to ensure that have enough trained operators to allow for some flexibility and a contingency plan for staff shortage emergencies. If possible, all of your operators should have some training on every piece of equipment even assets they don't typically work with.

Most importantly, never allow an operator to use equipment they are not qualified to run. Not only will this help to reduce operational errors, but in some industries, it's imperative for regulatory compliance. The Occupational Safety and Health Administration (OSHA) set regulations for operator training requirements for certain types of equipment and for general occupational safety. It's up to, however, to know the regulations applicable to your industry and ensure that you have adequate compliance procedures in place.

Perform preventive maintenance

Most equipment requires regular maintenance for optimal performance, but too often, preventive maintenance is the first task to go when you're short-staffed and overwhelmed. It's easy to brush off regular maintenance when things seem to be running just fine, and many companies work under the assumption that experienced workers will identify impending trouble before equipment fails entirely.

That said, many of the subtle signs of slowing performance or the early stages of failure aren't easily detectable and often go unnoticed. In other cases, companies simply lack efficient planning methods for ensuring that ongoing maintenance is performed. Tracking equipment and machinery with asset tags can help to keep maintenance schedules on track and equipment operating at maximum operational efficiency.

Preventive maintenance is one ongoing function that should never be allowed to fall by the wayside. Taking care of the equipment with regular tune-ups will extend the usable life of the equipment, ultimately giving more for every dollar. Additionally, preventive maintenance can identify small problems with inexpensive solutions before they become major, costly breakdowns. When you use effective inventory control strategies to ensure that have the right spare parts in supply for the most common maintenance tasks and malfunctions, downtime for routine maintenance and repairs is minimal. In fact, the estimates that preventive maintenance results in:

- Up to a 30% reduction in energy and maintenance costs
- 35% to 45% fewer breakdowns
- Reductions in downtime by up to 75%

Continuously monitor equipment

The cure here is simple in concept but a bit more complex in execution: condition-based maintenance. This is maintenance that's done based on the operating condition of a piece of equipment, instead of just a 'set it and forget it' schedule. It takes a lot of things into account, from manufacturer information equipment history to real-time data like vibration analysis.

Continuous monitoring relies on sensor data to establish a baseline for what good equipment condition looks like in order to detect subtle changes, which can be used to predict breakdowns and failures. This allows more time for contingency planning and scheduling downtime to minimize production interruptions. This type of monitoring and the data that's collected in the process can help companies identify the causes of increased stress on machinery and adjust workloads and schedules to lessen the load on equipment showing early indicators of impending failure.

Self-check 3	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What is preventive maintenance and write their advantage?(8pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 4 - Collecting data or record sheets/books

A fish farmer without record keeping is like a hunter without aiming and will waste bullets without achieving anything. In any business the keeping of accurate records is a must. The keeping of records in aquaculture is no different and may be even more important than in other types of agricultural enterprises. In an economically viable aquaculture enterprise, the critter may be smaller and in a wet environment, but the producer is no different from a large scale feed lot operator in the Mid-west.

Record keeping should be considered as one of the most important activities for successful farm management and should meet the requirements ISO standards.

Culture Activities:

- Brood stock and back up stocks
- Nursery
- Grow out
- Holding area
- Packing area
- Sales area

These areas should include,

- Date of stocking
- Date of harvesting
- Stocking density
- Mortality, survival rates, discards for each tank
- Target and actual production records
- Daily, weekly, monthly productions
- Feeding records and schedules should be maintained
- Growth rates should be monitored to ascertain expected growth
- Water quality parameters such as pH. Temp. , Hardness. Alkalinity, Ammonia. Nitrite and suspended solids should be monitored.

Disease problems

- Records should be maintained about the occurrence of diseases
- Date of occurrence

- Type of the disease
- Disease symptoms
- Severity
- Applied treatments and success of the treatments
- Prophylactic treatments

Records on environmental parameters (Tank and outside)

- Rainfall
- Temperature
- Wind
- Humidity
- Natural disasters

Management activities

- Cash book should be maintained
- Inventory should be maintained
- Stock book should be maintained
- Leger should be maintained (Sales records, expenses) for cost analysis

Formats of fish farm recording

A. Marketing record

Date	Name and No. of pond	NUMBER OF FISH HARVESTED	AMOUNT OF MONEY SOLD	Remarks

B. General fish management

Tank/POND_-----	Species _____	Initial size: _____ mg Initial number _____	From tank: _____
Transferred to:			
Date			
Age			

Degrees-day
WATER QUALITY
T°C
Salinity (ppt)
DO (ppm)
pH
NH4+ (ppm)
FEEDING
Dry feed 80-200 (g)
Dry feed 150-300 (g)
Dry feed 300-500 (g)
Dry feed 500-800 (g)
Dry feed 800-1200 (g)
Dry feed 1200-2000 (g)
Moist feed (g)
LARVAL QUALITY
Mortality
Average size (mg)
Grader size (mm)
Size dispersion (%)
Deformity rate (%)
Swim-bladder rate (%)
TANK MANAGEMENT
W. exchange rate (%)
Bottom cleaning
Treatments
NOTES

C. Veterinary vaccination records

Date	Name and No. of pond	Frequently happened disease	Treatment and control method	Remarks

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. **What points are included under health record**?(3pts)
2. What is the importance of record keeping?(3pts)

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

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

Information sheet 5 - Taking and analyzing samples

The selection of sampling methods and sampling sites depends of the ultimate purpose. For chemical analysis different principles apply from those relevant to microbiological or veterinary studies. The samples should, of course, be representative both in quality and quantity. A sufficient number of replicates are required to obtain a reliable result. Three replicates are usually considered as a minimum for any statistical treatment of the results. As pointed out in the chapter on the microbiological analysis, the required number of microbiological samples is often five per production lot. This can be considered sufficient also for chemical analysis. The person, who takes the samples, should also have sufficient knowledge of fish anatomy, food processing and environmental niches in the fish habitat to make sure that the samples are truly representative.

Types of sampling from fish and ecology

Sampling from fish

Fish samples are generally taken either from the skin and the mucus (slime), of muscle tissues and of various internal organs (gills, liver, spleen, gonads, and various parts of the gastrointestinal tract.

The following tools and materials are routinely used for fish sampling:

- Substances or instruments for chemical or mechanical euthanasia of fish
- Knives for scraping skin samples (slime, parasites)
- Knives, scissors and forceps or tweezers for cutting fish muscle and internal organs (histology samples, samples for chemical analysis)
- Biopsy needles for sampling fish organs such as kidney, gills, gut, slime (microbiological samples, samples for chemical analysis)
- Saline (0.6%), peptone water, fixatives (histological samples)
- Tools for handling, drying, freezing, homogenization of the tissue sample

Sampling from the fish habitat (sea, lake, river, fish pond)

Water analysis

For the collection of samples for laboratory studies a suitable water sampler such as Ruttner sampler can be used.

