# CHAPTER 5
# Aquaculture

**OBJECTIVES**

At the end of the chapter, students should be able to:
â—† define aquaculture and name different types of aquaculture.
â—† explain the meaning of fish farming.
â—† state the importance of fish farming.
â—† state the conditions necessary for siting a fish pond.
â—† establish and maintain a fish pond.
â—† state the basic laws and regulations on fishing.
â—† identify different fishing tools and their uses.

## 5.1 Introduction

Fishing in natural rivers and sea is becoming less preferred due to the increasing cost of fuel and other inputs such as fishing boats and associated gadgets. Also fishing in natural waters is restricted to areas with rivers or natural proximity to the sea and ocean. It is therefore necessary to look for other means of supplying fish to meet the needs of the people. Rearing fish in artificial ponds and tanks has become popular because it provides opportunity for all interested persons to establish a fish farm.

Fish is very important in human and livestock diet. It contains large quantities of protein for good health and growth of the body. Fish contributes to the food supply of human beings.

The term â€˜fishâ€™ is applied to a variety of cold-blooded, water-dwelling (aquatic) of the phylum Chordata. Fishes belong to four different classes consisting of bony, cartilaginous, jawless and fleshy-finned fi shes.

Fishery is the study and production of fishes, shrimps and other aquatic organisms. It involves the rearing of fish in artificial ponds, cages and other enclosures in coastal waters, lagoons, fresh waters and reservoirs.

## 5.2 Definition of Aquaculture

Aquaculture is the propagation and husbandry of aquatic animals and plants for commercial, recreational and scientific purposes. Aquatic animals reared in aquaculture include fishes and shell fishes.

### Types of Aquaculture

â—† Fish rearing or fish farming
â—† Shrimp rearing
â—† Crab rearing
â—† Crayfish rearing
â—† Lobster rearing
â—† Prawn rearing
â—† Oyster rearing
â—† Marine snail rearing
â—† Squid rearing
â—† Mussel rearing
â—† Clam rearing
â—† Whelk rearing
â—† Octopus rearing
â—† Scallop rearing

â—† Rearing of aquatic mammals such as whales
â—† Seaweeds and plankton raising

## 5.3 Meaning of Fish Farming

Fish farming is the act of rearing selected fish species in an enclosed body of water such as ponds, lakes, streams and rivers, for food or other useful purposes. When fish farming includes other fresh water and marine species such as prawns, shrimps, crabs, lobsters and crayfish, it is usually called aquaculture.

## 5.4 Importance of Fish Farming

Fish farming is important for the following reasons:
**1.** As a source of good quality protein in human and livestock diets.
**2.** Fish farming provides employment and income for those engaged in it.
**3.** Fishes are used in controlling diseases like malaria and other mosquito-borne diseases by feeding on mosquito larvae.
**4.** Some whole fish and fish bones serve as raw materials in making livestock feeds.
**5.** Fish oils (cod liver oil) serve as food and are also used in the manufacture of soaps.
**6.** As ornament – the scales of some fishes yield a substance that when coated on the inside of glass beads makes artificial pearls.
**7.** The lining of the air bladder of sturgeons is used to make glass and a shiny powder used as an absorbent in the wine industry.
**8.** Fish farming ensures better utilization of land and water.
**9.** Fishes are used in the laboratory for educational activities and other scientific researches.
**10.** Provides a means of recycling domestic wastes such as animal dungs.
**11.** Fish farming helps in the preservation and propagation of various kinds of aquatic species.
**12.** Important for sports and recreational activities such as fishing festival and sport fishing.
**13.** It is also important for aesthetic pleasure as in the case of home and public aquaria.
**14.** Source of foreign exchange through the exportation of fish and fish products.

## 5.5 Classification of Fishes

Fishes can be classified into two types on the basis of:
**1.** Habitat
**2.** Morphology

### 5.5.1 Classification Based on Their Habitat

**i. Fresh water fishes:** These live and reproduce in fresh water, free of salt such as rivers, ponds, lakes and streams. Examples of fresh water fishes are tilapia, mudfish, catfish, *Heterotis niloticus*, pike, trout, moon fish and Nile perch.

