Unit 9 Poultry Production and Management

Contents	Learning Outcomes
9.1. Poultry breeds, classification and selection 9.2. Poultry feeds and feeding 9.3. Poultry housing 9.4. Poultry incubation and hatchery management 9.5. Poultry brooding and rearing 9.6. Layers and broilers management 9.7. Major diseases of poultry and controlling methods	At the end of this unit, you will be able to: ▪ analyse the characteristics of both indigenous and exotic poultry breeds in Ethiopia ▪ recognize poultry breeds, classification and selection methods ▪ clarify poultry feed resources and feeding methods ▪ estimate the feed requirements for different types of poultry breeds ▪ compare common types of poultry housings ▪ describe egg incubation and hatchery management ▪ explain poultry brooding and rearing methods ▪ describe layers and broiler management ▪ mention poultry diseases and suggest their controlling methods ▪ initiate their classmates to engage in poultry production and management

9.1. Poultry breeds, classification and methods of selection

There are three main categories of chicken breeds: pure commercial breeds, hybrid breeds (i.e., cross- and local) and local or land races. There are also four types according to utility or economic values: Egg type (e.g. Leghorn), Meat type (e.g. synthetic), Dual purpose (e.g. Rhode Island Red), and Ornamentals (e.g. Bantam).

Brainstorming 9.1.

In small groups, discuss the types of chickens kept in your area and breeds that you already know.

9.1.1. Indigenous poultry breeds of Ethiopia

There are ten common local chicken breeds or ecotypes: Chefe, Gebsima, Horro, Jarso, Kei, Naked neck, Netch, Tepi, Tikur and Tilili. The indigenous chickens are non-descriptive breeds. They are closely related to the jungle fowl. They vary in color, comb type, body conformation, and weigh. They may or may not possess shank feathers. Broodiness (maternal instinct) is pronounced. Indigenous chickens have an inherent scavenging and nesting habit. They are more resistant to diseases, less prone to predator attacks and can survive under harsh nutritional and environmental conditions. Slow growth, late maturity and low production performance characterized Indigenous local chicken breeds.

Figure 9.1. Horro breed (A), Chefe breed (B) and Tepi breed (C).

9.1.2. Commercial or exotic breeds

Commercial or exotic breeds are those chicken brought from other countries for the purpose of improving the local chicken production such as egg, meat or both.

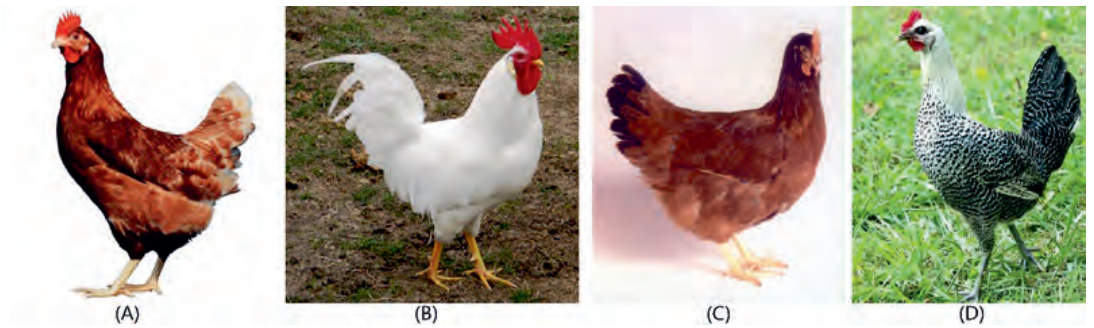

Figure 9.2. Bovans Brown (A), White leghorn (B), Babcock (C), and Fayoumi (D).

Layers

These breeds are used primarily for egg production. Most of the time, the eggs of the parent stock are imported. Then the generations are used for their egg production while the parent stock is used for hatchery purposes. In the past, several layer breeds used to be imported to Ethiopia, but today only layer breeds are imported for egg production. Layer breeds Bovans Brown and White Leghorn.

Bovans Brown

It is the bird of choice for today's egg farmers who expect high egg numbers. Giving the breed essential ingredients, can make the farm a profitable business. The breed performs well for egg producer with traditional production facilities. Bovans Brown is a very docile breed. This makes the breed the perfect bird for an alternative production.

White Leghorn

These are known for laying lots of white eggs. They need little feed, due to their small size. White Leghorns are therefore very efficient layers. At the end of the laying period, the breed gives little meat.

Broilers

Modern commercial broilers are specially bred in large scale for efficient meat production. They grow much faster than egg laying hens. Broilers often reach a harvest weight of 4 - 5 pounds, dressed, in only five weeks. Those that grow more slowly in free-range, they reach slaughter weight at 12 - 16 weeks of age. Babcock is the chicken breed that is currently

imported and used for a fattening purpose.