- Instead laboratory analyses, field measurements and monitoring are nowadays more often used in aquaculture, as follows:
- Automatic analyzers to monitor water quality, flow etc. (multi-purpose diagnostic kits for main parameters are available, but quite expensive)
- Automatic dissolved oxygen (DO) and temperature meters combined with alarm device.
- Portable temperature recorders; oxygen probes; secchi disc to analyze water transparency; pH meter,

Veterinary sampling

In case of any signs of fish diseases, parasites or other abnormalities in fish behavior are noted, the farm personnel should take independently immediate samples of fish, water and/or plankton community to primarily identify type and occurrence of fish diseases.

Assist veterinary authorities in sampling internal organs of fish and preparing a bacterial sample from fish skin, gills and kidney:

- Open the ventral side of fish with scissors or knife with a longitude cut from head towards anus
- Remove vertical flesh if necessary to see internal organs
- Remove viscera (stomach, gut, organs) and swim bladder
- Take a sample from the kidney by a sterilized tool and place the piece of kidney on a plate with agar nutrient medium in order to start bacterial culture of possible disease organisms
- The sending of the fish to the veterinary authorities should be done as follows:
- Send a few live fish suspected for a disease; plastic bag with 2/3 of water and 1/3 of oxygen
- Kill sample fish by breaking the neck (< 5 cm fish), cutting vertebrate column (<15 cm fish) or by hitting the head (large fish)

- Wrap the sampled fish in moist and thick newspaper
- Cover the package with ice
- Label the package with contact information and details of sample, species, size, age, symptoms

Some specific aspects that should be taken into consideration include:

- Labeling with water proof ink on the label or sampling bottle
- Keep a journal indicating the sampling procedures, samples taken, data on environmental conditions, weather, time of the day, and any other relevant information possibly affecting the analytics and results
- Take photos or otherwise describe of the appearance of sampled water, plankton, mud, fish, seafood, etc. as an additional file of information

Storage and transportation of samples

The general principles of the storage of samples have already been outlined in previous sections. Some special aspects related to certain types of samples or otherwise need to be emphasized includes:

- Plankton samples are fixed with 4% formaldehyde solution and kept in stable conditions
- Water samples are kept in shade, not exposed to sunlight and in insulated cool box (possibly on ice)
- Fish samples are kept alive or on ice depending on the coming analytics
- Primary samples of fish skin, gills, slime etc. are taken on-board the vessel and stored wet and refrigerated for the microbiological analyses
- Seafood samples are kept alive or on ice depending on the coming analytics
- Samples are transported to the harbour/ laboratory during the same day if possible and the cold-chain kept up all the way
- Long-term storage of the samples should be avoided (particularly for hygienic or safety diagnostics) but fixed tissue, plankton, and fish samples keep well for several weeks or months storage

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Write the procedures of Veterinary sampling?(10pts)

2. What are the factors should be analyzed by taking Water sample?(8pts)

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

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

Information sheet 6 - Confirming labor and resource requirements

Resource requirements

Working areas has sufficient size for where the work to be carried out under adequate hygienic conditions. Their design and layout shall be such as to preclude contamination of the product and keep quite separate the clean and contaminated parts of the building.

In areas where products are handled, prepared and processed:

a. Waterproof flooring, which is easy to clean and disinfect and laid down in such a way as to facilitate the drainage of the water or provided with equipment to remove water;
b. Walls, which have smooth surfaces and are easy to clean, durable and impermeable;
c. Ceilings or roof linings which are easy to clean;
d. Doors in durable materials, which are easy to clean;
e. Adequate ventilation and, where necessary, good steam and water-vapor extraction facilities;
f. Adequate natural or artificial lighting;
g. An adequate number of facilities for cleaning and disinfecting hands. In work rooms and lavatories taps shall not be hand-operable. These facilities shall be provided with single use hand towels;
h. Facilities for cleaning plant, equipment and utensils.

In cold rooms where fishery products are stored:

- Where necessary, a sufficiently powerful refrigeration plant to keep products at temperature prescribed in this Code.

Appropriate facilities for protection against pests such as insects, rodents and birds.

Instruments and working equipment such as cutting tables, containers, conveyor belts and knives made of corrosion-resistant materials, easy to clean and disinfect.

Special watertight, corrosion-resistant containers for fishery products not intended for human consumption and premises for the storage of such containers if they are not emptied at least at the end of each working day.

Facilities to provide adequate supplies of drinking water or alternatively of clean seawater treated by an appropriate system, under pressure and in sufficient quantity. However, by way of exception, a supply of non-drinking water is permissible for the production of steam, fire-fighting and the cooling of refrigeration equipment, provided that the pipes installed for the purpose preclude the use of such water for other purposes and present no risk of contamination of the products. Non-drinking-water pipes shall be clearly distinguished from those used for drinking water or clean seawater.

Personal hygiene and conduct

No person who is suffering from a communicable disease or who is a carrier or who is suffering from a condition causing a discharge of pus or serum form any part of the head, neck, hands, or arms, or has reason to believe or suspect that he is likely to transmit disease producing organisms to any fish shall engage in the preparation, packaging or handling of fish or fish product for sale, or of any material used or likely to be used as wrapper or container for fish for sale.

If the occupier of any establishment engaged in handling fish has reason to believe or suspect that any person, whether suffering from a communicable disease or not, is likely to transmit disease shall be excluded from working in any such establishment until the person furnishes a certificate from a medical practitioner that he is free from infection and any condition causing a discharge of pus or serum form any part of the head, neck, hands or arms:

- No person shall spit or smoke or chew tobacco being handled. The consumption of food or drink shall be prohibited. Notices to this effect shall be prominently displayed.
- All persons in the processing area shall wear clean Protective clothing's, including headgear.

- All personnel coming in contact with unpacked fish shall wear waterproof protective clothing, which shall be kept clean at all times and treated with a sanitizer after each days operations.
- Glove used for handling of fish shall be maintained in a sound, clean, and sanitary condition, and shall be made from an impermeable material except where their usage would be incompatible with the work involved.
- Staff shall keep their fingernails short and clean. The wearing of fingernails varnish by employees while handling processed fish with the bare hands shall not be permitted. Employees shall wash their hands with soap and water before starting work and also after each absence from the processing area.

Self-check 6	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What are the Resource requirements in areas where products are handled and processed? (8 pts.)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 7 - Selecting and checking suitable PPE.

Personal protective equipment

Personal protective equipment (PPE) is extremely important in the fishing and aquaculture industries. It includes any clothing or equipment that helps to protect you from injury. To be effective, it must fit properly and be used according to the manufacturer's guidelines. Also, take care not to wear jeweler or loose-fitting clothing that can get caught in nets, hooks, or machinery.

Wear hard hats in areas where you may hit your head. Hard hats should fit snugly around the head, and the chinstrap should always be done up. Newer hard hats are adjustable. Many hard hats also have clamps to secure a light or hearing protection.

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.

Foot protection

Wear boots in areas where you may hurt your foot. 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.

Eyes protection

The eyes are sensitive, fragile, and irreplaceable. Wear protective glasses or goggles when working with hooks, winches, or hoists, and when hauling in nets with live fish. The fish will become agitated and flop around. A fin to the eye could be disastrous.