FIGURE 5.1 Some examples of fresh water fishes

**ii. Salt water or marine habitat:** These live and reproduce in salt water, such as lagoons, oceans and seas. Examples of salt water fishes are shark, tunas, mackerel, skate, sardine, croaker, ray, dogfish and stock fish.

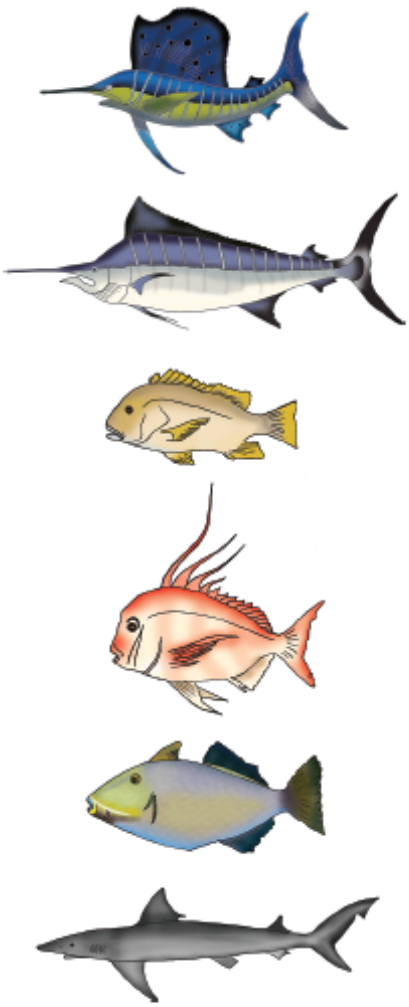

FIGURE 5.2 Some examples of salt water fishes

### 5.5.2 Classification Based on Their Morphology

There are two types of fishes based on body morphology.

**i. Bony fishes:** These possess bony skeletons or hard bones. Examples are catfish, tilapia, salmon, mudfish, croaker and mackerel.

**ii. Cartilaginous fishes:** These possess soft bones or cartilage (biscuits bone) instead of true bones. Examples are shark, dogfish and dolphin.

### 5.5.3 Conditions Necessary for Sitting a Fish Pond

The following conditions are necessary in the sitting of a fish pond.

**1. Availability and quality of water:** Fishes can survive only in water because they are aquatic animals. The source may include streams, rivers, springs, wells or boreholes. There must be adequate or sufficient water to rapidly fill the pond. Such water must be free of pollutants and aquatic weeds. The water must be colourless, odourless and tasteless.

**2. Soil type:** Since a pond is a depression for holding water, soil with a good proportion of clay is desirable, in order to hold water and prevent seepage from the bottom.

**3. Vegetation of the site to use:** Grasslands are preferred since they are cheaper than wooded sites. Clearing and stumping of trees will greatly increase the cost of the project.

**4. Topography:** The ideal topography for fish ponds is that which allows the farmer to fill and drain ponds using gravity. Ponds built on a slope can be drained easily.

**5. Presence of suitable fingerlings:** Fish fingerlings to be stocked must be suitable, able to grow rapidly within a short period for quick maturity. They must possess high feed conversion efficiency and be ready for harvest at about 6–7 months from the time of hatching.

**6. Availability of high-quality feed:** Artificial feeds (pellets) are needed to supplement the natural feeds (planktons). For fish fingerlings to grow rapidly, they must be fed adequately with the right kind of feed.

**7. Market:** It is necessary to ensure that there is ready market in the farm area because fish is highly perishable unless it is processed and preserved.

**8. Availability of labour:** Fish pond should be sited in a place where labour supply is high, since the required work such as clearing, stumping, land excavation, feeding of fish down to harvesting and processing activities is labour-intensive.