Dual purpose:

Dual purpose breeds of chicken are the chicken used both for egg and meat production. Fayoumi breed are known for their best adaptability to the harsh, hot and arid environment of Egypt.

Activity 9.1.

In small groups,

a. list local poultry breeds common in your area.

b. identify the breeds that owners prefer to keep.

c. which breeds are more common, those kept for utility or the breeds kept for economic values?

Your teacher will tell you what to do with your finding.

Poultry breed Selection methods

Selecting the best breed involves evaluating color and conformation, demand for vaccination and susceptibility to disease. Consumption of feed, hardiness and adaptability, productivity, and efficiency are equally essential characteristics to be considered in poultry breed selection. Layers, for example, are selected and/or culled on the basis of their performance and appearance. See below:

a) Individual performance

- Precocity
- Intensity of laying
- Persistency of laying

b) Individual appearance

- Physical body make up (vigor, head and comb)
- Physical body change (pubic bone, abdomen and vent)
- Physiological change (pigmentation and mounting

Activity 9.2.

Individual Work: Answer the questions below individually. Compare your answers with your neighbors' answers. Discuss your answers with neighbors. Report any differences in the criteria of breed selection methods.

a) Do your parents keep chicken? If they do, for what purposes? How do they select the specific chicken breed they keep?

b) If there are smallholder poultry farms in your community, visit them and take notes on some important aspects of the farms and the animals. Study the important points you learned in this unit and choose important aspects to focus on during your visit.

9.2. Poultry feeds and feeding methods

Poultry feed resources

Crops grown and their by-products can be used as potential sources of feed for smallholder poultry farmers. The potential supplementary feed resources used by smallholder poultry farmers are maize and cereal debris. Smallholder farmers also use major green feeds available (like e.g., cabbages, grass, vegetable, weeds, enset by-product, and alfalfa). Non-conventional feed resources including worms and insects are also available. Figure 9.3 shows examples of poultry feed resources.

Figure 9.3. Examples of poultry feed resources.

Poultry feeding and nutrient requirements

The average feed consumption of chicken is usually 40gm/head/day up to their age of 8 weeks. Recommended calorie-protein ratio is 135:1. In the

day old chicken, flat feeders cut out from chick boxes, egg trays and flats can be used. As they grow up, the feeders should be changed to deeper and longer containers. Shallow drinkers must be used during this period.

For Layers the requirement is:

ME/ kg/kcal	Cp	C.fat	Lys	Met	M+c	C	P
2750	16.5	8	0.7	0.28	0.6	3.5	0.8

The recommended calorie-protein ratio (C: P ratio) of layers ration is 170 -180:1. The average feed consumption of layers is 115 – 125 gm/ head/day. Normal feed conversion ratio (FCR) is 1.8. In case of Broilers, the objective is rapid growth rate. This makes it important to provide sufficient feeding spaces and good quality feed. Always adjust Cal/protein ratio according to standard. Lower calorie content reduces growth.

The recommended Cal/protein ratio is:

- Starters chicken (0 - 3 weeks) = 135:1
- Finishers chicken (>3 weeks) = 155:1

Activity 9.3.

In pair

a. identify poultry feed resources, and

b. poultry feeding methods and explain to the class.

9.3. Poultry housing

Why do we keep chickens in house? Below are some reasons:

- to protect chickens against rain, wind, other animals and predators.
- to reduce outbreaks of disease.
- to provide chickens with nests, comfortable dark places to lay, brood and hatch their eggs.
- to increase egg and meat production.
- to increase income.

A properly constructed poultry house has certain essential features. Poultry house should have watertight roof and proper ventilation. The inner surfaces should be easy to clean. It also shouldn't let in rats and wild bird, etc.

The common types of poultry houses are Open Houses, Open Front Houses, Curtain Houses, Closed Houses, Deep Pit House, and High Rise Houses.

Open Houses

- Have two open sides.
- Roof often has large overhang (1.0 meter or more) to protect birds from rain & sun.
- Wire mesh often used for the sides.
- Additional removable/ ventilation fans are recommended in large houses.
- Suitable for tropical areas.

Figure 9.4. Poultry house with two open sides.

Open Front Houses

- Comparable to open house, main difference is they have only one side open.
- Suitable for areas where temperatures range from 15-30 °C.
- Open houses and open front houses should not be wider than 9 meter.
- The climate inside & outside the houses is almost the same.

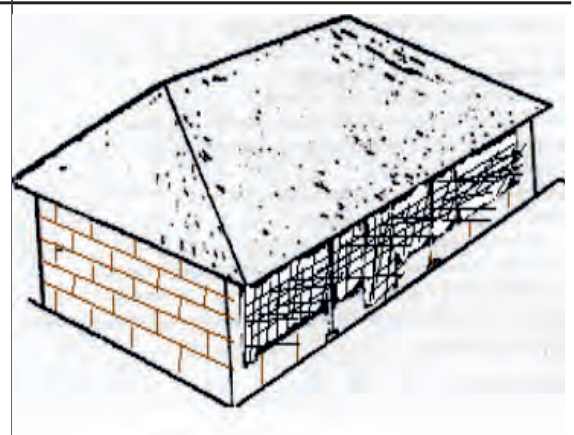

Figure 9.5. Open front poultry house design.