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. Report any equipment not in working order to the supervisor. Ensure that the person using the equipment is properly trained in its use. If you do not know how to use a piece of equipment, ask for help.

Self-check 7	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. List the PPE important for fish farming?(6pts)

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

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

Information sheet 8 - Identifying health factors of stock

Fish diseases may cause severe losses on fish farms through:

- Reduced fish growth and production;
- Increased feeding cost caused by lack of appetite and waste of uneaten feed;
- Increased vulnerability to predation;
- Increased susceptibility to low water quality;
- Death of fish.

While it may be difficult to avoid fish diseases completely, it is better to try to prevent their occurrence rather than to allow them to develop and then attempting to cure them once they start to cause problems. To cure a fish disease is much more difficult and generally calls for the services of a specialist. By the time proper treatment can be organized, the disease may have become more serious. In some cases surviving fish are so weakened that effective treatment becomes difficult.

Main causes of disease in farm fish

There are several causes of disease that may affect the fish directly or may continue to cause disease problems. Basically, any factor which causes stress or difficulty to the fish decreases its resistance to disease and increases the chance of disease problems occurring.

The three main causes of disease are:

- Improper feeding;
- Stress through extreme or toxic condition;
- Attack by disease organisms.

Characteristic of Health of stock

- Shining and glossy body color
- Normal food and feeding
- Normal swimming
- No external lesion on skin, gills, head, fin and body surface
- Well respiratory rate

- No change of external organ
- No loss of scale
- No physical damage
- Normal growth
- Color of skin and scale are normal and shiny
- No lesion, ulcer, hemorrhage or parasite on the body, etc.

Characteristics of diseased fish

A diseased fish have the following characteristics:

- **Head-standing -** Head standing is a fish assumes a vertical position in the water with its head down.
- **Flashing -** This describes a fish that turns on its side and makes a rapid semicircular swimming motion. These fish will frequently rub on objects in the aquarium as well.
- **Drifting -** This is described as aimless, unprompelled, motion through the water. This is generally thought of as indicative of moribund (dying) state
- **Circling-** This may be a sign one-sided blindness or one-sided fin damage. Circling typically becomes apparent prior to recognizable noticeable fin damage.
- **Color change -** This may involve a fish becoming blanched (paleness or decreased intensity of the entire body). This is commonly seen in situations stress as in cold shock or low levels of dissolved oxygen.
- **Fin-nipping -** Damaged fins and surrounding tissue are potential sites for bacterial infectious
- **Chasing -** This is the rapid movements of one fish in close pursuit of another.
- **Breathing -** Breathing right below the water surface-this is a common symptom which might be telling that the water condition is poor.
- **Difficult swimming -** If fishes are having difficult swimming, it is most likely due to an illness or injury.
- **Loss of appetite -** Loss of appetite is commonly a symptom of disease fish.
- **Gasping at surface -** Fish is gasping his mouth at the surface; this is a sign of stress brought on by poor water conditions, usually a lack of oxygen.

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What are the main causes of disease? (3pts)

2. What are the losses fish farms due to diseases? (6pts)

3. Write the Characteristics of Health and diseased fish stock? (12pts)

Note: **Satisfactory rating - 21 points** **Unsatisfactory - below 21 points**

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

Information sheet 9 - Identifying and discarding Infected fish

All aquaculture operations experience stock mortality and/or harvest of unsaleable stock. Disposal of discarding fish also requires consideration of appropriate biosecurity handling procedures.

To minimize the risk of potential transfer of disease through either carcasses or equipment, the following basic protocols should be adhered to:

- Biological material should be separated from other waste and kept away from water bodies and other contaminates pathways to minimize the risk of spreading pathogenic agents.
- Personnel should maintain appropriate hygiene procedures including the use of safety gear (e.g. gloves).
- In the event of a fish kill, key data and samples should be stored to allow a thorough investigation.
- No disposal of stock mortalities or culls at sea. All stock mortalities must be placed in sealed containers for transport, returned to the mainland and disposed of in landfill according to local waste authority regulations.
- Dead fish should be disposed according to ecologically sustainable development principles:
    - ✓ Fishing operations should be managed to minimize their impact on the structure, productivity, function and biological diversity of the ecosystem

Disposing dead fish stock

- To discourage scavenging or predation by marine fauna, dead stock will be removed from sea cages on a daily basis and disposed to landfill on the mainland in accordance with waste management authority regulations. Under no circumstances is biological waste to be disposed of at sea. To minimize mortality, the following control techniques should be implemented:
- Minimize stock stress during inspections and dead stock collection.

- Implement a Veterinary Health Plan and promptly address any health or welfare problems (in consultation with fish health experts where appropriate).
- Maintain complete records of each inspection, including number of mortalities removed and likely cause of death (determined by appropriately-competent person). Mortalities can then be subtracted from total population to maintain population estimates.
- the identification of appropriate insurance brokers and marine mutual associations,
- Daily removal (weather permitting) and disposal of dead or moribund (wounded or sick) stock to ensure predatory species are not attracted to the farm as well as limit any risk of disease spread.

Self-check 9	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. How to Identify Infected fish?(4pts)
2. Why discard dead and Infected fish?(4pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 10 - Identifying and following treatment

Ich (Ichtyophthirius)

Cause:

It is most common for ich to affect fish that are stressed, which is commonly caused by factors such as rapid temperature increases and pH variations.

Symptoms:

- white salt-like spots starting on the head and spreading over the whole body
- Rapid breathing or gasping at the surface of the water
- Glancing itching itself against tank objects and gravel due to irritated skin
- Clamped fins

Treatment:

Ich is a common disease of fish, and if the fish are treated immediately, you can usually cure ich and avoid more serious stress and disease. A white spot treatment is a low stress-inducing, gradually compounding treatment ideal for treating ich, although this cannot be used to treat sharks, rays, Harlequin Tusk fish, invertebrates and other related species.

Hemorrhagic Septicemia

Cause:

Hemorrhagic Septicemia is an infection that is brought into aquariums by fish already infected with the virus.

Symptoms:

- A variety of different symptoms may be present, however, some fish may show no symptoms
- Bruised-looking red hue to eyes, skin, and gills
- Open sores
- Bulging eyes
- Distended abdomen
- Unusual behavior
- Hemorrhaging of internal organs and skin

Treatment:

Whilst can treat the fish with a multipurpose antibiotic to try and reduce mortality, sadly there is no known cure for Hemorrhagic Septicemia.

Fungus

Cause:

The most common causes of fungus include poor water quality and large amounts of decomposing material present in the aquarium. It often occurs when fish are suffering from an injury or another illness is present.

Symptoms

- Initially, it looks like a white or grey growth in and on the skin, mouth or fins
- Over time the fungus will develop a cotton wool like appearance
- Excess mucus present
- If left untreated, the fungus will kill a fish by continuing to eat away at the fish's body.

Treatment:

Fungus can be treated with the use of a fungal treatment with four separate applications to ensure that it does not burden the already stressed fish.