**9. Location of the hatchery:** Fish fingerlings are very fragile and die off easily; hence they must be introduced into the pond immediately after being taken from the hatchery.

**10. Security or safety of the fish:** The fish pond should be located where there is adequate protection from thieves and predators.

**11. Size and location of the pond:** The size depends on the available funds and the types of fish farming to be practiced. For commercial fish farming a large expanse of land is required. The location can be either in lowland or in upland.

## 5.6 Establishment of a Fish Pond

The following operations are necessary for the establishment of a fish pond:

**1. Site selection:** All the conditions necessary for sitting a fish pond such as perennial source of water, soil type, topography, vegetation and a fairly open area should be fulfilled.

**2. Survey of the site:** It is important to determine the volume of earth, height of the pond, total water surface area and volume of water in the pond. A detailed survey of the selected site must be carried out.

**3. Clearing and stumping:** Complete clearing and removal of stumps and roots with the use of machine or manual labour.

**4. Construction of dam:** The dam should be constructed across the stream. Digging may be done manually or by the use of an excavator. The shallow end should be 1.2 m and the deep end 1.5 m to create a water current which improves aeration.

FIGURE 5.3 Fish pond

**5. Construction of core trench:** This involves the excavation of the land at the right angle to the dam. The walls should be consolidated with stones or cement walls.
**6. Construction of spillway:** Spillway or overflow is positioned above the required level of water to drain away excess water. It is screened at the inside with wire mesh to prevent fish from escaping.
**7. Fencing, shading and grassing:** Fencing is for security, shading at one end provides cool, comfortable water and grassing helps to check erosion and also attracts insects which serve as food for fish.
**8. Liming:** This is the addition of calcium containing compounds such as calcium carbonate ($CaCO_3$) powder. Lime is broadcast into the pond to reduce seepage and to enhance the growth of planktons. It also reduces the acidity of the pond/soil.
**9. Fertilizer application:** Fertilizers such as single superphosphate and sulphate of ammonia should be applied after liming to encourage the development of planktons such as algae.
**10. Impoundment of pond:** This is the filling of the pond with water and allowing it to stand undisturbed for 2 weeks. During this period, planktons will grow on the water and the water appears green.
**11. Stocking:** This is the introduction of fish fingerlings into the pond. It involves putting the required number of fish fingerlings into the water. Fishes of the same age and species (monoculture) should be stocked. The stocking rate varies with species ranging from 10,000–20,000 for carp and 20,000 for Tilapia per hectare. Stocking is done in the morning or evening. The bag containing the fingerlings
should be placed gently into the water and the fingerlings are allowed to swim into the pond themselves.
**12. Introduction of feeds:** Feeds should be provided for the stocked fingerlings. The feeds should be rich in vitamins, proteins, carbohydrates and minerals for the proper growth of fish.

### 5.6.1 Maintenance of Fish Pond

**1. Regular feeding:** Supplementary feeding must be done twice daily to ensure rapid growth and early maturity of the fish. The natural food of planktons should be supplemented with pellets such as groundnut cake, soya bean cake and maggot meal.
**2. De-weeding:** Weeds should be removed from the pond in order to ensure adequate supply of dissolved oxygen. It ensures hygienic medium for the fish. It improves penetration of sunlight for increased photosynthesis by phytoplanktons.
**3. Desilting:** This is the removal of silts from the bottom of the pond. It makes the water clear so that adequate water is taken in. It also ensures adequate oxygen supply and reduces turbidity of pond water. It also reduces accumulation of unconsumed feed. Desilting is also carried out to maintain proper depth of fish pond, makes movement of fish easy and prevent water pollution.
**4. Pond fertilization:** This involves regular application of fertilizers to ensure efficient supply of aquatic plant food in the pond. It stimulates the growth of phytoplanktons which are major suppliers of protein and carbohydrates needed for the rapid growth of the fish.
**5. Eradication of predators:** The pond surrounding should be clean to prevent predators. Carnivores such as snakes, frogs, crabs and wild fish should be removed from the pond for maximum yield.
**6. Disease control:** Fish disease can be easily prevented through good pond management such as

adequate feeding, adequate stocking, weeding, manuring and proper aeration. If infection occurs, it should be treated with appropriate drugs such as copper sulphate, bromex and potassium permanganate.