High Rised Houses

- Built above ground level or above a fish pond, as a system of integrating.
- Always have the cage system or full slatted floors.
- Suitable for tropical climates.

Figure 9.6. High Rised Poultry House.

9.4. Egg incubation and hatchery management

Incubation can be achieved either by natural means using broody hen or by artificial means.

Artificial incubation

The development of a fertile hen egg into a young chick requires:

- a temperature of 37.5 - 39 oC for three weeks
- a supply of fresh air allowing the embryo to breathe
- enough humidity to prevent the egg content from drying out
- space for movement (turning) of the egg to prevent the embryo from sticking to one side of the egg.

Figure 9.7. Natural (A) vs. artificial incubation (B) and their hatching techniques.

An incubator must therefore have a:

- source of heat
- thermostat to maintain the temperature at 37.5-39 oC
- tray which holds the egg steady but allows the movement of air around the eggs.

- supply of water to humidify of (to moisten) the air in the incubator.
- ventilator to provide fresh air and to remove stale air.

Cleaning and disinfection of incubator: HHatchery sanitation aids in breaking the disease cycle. This should be done after hatch and before using it for the next cycle.

Collection and storage of hatching eggs: Hatching eggs should be collected as at least four times a day.

The following are important factors to achieve a good production:

- temperature, humidity, ventilation, and hygiene.

Activity 9.4.

In a group,

a) Visit poultry housing systems available in your locality. Observe their incubation and hatchery methods.

b) Find out about the effects of their egg incubation and hatchery methods on production.

c) Interview the farm owners for information on the status of the farm.

d) Write your inclinations and opinion about feeling about poultry production and management. Do you want to engage in poultry production and management in the future? Why?

Your teacher will tell you what to do with the findings of your fieldwork.

Note: If there is no such farm in your area please use the internet or library and find out what is the common poultry housing system in Ethiopia. Explore their egg incubation and hatchery techniques.

9.5. Poultry brooding and rearing

Brooding refers to the period when young chicks require a lot of care. The period ranges from one-day of age to about four weeks in the tropics. During this period supplementary heat is provided for the chicks comfort. It is the most critical period in the life of the birds and there can be more deaths during this short period than throughout the rest of the birds' lives.

There are two methods of brooding chicks:

1. Natural brooding by the chicken
2. Artificial brooding

Artificial heat sources are (brooders can be made of):

- Electric brooder (infra-red heat bulbs)
- Kerosene brooders
- Hot air, hot water or radiant heat.

A B

Figure 9.8. Natural (A) and artificial (B) brooding and rearing.

9.6. Layers and broilers management

Layers

In well-developed poultry industry, hens start laying eggs when they are about 20 weeks of age. The production of the whole flock then rises rapidly to a peak after 8 weeks. At that point most of the hens lay eggs almost every day. Each day there are as almost as many eggs to be gathered as there are laying hens. The ratio of number of birds to the number of eggs gathered on one day is called 'laying percentage'.

A B

Figure 9.9. Layers housing (A) vs broilers housing (B).

Laying house equipment

Laying nest

- Laying nest is a place where hens lay their eggs.
- There are two types of laying nests: individual nest and communal nest. The individual nest should be 30 cm wide, 35 cm long and 40 cm high. Allow one nest for every 4 - 5 layers.
- Communal nest which can be used by 10 - 15 birds at the same time is not generally suitable for tropical condition.
- The hens need sufficient spaces to get rid of their body heat very well.

Figure 9.10. Laying nest for small-scale poultry production.

Perches

- An object on which a bird alights, typically a branch or horizontal bar.
- Provide 15 - 20 cm of perching space placed at 25 cm apart per bird depending on the size of the birds.
- Perches are installed at about 1 meter above the floor

Feeders

- Feeders are equipment or structures made to feed chicken or birds.
- Make sure that there are enough feeders (>12 cm depth) in the house. Provide 5 - 10 cm feeding space per bird of rectangular feeder and less than this in case of round feeder.
- Place a stick (spinner) above the feeder to avoid birds from sitting on the feeder.

Drinkers

- Drinkers are equipments or structures prepared for drinking purpose of hens.
- Provide 3 cm drinker space per bird.
- Provide clean cool water, it should be always available.

Lighting

- Lighting increases feed intake, promote growth, stimulate laying, deter hens from their eggs, reduce stress and energy.
- Provide a laying flock natural or artificial light of 16 hours per a day (min. of 12 hrs, and maxim. of 16 hrs).
- A 40 watt bulb is recommended to be placed at 3 meter apart
- A 60 watt bulb can be placed at about 5 meter apart.