Dropsy
Cause:

Dropsy is usually caused by a bacterial infection of the kidneys which triggers fluid retention, although it can also be the result of poor water quality and micro-organisms in your aquarium. The disease more commonly affects fish experiencing stress, which compromises their immune system.

Symptoms:

- Swollen abdomen
- Protruding scales around the swollen area
- Loss of appetite
- Sluggish and lack of energy

Treatment:

Catching the disease early is crucial to the success of treatment. Parasite treatment can be applied to your tank over the course of 2 days, but one treatment should work.

Perhaps the most significant treatment is to remove the underlying cause of stress for the fish, and providing supportive care to the sick fish. Examining the water quality, temperature, ammonia levels, tank mate compatibility and other diseases present in the tank are highly recommended.

Fin Rot

Cause:

Fin Rot is often a symptom present in other illnesses; however, this can occur as a stand-alone issue. This is normally a result of a bacterial infection, which causes the tail or fins to fray as the body's immune system is lowered whilst fighting off the illness. Fin rot can also be induced by stress, where fish are bullied or injured by aggressive tank mates.

Symptoms:

- A progressive deterioration of the tail and/or fins
- Fins color may fade

Treatment:

Firstly it is advisable to check that your pH levels are correct. Adding salt to the water can help treat this illness by adding electrolytes to help repair fins. Typically fin rot resolves itself over time; however a treatment of Myxazin can be applied to the water.

Pop Eye (Exophthalmia)

Causes:

Pop eye is often the result of a bacterial infection behind the eye, which causes them to bulge outwardly. However, it can be the result of other issues, such as poor water quality or injury.

Symptoms:

- large protruding eyes, either one or both eyes

Treatment

Whilst pop-eye is very easy to identify, it can be more difficult to treat as it has many possible causes.

If it is affecting more than one fish, water quality is the likely culprit. Carry out daily 30% water changes for up to five days and check your pH levels. If it is the result of an injury, quarantine your fish in a hospital tank to let it recover.

If both eyes are affected, it is more likely to be a bacterial infection and an application of Myxazin to your water can resolve this.

Anchor Worms

Cause:

Anchor worms are small parasites that burrow into the fish's skin and enter the muscles where they lay their eggs. They are the result of introducing new, infected fish into your tank.

Symptoms:

- String-like worms visible on fish's skin
- Points of attachment are marked by inflammation
- Glancing - scratching against objects to itch the infected area

Treatment:

A single dose water treatment such as Aquarium Rescue Parasite Control can be applied to the water to destroy the parasites. Any visible wounds can be cleaned with an antiseptic like iodine.

Self-check 10	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

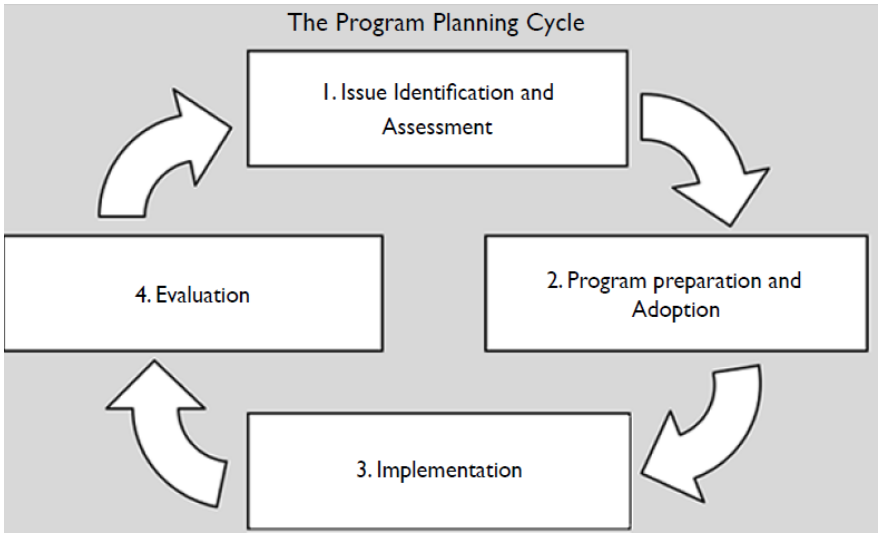
6. **Write the Cause, Symptoms and Treatment for 3 common fish diseases**?(18pts)

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

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

Information sheet 11 - Planning and communicating operational guidelines

Fisheries management planning, not unlike planning in other sectors, follows several basic steps as shown in the figure below. These include: Issue assessment (Step 1); Program preparation and adoption, (Step 2); Implementation (Step 3); and Evaluation (Step 4). Planning and implementation are not necessarily linear, but cyclical and iterative. Fisheries management planning is a strategic process of identifying important fishery and aquaculture issues, setting priorities and articulating specific goals, selecting appropriate activities that address key issues, and developing systems to monitor impacts. This section of the guide is structured around the steps of the planning cycle as they apply to capture fisheries.



Consideration of scale

One of the first considerations in program planning is “scale.” Scale can be viewed in several ways:

- Size scale (i.e., small-scale versus large-scale fishing)
- Geographic scale (i.e., communities or municipalities involved in a fishery, or the fish stock itself)
- Implementation scale (i.e., small pilot demonstration, large-scale sector reform using social networks or seascapes approaches or working with large marine ecosystems or regions)

A complete plan should be prepared covering the project proposal, investigation, the production including its proposed method, engineering features, execution of construction, summary of costs, etc. It should contain a general description of the design including the drawings. The following outline of the items which the plan should cover is included as a guide. Obviously, all of the information listed in this outline is not necessary for any particular small project, but the greater part of it will be usually required for a larger project.

I. Planning considerations

Design criteria and specifications, description of the facilities, and schedule of execution should be stated in this section of the report.

A. Layout of the fish ponds size of ponds
   - Water depth in the ponds

B. Water requirement summary of the water demand calculations

C. Water supply and drainage systems
   - For fish ponds
   - For hatchery building
   - For additional concrete tanks
   - For raceways methods for water filtration or water treatments

D. Description of the facilities
   - Fish ponds
     - ✓ Dikes dike protection
     - ✓ Internal roads
     - ✓ Structures

E. Description of the construction works schedule of execution

II. Cost estimate and cost of production

III. List of detailed drawings

It should contain all drawings required for the project to be executed. The following drawings are most commonly prepared and enclosed with the project plan:

A. Location map

B. Layout plan
C. Setting out plan
D. Cross and longitudinal sections
E. Structural detailed drawings
F. Plans of hatchery and other buildings
G. Plan of pumping station
H. Installation plans

Self-check 11	**Written test**

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What are the steps of fisheries management planning? (8pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

LG #87	LO #5- Harvest and handle stocks

Instruction sheet

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

- Seining pond and cages
- Lifting cages
- Packing and transporting harvested fishes
- Harvesting fish process and store

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:

- Seine pond and cages
- Lift cages
- Pack and transport harvested fishes
- Harvest fish process and store

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, ask your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1 - Seining pond and cages

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

Passive Fish Capturing Methods

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

Fishing with Traps: Fishes can be caught with simple locally made traps such as basket from bamboo made in conical shape. In this method it allows the fish to enter easily but prevent its escape by means of a valve net. Farmers put food inside to attract fish in the non- return valve trap .It is common in lake and rivers the fish are used for home consumption.