**7. Maintenance of water level:** Always ensure that the pond is full of water. Block all sources of leakages and top up the pond water to its required level.

**8. Oxygen management/aeration:** This could be achieved by stirring water, removal of weeds, silts or organic matter from the pond.

**9. Liming:** This helps to correct pond acidity. It controls leaching and enhances fertilizer effectiveness.

**10. Test cropping:** This is done to check the growth rate of the fish in order to detect any outbreak of disease and to know the food conversion ratio of the fish stocked.

**11. Regular harvesting:** Fish should be harvested when they are matured at about 6 months after stocking. This is necessary to prevent overpopulation, disease outbreak and cannibalism.

## 5.7 Harvesting/Cropping of Fish

Harvesting is the collection of mature or grown fish from the pond for cooking, preservation or for sale at a market.

There are two main methods of cropping:

**(a) Partial or selective cropping:** This is the removal or scooping of the fish of the desired size by using basket or scoop net.

**(b) Complete or total cropping:** The pond is drained and all the fish are collected at the deepest end.

## 5.8 Fishing Gears and Equipments

**1. Nets:** There are different kinds of nets which can be used in ponds. Examples include scoop nets, gillnets, seine nets and drag nets.

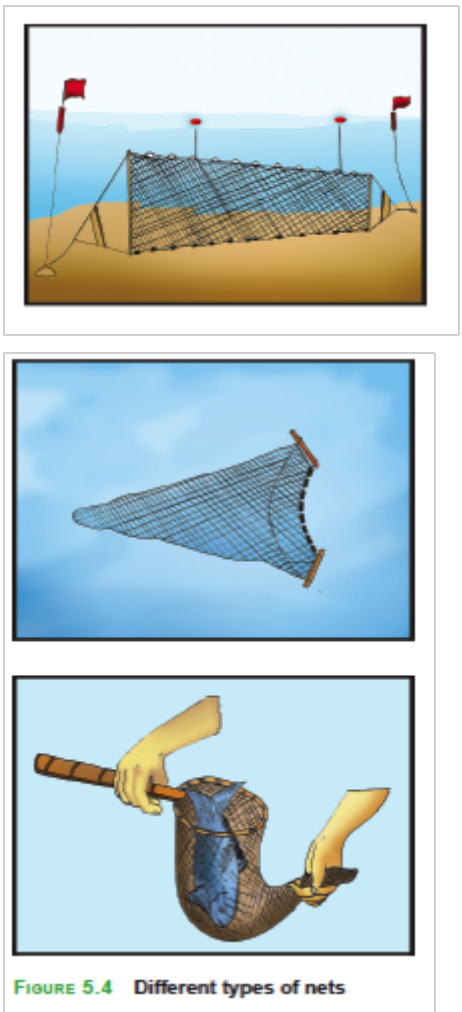

FIGURE 5.4 Different types of nets

**2. Hook and line:** This consists of a hook, long twine, fl oat and long pole. Bait is fixed to the hook and as the fish is trying to bite the bait, the fish swallows the hook and is caught.

FIGURE 5.5 Hook and line

**3. Fishing basket:** This is used in shallow rivers or streams for cropping. It has wide mouth and a bait inside. It has a trigger that holds the bait. As the fish enters the basket to eat the bait, the trigger is pulled down and the mouth closed. The fish gets trapped and caught.

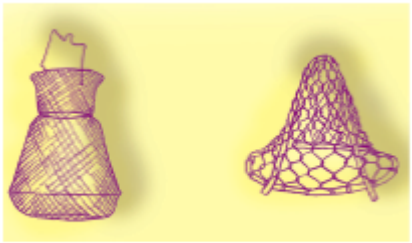

FIGURE 5.6 Fishing basket

Other fishing gears include spears, arrows, harpoons, trawlers and bolts. These are used to attack and catch big fishes such as sharks.