Age of moving to laying house

- Pullets can be moved to permanent laying house starting from 18 weeks of age.
- Change of ration to layer diet can be done just before the first egg is laid

Broilers

The main guiding principle of broiler rearing is the "all-in, all-out" principle. This means only birds of the same age are kept on the same site. The birds can be reared to slaughter weight in eight weeks, and two weeks are needed between each batch. Special care is needed for the litter, since caked litter can lead to the formation of breast blisters and the down grading of the carcasses

Figures 9.11. Broiler birds.

A small chicken business scenario

Assume Mr Tadesse has 50-layer chickens and produces eggs every day. She/he collected about 43 eggs a day.

In the nearby market, the price of a single egg is 8.5 ETB on average. This sums up a gross income of 365.5 ETB per day. The production cost (i.e., the cost of feed, medication, transport, labor, and other expenses) of one egg is estimated to be 4.70 ETB.

Net profit per week is 1143.8 ETB (or 4575.2 ETB per month).

*Discuss in a small group (3 to 5 students) on how possible it is to reduce the production cost of an egg and share your outcomes with the students sitting next to you.

9.7. Major Diseases of Poultry and Methods of Their Control

In poultry, it is very important to keep infection by contacts with sources of infections to a minimum. Germs can be spread via animals and people. Infection is also possible through contact with infected objects such as crates or cars. All kinds of diseases can be transferred by birds, vermin, insects and other parasites. Remember that feed and dirty drinking water can also carry germs.

There are three main causes of poultry disease: Infectious (viral, bacterial), Parasites, and deficiencies of a certain kind of nutrient. Other issues include feather pecking and cannibalism.

Newcastle diseases, infectious bursal diseases, avian coccidiosis, helminth infestation, ecto-parasite infestation, and Salmonella and Campylobacter infections are the most common chicken diseases.

Poultry disease controlling methods:

- The best prevention of diseases is good hygiene and disinfect.
- To use the 'All- in- all-out' system.
- Vaccinate against some diseases or use anti-coccidial agents.
- In case of serious problems, consider slaughtering the whole stock and start anew. To do this, thoroughly clean and disinfection the place.

Activity 9.5.

In small group,

a. list out the major diseases of poultry that you observed or experienced in your area

b. explain their possible indigenous controlling mechanisms.

Unit Summary

In this unit, you have learned that:

- pure commercial breeds, hybrid (crossbred) and local breeds are the main categories of chickens by breed.
- based on utility or economic values, chicken are classified in to Egg type, Meat type, and Dual purpose.
- color and confirmation, demand for vaccination and susceptibility to disease, consumption of feed, hardiness and adaptability, productivity, and efficiency are the common criteria to select breed or individual poultry for breeding.
- in rural poultry, scavenging in and around the homesteads and household leftover, wastes, anything edible found in the immediate environment are the feed resource. Small amount of grain supplements are provided by the household.
- in case of the (mixed farming) smallholder farmers, Crops grown and their by-products can be used as a potential source of feed for poultry.
- poultry housing is to protect against rain and wind, predators, provide comfort, increase income and efficiency of work.
- incubation can be achieved either by natural means or by artificial means.
- infection (viral, bacterial), Parasites, deficiencies of a certain nutrient, and other abnormalities and major disease causing in poultry.
- poultry disease controlling mechanisms:
  - good hygiene and disinfection.
  - best is to use the "All- in- all-out" system particularly in poultry.
  - vaccinate against some diseases according to the vaccination calendar.
  - quarantine, if suspected
  - provide a clean environment for the animals.

Review Exercise

Part I. Choose the correct answer from the given alternatives to the following questions.

1. One of the following is not the characteristics of local chickens. Which one is it?
   A. They vary in color
   B. They have pronounced brooding ability.
   C. They have an inherent scavenging habit
   D. They are prone to predator attacks.
2. Based on utility or economic values, chickens can be classified as_____
   A. Egg type C. Dual purpose
   B. B. Meat type D. All of the above.
3. Which one of the following traits is not considered in breed selection?
   A. Conformation C. feed consumption
   B. B. Adaptation D. None of the above
4. The development of a fertile hen egg into a young chicken requires:
   A. A temperature of 37.5 to 39 ^{0}C.
   B. A supply of fresh air
   C. Some space for movement or turning around
   D. Humidity to prevent the egg content from drying
   E. All of the above.
5. Artificial brooder can be;
   A. Kerosene brooder C. Radiant heat
   B. Electric brooder D. All of the above

Unit 10 Fishery Production and Management

(b)

Contents	Learning Outcomes
10.1. Basic terms in aquaculture and farmed fish species in Ethiopia 10.2. Basic anatomy of bony fishers 10.3. Fish feeds and feeding practices 10.4. Fish culture techniques 10.5. Fish rearing 10.6. Fishing methods 10.7. Handling fish and fish products 10.8. Diseases in aquaculture 10.9. Indigenous knowledge in fish processing	At the end of this unit, you will be able to: ▪ recognize farmed fish species in Ethiopia. ▪ explain basic anatomy of bony fishers. ▪ describe fish feeds and feeding practices. ▪ examine the fish culture techniques. ▪ explain fish rearing methods. ▪ identify fishing methods. ▪ express the handling of fish and fish products ▪ list the major disease of fish and control methods. ▪ elaborate the application of indigenous knowledge in fish processing. ▪ give values for indigenous knowledge in fishery management. ▪ practice handling fish and fish products effectively.