Gill Net: The principle in this method is that if a net is hung in a pond or lake the fish will attempt to swim through the net by selecting the appropriate mesh size the farmer can make sure that any fish smaller than he wishes to harvest will swim through the net while the larger fish will get stuck. Fish are caught by the operculum (gill cover), and because of this the net is called a gill net, which rank first in tropical small scale fisheries.

Hook and Line (Angling): The principle used in hook and line fishing is to offer the fish a bait (food) fixed to hook and at the end of a line (rope) Which is attacked to a short bamboo or wooden pole. The fish while trying to bite the bait (food) swallows the hook and then gets caught. The bait may be small animals as earthworms, insects, small fish, and pieces of bread. With this method several hooks could be attached to a long rope fitted with float to catch more fish at one time.

Active Fishing Methods

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

Seine Nets: Seine nets are the most common and effective to collect all the fish in ponds. During Operation, one end of the net is fixed either by means of a stick or by anchoring to the bottom. The free end of the net is moved or pulled along to surround a certain area making a semicircle and finally brought to the fixed stick end(i.e. the starting point) the net is then dragged or pulled into the bank(dyke) enclosing the fish. This can be used in lakes one standing on the shore and other person standing on boat holding the other end and making a circle and then collect them.(This is the method mostly used in different Ethiopian lakes such as lake Ziway, Lake Tana, Lake Awassa.

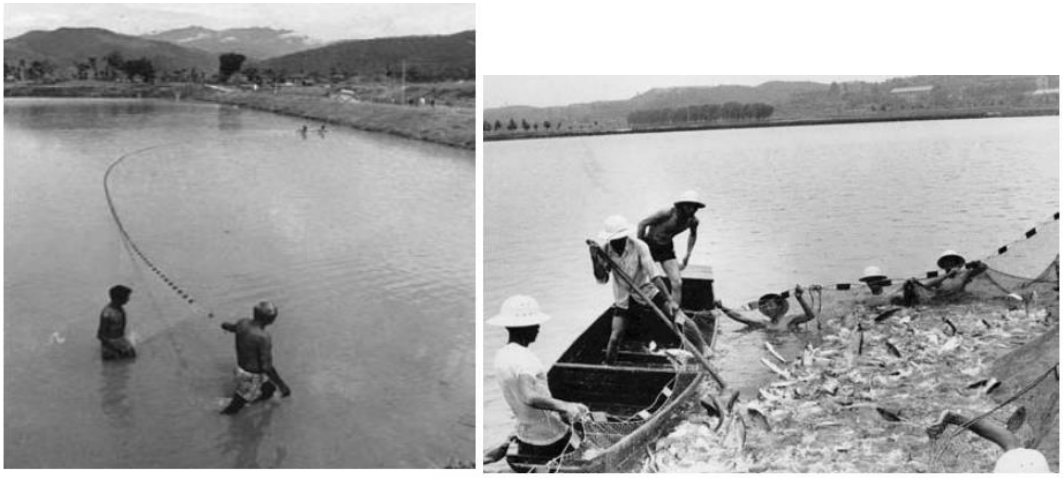


Fig22. A Seining a small scale pond B. Harvesting a large pond with drag net operated from work boats. The net is provided with a mudline.

Cast Nets The cast net is thrown over a group of fish either from land as in ponds or from a boat. The net encircles the fish. The hand line (rope) fatted with lead (weight) and then slowly pulled closing the net, which is then lifted up with the fish.

Hand (scoop) Net: This net consists of bag of netting materials with the mouth of the bag kept open by circular framing with iron fixed to wooden pole or stick. This method usually used to take out alive fish for sample from the pond.

Harvesting by complete and partial draining of the pond if the ponds are small and have convenient inlet and draining system and enough water resource, it is the best

measures for harvesting by complete draining of the pond. The correct harvesting time should be determined according to marketable requirement and size and age of fish.

The following times are the best for harvesting:

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

Harvesting cage and raceway farms

It is comparatively easy to harvest stocks from intensive culture systems, particularly tank and raceway farms. They can easily be drained partially or completely as required and the animals removed by dip nets or suitable mesh.

Special care is taken to avoid undue stress to the fish during harvest, as meat quality is known to be affected by stress. Generally, the fish are transported by live-hauling boats or in plastic tanks installed in boats or trucks.

Harvesting is a complex operation that can be divided into three major parts, as follows:

- Driving and concentrating the fish stock to the catch basin
- Lifting the fish out of the catch basin and placing them on a sorting table
- Sorting the fish and loading them on the transporting vehicle

Self-check 1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What is the advantage of harvesting fish at correct time?(4pts)

2. What is the difference b/n passive and active harvesting?(4pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 2 - lifting Cages

Lifting the fish out of the catch basin is a critical process because the fish are separated from their natural living medium: therefore, gentle handling is needed. Moreover, this process has to be intermeshed with the driving of fish into the catch basin and with sorting and transporting. Different lifting devices have been developed for fish harvesting, but the two major groups are mechanical and hydraulic devices.

Electrical Driving

Electric grids or electrified seines can also be used for driving, where the electric field forces the fish to swim towards the catch basin.

Fish sorting

The harvested fish stock can be sorted according to size and, in polyculture, according to species. When the fish stock is sorted into species it has to be done by hand and the mechanization is restricted to transporting the fish to the feeding table. Usually a horizontal conveyor belt is built into the table that conveys the dominant fish of the polyculture, and only the other species have to be touched by hand and placed aside.

The fish can be sorted into size by different screens. The screen can have several pairs of ribs with an increasing distance from top to bottom. The distance between two ribs is adjustable according to the grading requirement. There are graders where, instead of having fixed ribs, revolving rollers are used.

In order to achieve more accurate grading, there are graders where the fish does not merely slide down on the slope of the table by gravity but is led by an electric motor-driven endless rubber belt with soft rubber fingers above the slot.

Different types of scales are available to weigh the fish, but the four major types are described below:

- Steelyard
- spring balance
- tipping balance
- displacement type of balance

A mobile fish conveyor belt or fish screw is the most efficient method of loading the fish from the sorting table to the transporting vehicle.

The mechanization of fish harvesting does not necessarily mean total mechanization. In some cases, only one phase of the operation is mechanized but there are farms where complex mechanized harvesting lines have been installed.

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What is the advantage of grading?(3pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

Information sheet 3 - packing and transporting Harvested fishes

3.1. Packing and transporting Harvested fishes

I. Packaging of fish

All fish will be wrapped in aluminum foil and then sealed in plastic. The steps to be followed are listed below:

- Place the fish on a clean section of aluminum foil.
- Wrap the fish tightly in the foil.
- Tape the middle section of the corresponding tag to the wrapped fish, and seal it in plastic.
- Bagged fish are placed in the freezer in a larger open bag containing all fish of that species from that site.
- The freezer temperature will be maintained at $0^{o}F$ ($-20^{o}C$) and checked with a thermometer kept in the freezer.
- The processor will initial the sample data sheet when the data is transferred to the computer.