FIGURE 5.7 Spears, arrows, harpoons, trawlers and bolts

## 5.9 Fish Processing and Preservation

Processing and preservation is necessary because upon death, fish rots very quickly. Fish can be preserved in the following ways:

**1. Drying:** Fish are spread under the sun to reduce the moisture content.

Artificial drying (by using mechanical drier) minimizes changes in appearance, colour, flavour,

texture and nutritive value.
**2. Smoking:** The fish is first soaked in a salt solution or sprinkled with salt and thereafter placed on fire. This keeps the fish for a longer time and adds a distinctive flavour which varies with the kind of wood used, humidity, temperature and air distribution.
**3. Canning:** This is common in commercial preservation of fish such as sardine, salmon and shrimps. It requires machinery, capital and skilled labour. It consists of cooking, scaring and sealing the fish in cans under controlled conditions.
**4. Freezing:** The action of spoilage bacteria is slowed down or prevented by ice. Frozen fish will keep for months. After freezing the fish is kept in cold storage and distributed in that form. Freezing is possible where there is constant power supply.
**5. Salting:** Salt acts as a preservative by extracting water from the fish. This process may be combined with drying or smoking. The process of dipping fish in a salt solution is called brinning.
**6. Fish meal:** Fish can also be preserved in the form of powder (fish meal). Fish meal is obtained by drying and grinding fish or fish waste.
**7. Frying:** Fried fish can be kept for a long time. It is done by cleaning the fish and frying in vegetable oil.

## Fishery Regulations

Fishery Laws and Regulations of Nigeria mainly deal with the development, management, exploitation and conservation of the living resources of Nigerian marine waters. There are both national and international laws governing the use of fish resources. They are contained in various acts, decrees and regulations such as:
**i.** The Sea Fishery Act of 1971
**ii.** The Sea Licensing Regulations of 1971
**iii.** The Sea Fishery Regulations of 1972
**iv.** The Exclusive Economic Zone Decree of 1978

### 5.10.1 National or Local Regulations

This is the summary of the contents in various acts, decrees and regulations listed above. It relates to national water use and fisheries.
**1.** Motor fishing boats operating within the territorial waters of Nigeria must obtain a licence before operation.
**2.** No vessels except canoes shall fish within the first two miles of the Nigerian continental shelf (No trawling zone).
**3.** The minimum mesh size of nets for inshore trawling shall not be less than 3 inches (76 mm).
**4.** All catches must be landed at the port and no part of it must be exported at the sea since exportation of fish commodity shall be subjected to foreign exchange regulations.
**5.** The use of explosives or chemicals for harvesting of fish is prohibited.
**6.** Authorized government officials shall inspect the building and premises for curing, preserving, storing and selling fish to ensure that they meet good standard of hygiene.
**7.** Fish and fish products found unfit for human consumption must be seized and destroyed.
**8.** Discharge of effluents from factories into bodies of water is prohibited.

### 5.10.2 International Regulations

This declares the international and territorial waters of a country and regulates the use of such waters.
The following are some of the regulations:
**1.** The first100 nautical miles of water substending the nationâ€™s land mass is declared the national fishing zone.
**2.** The body of water outside 100 miles are international waters.
**3.** Hunting of endangered species such as blue whale is prohibited.

**4.** Mining and pollution of international waters are prohibited. The enforcement of these laws and regulations to protect the countryâ€™s water, land, air and other aspects of the environment is vested in the Federal Ministry of Environment.
People and organizations which flout or contravene such laws are made to face stiff penalties.

**ACTIVITY**

**1.** The schools should set up a fish pond involving all students. Each student should be given specific assignment in the establishment process and thereafter each submits a wri! en report on the establishment, stocking and management of the fish pond.
**2.** Visit a nearby fish farm and observe how the pond is constructed. Record all your observations.