10.1. Basic terms in aquaculture and farmed fish species in Ethiopia

Aquaculture is the farming of aquatic organisms. Ethiopian fish fauna are the bony fish. Fresh water contains the majority of teleost (i.e. the group contains most of the bony fishes) fish type. Ethiopian fish fauna consists of 153 indigenous and 10 exotic species. The diversity and abundance of Ethiopian fish fauna is not complete and further works are still underway. The Ethiopian indigenous freshwater fauna is a mixture of three different forms.

- Nilo-sudanic forms,
- East African high land forms and
- Endemic forms.

These are the dominant forms in terms of diversity and are represented by a large number of species found in the Omo-Gibe, Baro-Akobo, Tekeze and Abay drainage basins. They are predominately found in the Nile basin (Baro-Akobo, Tekeze and Abay). However, some elements of these forms also occur in the Southern Rift Valley Lakes (Lakes Abaya and Chamo), and the Shebelle-Ghenale basins. The Grand Ethiopian Renaissance Dam (GERD) is also expected to have potential for fish farming. The Nilotic fishes are almost entirely absent from the Awash and northern rift valley lakes.

The East African highland forms are those related to fishes of eastern and southern Africa and include genera such as Labeo, Barbus, Clarias, Garra, Oreochromis, and Varicorhinus. These are found in the northern Rift Valley lakes (e.g. Lakes Hawassa, Ziwai, Langano), the highland lakes (e.g. Tana and Hayq), and associated river systems, and the Awash drainage basin.

The endemic forms are very few comprising about 38 species and 2 subspecies. Examples include a few genera such as Danakilia, Nemacheilus, and Gara (Lakes Abaya and Chamo), Barbus (Lakes Tana and Chamo), etc. Exotic fish that were introduced to Ethiopian water bodies include fish such as carp in Koka and Fincha dams. The economically important families of Ethiopian fish include the following.

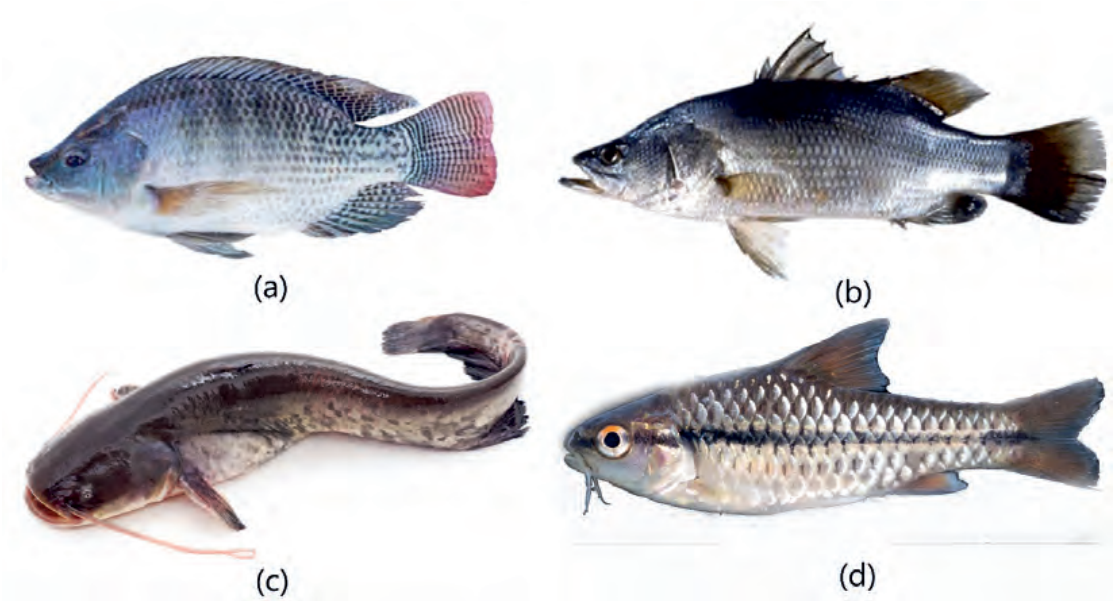

Figure 10.1. Oreochromisniloticus (Nile tilapia) (a), Latesniloticus (Nile perch)(b), Clariasgariepinus (commonly called Catfish, "Ambaza") (c), and Barbus sp (Commonly named as Nech-asa) (d).