Requirements during Packaging of fish

- The packaging of fish shall be such as to ensure that the product is properly protected from mechanical damage, contamination, leakage, desiccation, and excessive oxidation.
- Units packed within a container shall be reasonably uniform in size.
- Material, which Spares a flavor to or causes discoloration of the fish, or is itself discolored by contact with the fish, shall not be used as the immediate package or carton.
- Frozen fish shall be protected by means of waterproof or vapor proof wrapping.
- All smoked fish shall cool

Treatment of fish

- All fish shall be washed, and the debris removed from the fish prior to storage. Offal and voter shall be kept clear of the fish, and shall be disposed of at the earliest possible time.
- Eviscerated fish shall be washed, and the belly cavity cleaned in clear cool running water.
- Containers for holding fish on the vessel shall conform to the requirements
- All ice shall be derived from water in accordance with and shall be clean and wholesome. Ice shall not be re-used.
- Storing of fish on the vessel shall be done under clean and hygienic conditions. Fish shall not be exposed to deterioration or damage, nor shall it be spiked in the flesh.
- Ice fish stored in boxes, pounds, bins or pens shall be packed with sufficient ice to maintain the fish at temperature between 20 °C and –1 °C for duration of the trip.
- Fish bins and pens shall be provided with removable shelves at not more than 1 m intervals so as to prevent the crushing of fish.
- Where one variety of fish is known to have a detrimental effect on another variety when stored together, each variety shall be stored in separate bins.

II. Transporting

A. Requirements at point of unloading from fishing vessel

- Unloading procedures shall be in accordance with sound commercial practice, and fish shall not be left exposed to sunlight, rain, wind, extremes of temperature, or contamination by birds and vermin.
- Any conveyors, fish pumps, or other mechanical systems which are used for unloading and which come into contact with the fish shall be maintained in good repair and thoroughly cleaned and treated with a sanitizer after each operation.
- Unless the fish is to be processed immediately, fish which has been de-iced during unloading shall be re-iced or placed in a chiller operating at temperature between 2° and –1° within 3 hours.

B. Requirements during transportation

I. From the fishing vessel to shore establishment

- Fish or fish products for human consumption shall not be transported in containers or vehicles where spoilage or contamination is likely to occur from contact with other goods. Offal or bait not treated in the same manner, as edible fish shall be kept physically separated.
- Containers and the freight compartment of vehicles shall be so constructed as to be easily cleaned and drained. Material used for lining shall be corrosion resistant and impervious to water.
- Containers and the freight compartment to vehicles shall be kept clean.
- Returnable containers shall be constructed of all metal or plastic material, or a combination of these materials. Returnable containers shall not be used for any purpose other than for holding and transportation of fish.
- Non- returnable fish containers shall be constructed form new uncontaminated materials. Non-returnable fish container shall not be reused for the holding and the transportation of edible fish.
- Containers shall not be filled to such a degree as to cause damage to the fish where one container is placed on another.
- Where removal trays are used as liners in a vehicle, fish shall not be carried loose in them unless completely protected from contamination. Trays used for the transport of fish shall be effectively cleaned and treated with a sanitizer after use.

II. Specific requirements for processed fresh fish

Fish or fish products shall not be offered for transport when the internal product temperature is higher than 2 °C, except as provided for in Clause 3.3 Fish in a spoiled or an incipient spoiled condition shall not exceed the external temperature of 2 °C.

III. Specific requirements for frozen fish and frozen fish products

- Frozen fish shall not be transported or offered to transport when the internal temperature of the product intermediately before loading is higher than –18 °C.

- Frozen fish shall be continuously maintained at a temperature not higher than –18 °C during transportation.
- Frozen fish shall be transported in insulated containers or insulated vehicles of thermal insulation efficiency, adequate to maintain the required temperature, or shall be kept at the required temperature by the use of mechanical cooling, frozen carbon dioxide, or other equivalent techniques.
- Containers and vehicles equipped with refrigeration equipment shall be pre-cooled to an air temperature not higher than –7 °C before loading starts. Loading and unloading of frozen fish shall be completed with the minimum of delay.
- Frozen fish shall be loaded within a refrigerated transport vehicle in such a manner as to leave an air space of at least 25 arm and preferably 50 mm between cargo and floor, wall and roof.
- During any time interval when loading or unloading operations ceases, mechanical refrigeration equipment shall be turned on and be operation, and doors or containers and vehicles shall be kept closed.

Self-check1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Write the procedures of Packaging of fish?(4pts)

2. What are the Specific requirements for processed fresh fish?(6pts)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

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

Information sheet 4 - Processing and storing harvested fish

Fish Processing

Chilling

Fish shall be chilled immediately after catching (or after bleeding and gutting if these processes are done immediately after catching) so as to reduce the temperature of the fish to below 20 C as quickly as possible, and shall be maintained between 2 °C and –1 °C until processing begins. The chilling media shall be ice, refrigerated seawater or chilled sea voter. The ratio of fish to ice shall be 1:2.

Frozen fish

Treatment Before freezing, fish shall be washed thoroughly and drained. The fish shall then be packed in suitable containers, and it shall pass through the critical zone from 0 °C to –5 °C in a period not exceeding 6 hours. The process shall not be regarded as complete unless and until the product temperature has reached –18 °C at the thermal center.

Smoked fish

Product designation

The end product of this process shall be designated under the following names, followed by the name of the fish:

- Hot smoked
- Dry smoked or hard smoked
- Cold smoked

Essential composition and quality factors:

- Raw material
  - ✓ Smoked fish shall be prepared from dressed fish fit for human consumption.
  - ✓ The fish after dressing shall be subjected immediately to the smoking process.
- Treatment
  - ✓ The fish shall be subjected in accordance with sound commercial practice, to the action of smoke from wood.

- ✓ The wood shall be free from gum, paint, timber preservative or other added substances.
- ✓ Hot smoking — the fish shall be subjected to the action of hot smoke until the fish is well cooked. The temperature for smoking shall not be less than 40 °C.
- ✓ Dry or hard smoking — the fish shall be subjected to the direct action of fire until the fish is well cooked. A subsequent treatment by a cold smoke shall follow for at least one day, depending on the quantity and size of the fish being smoked.
- ✓ Cold smoking — the fish shall be washed and salted. The fish shall then be subjected to the direct action of cold smoke at a temperature of not more than 40 °C.