## SUMMARY

â—† Aquaculture has been defined as the propagation and husbandry of aquatic animals and plants for the use of man.
â—† Fish farming is also the act of rearing selected fish species in ponds for food and other purposes.
â—† Fish farming is important because it is a source of food, income, raw materials, oils, foreign exchange and recreational and aesthetic purposes.
â—† Fish are classified based on habitat and morphology.
â—† The conditions necessary for sitting a fish pond include availability of good quality water, soil type, vegetation, topography, market, suitable fingerlings, labour and safety of the fish.
â—† Fish pond can be maintained through regular feeding, de-weeding, desilting, fertilization, control of predators, aeration, liming and regular harvesting.
â—† Harvesting of fish can be partial or total using any of these fishing equipments: fishing nets, hook and line, fishing basket, spears, arrows, harpoons and trawlers.
â—† Processing and preservation of fish can be achieved by drying, smoking, canning, freezing, salting, frying and fish meal preparation.
â—† Fishery laws and Regulation are the laws governing the use of fish resources and other living resources of Nigerian marine waters.

## REVISION QUESTIONS

### ESSAYS

**1.** (a) Define aquaculture.
(b) State five importance of fish farming.
**2.** (a) Describe five factors required for establishing a fish pond.
(b) Enumerate six management practices for maintaining high fish yield.

**(WASSCE Nov 1989)**

**3.** Explain how each of the following practices can bring about high fish yield from a fish pond.
(a) De-weeding (b) Desilting
(c) Supplementary feeding (d) Fertilization

**(WASSCE Nov 1990)**

**4.** (a) Describe four methods of harvesting fish.
(b) Discuss briefly four fishery regulations

**(WASSCE 1993)**

**5.** (a) Mention four factors that should be considered when sitting a fish pond.
(b) Explain six ways of maintaining a fish pond.

**(WASSCE 2003)**

## OBJECTIVE QUESTIONS

**1.** A common means of aerating a fish pond is by stirring the water and
(a) removing dead and decaying matter.
(b) adding water plants.
(c) adding cold water.
(d) pumping oxygen into the water.
**2.** Government ensures continuous availability of fish through
(a) fishing regulations. (b) marketing.
(c) fish feeding. (d) fish processing.
**3.** Which of the following factors is not considered in selecting fish for stocking?
(a) Ability of being reared in captivity (b) Colour of the fingerlings
(c) Ease of caring for fingerlings (d) Marketing of the species
**4.** Cropping in fish farming refers to
(a) stocking fish. (b) processing fish.
(c) harvesting fish. (d) feeding fish.
**5.** Fertilizing a fish pond with compost manure would most likely
(a) decrease phytoplankton population and decrease fish yield.
(b) increase phytoplankton population and increase fish yield.
(c) decrease phytoplankton population and increase fish yield.
(d) increase phytoplankton population and decrease fish yield.
**6.** Temperature is an important factor in fish ponds because it
(a) affects the metabolic processes in fish.
(b) determines the sex of fishes.
(c) encourages the growth of phytoplankton.
(d) affects the types of species of fish.
**7.** An illegal method of harvesting fi h is by the use of
(a) potassium cyanide. (b) drag net.
(c) hook and line. (d) calcium carbonate.
**8.** In which of the following ways can fish be processed and preserved?
(a) Salting and fermentation (b) Salting and smoking
(c) Smoking and fermentation (d) Smoking and pasteurization
**9.** Some of the by-products of fish include the following except
(a) fish meal. (b) fish oil.
(c) fish leather. (d) fish silage.
**10.** The major cause of spoilage in fresh fish is
(a) high humidity. (b) fungal attack.
(c) bacterial attack. (d) protozoa.

## Answers to Objective Questions

Answers to Objective Questions

1. d 2. d 3. a 4. c 5. b
6. c 7. a 8. b 9. d 10. c