1. Family Cichlidae (Cichlids)

This family includes three species of tilapias in Ethiopia.

These are

- Oreochromisniloticus (O. niloticus),
- Tilapia zilli and
- Tilapia galilaea

O. niloticus is found in most Ethiopian freshwaters and commonly known as "Qoroso", St. Peter fish, Chogofe, etc. O. niloticus is the predominant fish in most the Ethiopian fisheries.

2. Family Centropomidae (Centropomids)

Most members of this family are marine and only genus Lates is a freshwater form both in Ethiopia and in other parts of Africa. L. niloticus (commonly called the Nile perch) is the major species of the genus found in Ethiopian Lakes such as Chamo, Abaya, Gambella lakes and Baro River. L. niloticus is carnivorous on other fish and is not good to introduce them into water bodies other than their natural habitats.

3. Family Claridae (Clarids)

The common example is Clariasgariepinus (commonly Catfish, "Ambaza") found in Lake Tana, Lake Abaya and the Awash River. C. gariepinus can be easily recognized by their elongated body and long hair like barbells around their mouth.

4. Family Cyprinidae (Cyprinids)

This family includes genera such as Barbus (commonly in Nechasa), Labeo and Carp. Barbus is more common in rivers than in lakes and is much common in Lake Tana. Three carp species (Common carp, grass carp and silver carp) are the introduced species belonging to this family.

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Activity 10.1.

Field Visit

In pairs, visit a local fish market and

a. identify the species available in the market
b. if possible see if the same species can be found in rivers or lakes close to your school
c. identify the differences in color and physical appearances.
d. ask the farm owners about the local communities fish-eating culture

If there is no fish market in your vicinity use the library or internet to research.

* Report your finding to the whole class.

10.2. Basic Anatomy of Bony Fishes

Bony fishers have a bony skeleton. They are generally flattened. They have five pairs of gills protected by an operculum, and a mouth at or near the tip of the snout. The dermis (skin) is covered with overlapping scales. Bony fish have a swim bladder which helps them maintain a constant depth in the water column.

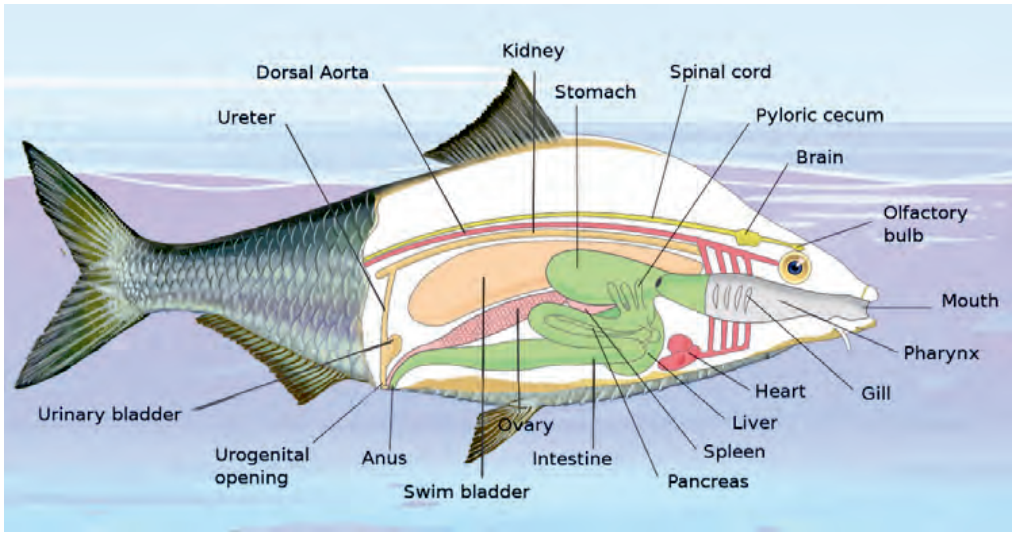

Figure 10.2. Internal anatomy of a bony fish.

The main external features of the fish, are composed of either bony or soft spines called rays which, with the exception of the caudal (tail) fins, have no direct connection with the spine. They are supported by the muscles which compose the main part of the trunk (Figure 10.3).