- Equipment — any smoking oven made from mud, concrete or drums may be used, provided that the distance from the fire to the fish shall be at least 90 cm. If the traditional rectangular ovens are used, any airtight material, so as to ensure a uniform smoked product, shall surround the gratings.
- The premises for smoking — the place for handling and smoking fish shall be enclosed with a roof and screened with mosquito netting and shall be rodent-proof.
- Characteristics of well-smoked fish
  - ✓ The smoked product shall have a characteristic smoke flavor.
  - ✓ The smoked product shall have a characteristic golden, color, and shall show the dry glossy pellicle condition typical of satisfactory smoking process.
- Storing temperature

Self-check 5	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What is the difference between chilling and frozen fish? (8pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

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

LG #89	LO #6- Control and prevent common disease and parasite of fish

Instruction sheet

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

- Identifying Common fish disease and recognizing their symptoms
- Recognizing and applying disease prevention and control measures
- Isolating and disinfecting Infected tools and equipment
- Marking and protecting the infected pond
- Reporting the outbreak

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 common fish disease and recognizing their symptoms
- Recognize and applying disease prevention and control measures
- Isolate and disinfecting Infected tools and equipment
- Mark and protecting the infected pond
- Report the outbreak

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, ask your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1 - Identifying Common fish disease and recognizing their symptoms

Pond owners should observe their fish for these symptoms to identify fish disease.

Risky Behavior – Some fish tend to rise to the surface and make them easily accessible to prey. Others change their usual behavior patterns and start staying at the bottom of the pond.

Breathing Difficulties – Some diseases make it difficult for the fish to breathe. In such cases, the fish gulp air above the water surface or breathe heavily.

Visible Spots – Certain infections cause spots and lesions on the fish's skin. Pond owners should check their fish's body for these physical signs of disease.

Physical Changes – Some fish diseases cause the pond fish to lose their appetite. The fish drop weight and also become lethargic.

Infectious disease

This type of disease is mainly caused by the pathogens of virus, bacteria, fungi or unicellular algae, for instance, bacterial enteritis, bacterial gill rot and bacterial erythema.

I. Characteristics of infectious disease

i. Infectious disease can be divided into acute, sub-acute and chronic forms based on clinic picture, e.g. if a fish occurs in an acute form; it develops rapidly and soon reaches the high peak of mortality. It also goes off quickly. On the contrary, chronic enteritis kills only a few fish per day, but it lasts a long time.

ii. Bacterial pathogens of infectious diseases are not strictly parasitic microorganisms. If the condition for parasitism is unsuitable, it will lead a saprophytic life. These pathogens have a high adaptability to the changes of environmental conditions.

iii. Most pathogens of infectious diseases show a preference for certain spp. some fish and to certain organs

II. The course and forms of infectious diseases

The infectious diseases can be divided into two forms: pure infection (a fish infected by one kind of causative agent) and mixed infection (infection with over two kinds of pathogens on a single fish.

III. The origin of infectious diseases and the mode of infection

Regarding the origin, there are two kinds of sources: primary source and secondary source. Most sick fish as primary infective source are the carriers of pathogens of variant infectious diseases in natural world. The pathogen infects intact fish school by virtue of direct contact or the discharge of morbific agents into ambient water. Sometimes healthy fish themselves in pond are the “carriers”, the outbreak of fish disease will happen if conditions are favorable.

Disease-free pond could be polluted by contact with the pond water, coming from diseased ponds, with contaminated feeds, gears, etc. resulting in an occurrence of disease. These are so called secondary source. Pathogens are widely spread through these approaches.

IV. Resistance of fish against infectious diseases

Infectious diseases normally attack fish body through tissues and organs, such as skin, gill, intestine tract or excretory organ but fish have their own resistance against pathogenic microbes. Such a surface texture of skin and mucous membrane of fish functions as a screen to keep the infectious microorganisms out of it. The pathogenic microbes entering digestive tract will be under the influence of high disinfecting secretions from the organs of digestive tract.

V. Invasive diseases

Such diseases are caused by animal parasites, like trichodinasis, , argulusis, etc. Fish carrying parasites or corpse of diseased fish are the direct sources of invasive disease. It is called the primary source. And objects accompanied with direct source, such as

contaminated feeds, gears, pond water and silt, etc. are called indirect source, or secondary source.

The occurrence and spreading of infectious and invasive diseases often appear in different seasons, because the pathogens and fish are influenced by outside factors (such as place, climate, physicochemical property of water and farming skills, etc.) and inner factors (such as growth and physiological status),

Self-check1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What the general symptoms disease? (8pts)
2. Write the Characteristics of infectious disease? (8pts)

Note: **Satisfactory rating - 16 points** **Unsatisfactory - below 16 points**

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

Information sheet 2 - Recognizing and applying disease prevention and control measures

Preventing fish diseases

Prevention is better than treatment has been a radical theory in medical science. Fish are schooling animals in water which brings up difficulties in observation, diagnosis and treatment. Apart from this, some effective drugs and measures to cure certain fish diseases are still unknown up to now. Therefore, perfect preventive measures must be taken since it is a key point to the control.

Good nutrition and proper water quality (= plenty of dissolved oxygen) are the most important factors for good fish health. Many of the potential pathogens (organisms which can cause disease) of fish species are normally present in the water waiting to 'attack' when environmental conditions become bad. Under such conditions the fish become stressed and their resistance to diseases is lowered. There are some basic rules to be observed in order to prevent, or control, disease outbreaks:

- Ponds must have separate water supplies. It is not advisable to supply a pond with water from another pond, since this water may carry diseases and the level of dissolved oxygen may be low. It is therefore wise not to design ponds in series.
- Fish must be kept in water with optimum conditions at all times: water with plenty of oxygen, with the correct pH and with low ammonia content.
- Fish must not get stressed. If you handle the fish, take great care so that you upset them as little as possible. Extreme stress can be the direct cause of fish death. Damage to their skin (rubbing off the scales and the protective slime layer), means pathogens can enter the fish more easily.
- Great care must be taken that no sick fish are introduced when mixing fish from different ponds, or when introducing new fish into the farm. New fish to the farm site should be kept in a separate pond until it is certain that they do not carry a disease. Only then should they be brought into contact with on-farm fish stocks.

- Any change in normal behavior may be a sign of disease. Signs to look for include gasping at the surface for air, rubbing the body or head against the sides of the pond, or ragged fins and sores on the body. Something is wrong when fish stop eating suddenly.
- Must check the fish often, especially in very hot weather, as dissolved oxygen shortages occur often (in warm water less oxygen can be dissolved than in cold water).
- Do not get discouraged if you occasionally find a dead fish in the pond. This also happens in nature. Watch out, however, for large numbers of dead fish. If large numbers of fish die, try to find out the cause.

To achieve a high production of fish in the pond, regular maintenance and monitoring is vital. Daily management includes:

A. Keep the pond environment in good condition

- Checking the water quality (oxygen, pH, color, transparency, temperature, etc.)
- Checking the pond for possible water leaks
- Cleaning the screen of the water inlet and outlet
- Observing the fish while they feed: Do they eat normally? Are they active
- If not, and if they are gasping for air at the surface, the oxygen level in the water is too low. Stop feeding and fertilizing and let water flow through the pond until the fish behave normally again. Otherwise, look for symptoms that could indicate a disease.
- Watching out for predators, or signs of predators such as footprints, and taking precautions if necessary
- Removing aquatic weeds growing in the pond Water quality is a vital factor for good health and growth in fish. Some of the most important water characteristics are described below.