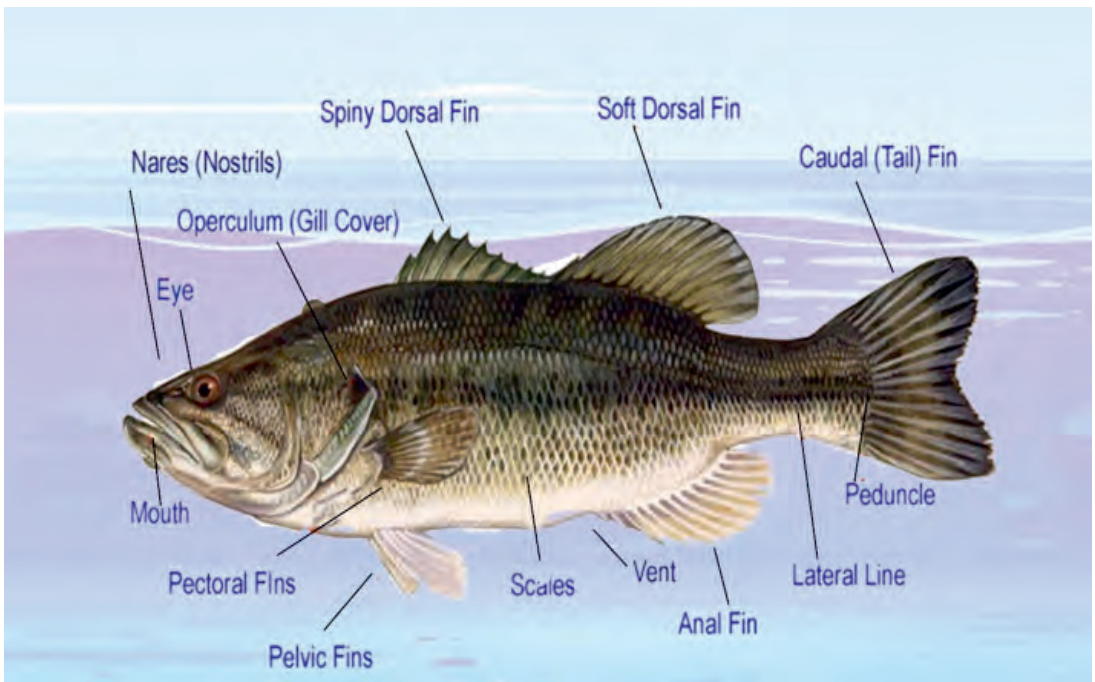

Figure 10.3. External body parts of bony fishes.

Activity 10.2.

Group Work

Visit fish market or other possible sources in your area.

a. See if there are some of the species mentioned in this unit on the farm.

b. Ask the owners or fisherwomen or fisherman to tell you about the basic anatomy of the fish

Your teacher will tell you what to do with the answers.

Note that if there is no river/lake and fish market/farm available in the area, practice with pictures provided by your teacher.

10.3. Fish feeds and feeding practices

The survival, growth and reproduction of fish depends on fish-feeding activities. Fish have a considerable capacity to resist starvation.

Feeding: food preparation, feeding mechanism of fish

Food capture: most food eaten by fish is obtained through three basic feeding styles. i.e. Ram feeding, Suction feeding, and Manipulating or Biting feeding method.

Feeding habits of fish

The food and feeding behaviour, varies characteristically in different species of fish. There are four categories of fish food. These includes basic food, secondary food, incidental food, and obligatory food.

Fishes occupy almost all trophic categories. i.e., from herbivores to piscivores. Trophic categories in fishes are:

- **Detrivorous fish:** are fishes that feed on the dead and partially decomposed plants by the action of bacteria and fungi. They are mostly benthos, fish that live on the bottom of seas or lakes. e.g, Tilapia, Barbus.
- **Scavengers:** are fishes that feed on the decaying animal flesh: e.g. Eel, clarias

- **Plankton feeders:** fish which feed upon the planktons, both on phyto and zooplankton are included in this category
- **Herbivorous fishes:** fishes that feed on the plant materials (vegetation) comprising flowers, fruits, seeds, leaves and pieces of stem of vascular plants, etc. They even scrap algae from the rocks and stones with their broad lipped mouth under the snout. Their stomach is delicate and less acidic. They have large intestine and small stomach. Non predator have narrow gap in size, Tilapia and Barbus sp. are among the fish species that possess this kind feeding habits.

Figure 10.4. Women feeding fish.

Activity 10.3.

In pairs, list down fish feed resources and feeding methods.
Report your findings to the whole class.

GERD as potential for Fish farming

GERD (Grand Ethiopian Renaissance Dam) is filled to the level of 600 meters which can serve as a potential for fish production and the reservoir volume is 74 billion cubic meters. The reservoirs under construction such as Gilgel-gibe III, GERD and others expected to significantly increase the total inland water when they are completed.

Task 1: For example lake of Hawassa is about 1.3 billion meter cubes of water and has a potential of 600 tones per year to harvest fish. GERD could be six times more productive than lake Hawassa.

In a small group, take one example of lake that you know most and compare the estimated potential for fish production of GERD.

Task 2: Researching the capacity of the GERD and type of water, region where it is located and suggest also what type of fish might be suitable.

Share your estimation potential for fish production with the other groups of students in your class.

Figure 10.5. Grand Ethiopian Renaissance Dam.

10.4. Fish culture techniques

Types of aquaculture can be classified on the basis of fish culture, enclosure density or integration.