B. Keep the fish in good condition: control stocking density. Keep different sizes or sexes separate if necessary to control fighting. Ensure good food supply. Handle the fish properly, especially during harvesting and sorting/grading. Care for your fish during storage and transport.

C. Prevent the entry of disease organisms from outside the farm:

- Control wild fish by using filters and screens and regularly eradicate them from canals and ponds
- Disinfect all fish stocks imported from outside as eggs, juveniles or adults
- Be careful when using trash fish or processing wastes as supplementary feed

Fish disease control

- Control fish-eating predators, particularly birds and mammals
- Disinfect ponds regularly to kill both the disease organisms and their intermediate hosts; keep different age groups of fish separate; disinfect breeding ponds well and, if possible, remove brood stock from them as soon as spawning has taken place;
- Use diversion ponds with parallel flow if possible; if your ponds are arranged in series, it is best to have the water flow from the ponds with the less infected and more sensitive, youngest fish into the ponds with the oldest fish (more infected and less sensitive);
- Disinfect juveniles before stocking them in clean fattening ponds; treat brood stock before using them for propagation in breeding ponds
- If a disease breaks out on the farm, remove dead or dying fish from the ponds as quickly as possible, at least daily, and do not disturb and stress remaining fish excessively;
- Bury diseased fish with quicklime away from the ponds; carefully treat infected ponds and disinfect all equipment that has come in contact with them
- In a hatchery have separate equipment for handling small and large fish, if possible keeping one set of hand nets, buckets, etc. For each tank or pond;
- Use disinfectant bins for routine disinfection of equipment, and clearly mark the equipment accordingly.

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. How to control fish disease though good management? (8pts)
2. How to prevent the entry of disease organisms from outside the farm? (8pts)

Note: **Satisfactory rating - 16 points** **Unsatisfactory - below 16 points**

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

Information sheet 3 - Isolating and disinfecting Infected tools and equipment

Fish diseases are easily transferred on wet, slime-laden or muddy equipment. In fact, exposing fish to fresh slime is almost as risky as exposing those to new fish. Drying equipment such as seines before each use kills many fish pathogens. Better yet, use warm water and detergents to clean equipment such as buckets, boots, waders and vehicles and then dry them. Transport trucks and other vehicles can be cleaned easily with a high-pressure hose at the local carwash. For the best results in killing pathogens, must clean, disinfect and dry equipment before it is used elsewhere on or off the farm. This is especially critical for equipment that has been used to handle, harvest or transport sick fish.

Disinfecting equipment on fish farms

For safe and hygienic practice, the following equipment should be regularly disinfected:

- hatchery equipment: incubators, trays, troughs, nets, brooms, buckets, tanks, pipes, valves, screens, etc.;
- handling equipment: containers, handling nets, transport equipment, graders delivery chutes, etc.;
- Boots, waders, protective clothing, vehicle wheels, sampling equipment.

To disinfect this equipment properly proceed as follows:

- Clean it well by brushing and rinsing.
- Apply one of the chemical solutions shown in the following chart, either with a sponge or a brush; whenever possible, immerse the equipment fully into the solution. Preferably use protective gloves.
- Wait for 10 to 15 minutes.
- Rinse thoroughly several times to remove toxicity, before using for fish.

Fig3. Transport trucks and other vehicles can be cleaned easily with a high-pressure hose at the local carwash.

Fig1. Drying equipment, such as seine nets, before using them kills many pathogens

In summary, prevent diseases by scrubbing equipment with warm, soapy water and then drying the equipment thoroughly before reuse. Clean, rinse and dry trucks, seines and other equipment used for fish from another facility or fish from the wild. Applying a broad-spectrum disinfectant to cleaned equipment gives further protection to your fish stocks.

Fig4. Earthen ponds can be disinfected by drying and treating with hydrated lime.

Disinfecting tanks

Clean the tank thoroughly, especially in corners and drain areas. Apply the recommended solution either by hand with a brush or sponge or using an agricultural sprayer. Protect yourself properly, with gloves, goggles, mask and waders, especially while spraying.

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

3. How to disinfect this equipment properly? (8pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory – below8 points**

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

Information sheet 4 - Reporting the outbreak

Out break

It is defined as an unexpected occurrence of mortality or disease. This may be due to significant pathogens or to water quality changes such as plankton blooms or sudden or severe decreases in dissolved oxygen levels. Vigilant monitoring and early detection is the key to good management of emergencies. Emergency disease control requires a coordinated response drawing on significant resources and input from all tiers of government and a range of industry groups.

In the event of a disease outbreak, the farm manager initiates quarantine, movement controls and assessments around the initial site which may include the submission of fish and water samples for diagnosis. The significant disease incidences should be reported to the Department of Fisheries within 24 hours. The farm manager will consult with farm and laboratory veterinarian on control strategy based on available information.

Successful control may require determination of where the disease might have come from, and where it might have been spread to. Depending on whether disease is in the notifiable livestock disease lists, there might be a need to eradicate by culling affected fish. There might follow a period of quarantine and movement control until surveillance clears the farm of the disease.

Investigation and report

The Veterinarian may require records and appropriate sampling to determine cause of the outbreak and best course of action. The Veterinarian and/or Fish Health Manager will give instructions for proper sampling. Water and feed samples may be requested. Samples will be properly handled, properly stored and promptly shipped as per the Veterinarian's or Fish Health Manager's instructions.

Parameters that may be useful to maintain records and from part of significant information or history during disease investigations include:

- Source of fish;
- Period on farm e.g. newly arrived;
- Dates of disease onset;
- Age/fish species affected;
- Recent handling, grading, net changes, tank transfer, etc;
- Stocking density;
- Mortality pattern; and

- Water quality/recent weather/tide conditions

Establish existence of an outbreak

"The occurrence of more cases of disease than expected in a given area or among a population of fish over a particular period of time"

- Epidemic applies to situations involving large numbers of fish over a wide geographic area
- An outbreak applies to a localized increase in incidence of disease
- A cluster is an aggregation of disease cases in a given location over a particular period without regard to whether the number of cases is more than expected.

Where do we start?

Diagram 1: step of investigation of disease

Subject to the type of reporting, a cluster of cases may/may not represent an outbreak
Other factors to consider:

- Severity of the disease
- Potential for spread
- Availability of control measures
- Political considerations
- Public relations
- Available resources
- Environmental

Standardized approach for field investigation

Fish disease investigation kit for site-based investigation should include:

- Data collection form
- Dichotomous key to reach a preliminary diagnosis
- List of suitable techniques for the preservation, storage and transport of samples collected during the initial investigation.
- List of veterinary laboratories that may be contacted, including contact details.

Dissecting and sampling instruments and suitable sampling and preservation chemicals and containers

Self-check 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. Write the information or history recorded during disease investigations? (8pts)
2. Write the step of disease investigation? (8pts)

Note: **Satisfactory rating - 16 points** **Unsatisfactory - below 16 points**

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

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