10.4.1. On the basis of culture

1. Monoculture: Raising only one species of fish in available water body. For example, raising of one of the following types: tilapia, rainbow trout, catfish, etc.
2. Polyculture: Culturing two or more than two species of fish in the same water body. For example, rearing of bighead carp and grass carp.
3. Mono-sex culture: Raising either male or female of single fish species. It is practiced for maintaining breeding male and female fish.

Advantages	Disadvantages
▪ Cultivation practices such as feeding, disease diagnosis and treatment is easier. For example, feeding is easier in raising single species due to uniform feeding habit ▪ Typical characteristics of fish can be studied more accurately	▪ Productivity of pond is not fully utilized ▪ Market supply cannot be fulfilled and is riskier.

4. Poly-sex culture
   - Either male or female of two or more species is reared in the same pond.

Advantages	Disadvantages
▪ Productivity of pond is fully utilized ▪ Yield per unit area is higher ▪ Less risky	▪ Cultivation practices is difficult ▪ Costly and labor intensive. ▪ Selective harvesting is difficult ▪ Costly and labor intensive

10.4.2. On the basis of enclosure

Classification of fish culture based on the basis of enclosure can be further divided into Pond fish culture, Cage fish culture, and Pen/enclosure fish culture (Figure 10.5).

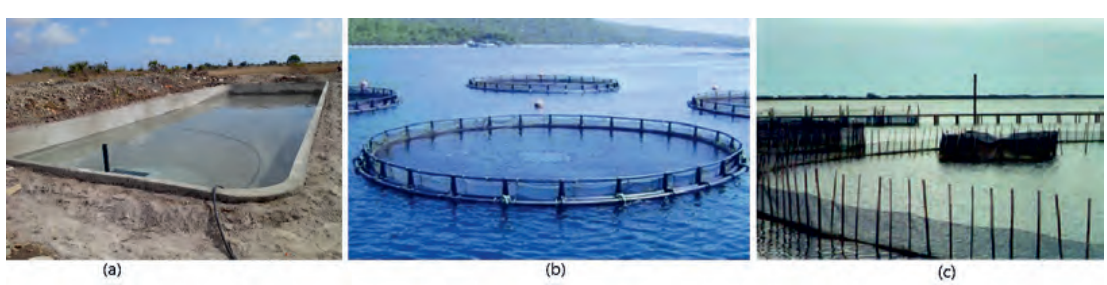

Figure 10.6. Pond fish culture (a), Cage fish culture (b), and Pen/enclosure fish culture (c).

10.4.3. On the basis of density

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

10.4.4. On the basis of integration

- Pig and fish farming
- Duck and fish farming
- Horticulture crop and fish farming
- Rice paddy and fish farming

Activity 10.4.

Work in a group,

a. discuss the common fish culture techniques in Ethiopia
b. reason for choosing these particular fish culture
c. types of fish farming the students know so far

Report the summary of your discussion to the whole class.

10.5. Fish rearing management

There are three main events in the fish rearing or farming timeline: hatching, rearing, and harvesting. Hatching includes caring for breeding colonies, inducing spawning, egg extraction or nursery isolation, etc. Once hatched, fry are then collected and moved to grow out ponds. Unlike other fish, fresh water fish like tilapia tend to be hardier against poor water quality.

Best practice shows that the dissolved oxygen level should be around 4 mg/l. Low oxygen levels in water often lead to mass fish death. In terms of pH, tilapia can tolerate a wide range but a pH over 6.5 is good for algae growth which is useful as feed for the fish. Temperatures around 25 ºC are most favored by the fish. Tilapia can be stocked at densities up to 60 kg/m cubed (depending on water and management conditions). However, high stocking densities may have a negative impact on growth performance and health status. Low stocking densities, however, can often lead to aggression between the fish. Rearing, or grow-out, is the part of fish farming that picks up after the hatchery has raised them to fingerling size. Harvesting or processing involves selecting of tilapia and moving them to a finishing pond.

Activity 10.5.

Work in pairs. Discuss fish rearing methods and share the summary of the discussion with the rest of the students.

10.6. Fishing methods

Figure 10.7. Local fishing techniques.

A number of different fishing methods are employed to capture fish. The method used is dependent upon the species being harvested, available technology and local conditions such as bottom type and water depth.

Fishing gears is a device used to capture fish. There are two major types of fishing gears, i.e. passive fishing gear and active fishing gear.

Passive fishing gear is a device that is not moved by man or machine to capture fish. The machine is set at a given position in the water and left for some times until the fish come to the gear to be caught. It is placed stationary in one place. Examples include long line, gill net, traps and pots, etc.

On the other hand, active fishing gears are towed or pulled in water column using fishing crafts to catch the fish. These include trawl nets, seine nets, dredge nets, lift nets, etc. The major types of fishing methods used for fish include netting, lining, trolling, trawling and seining. Trawling, dredging, jigging and pots are often used for capturing shellfish (such as squids and crabs).

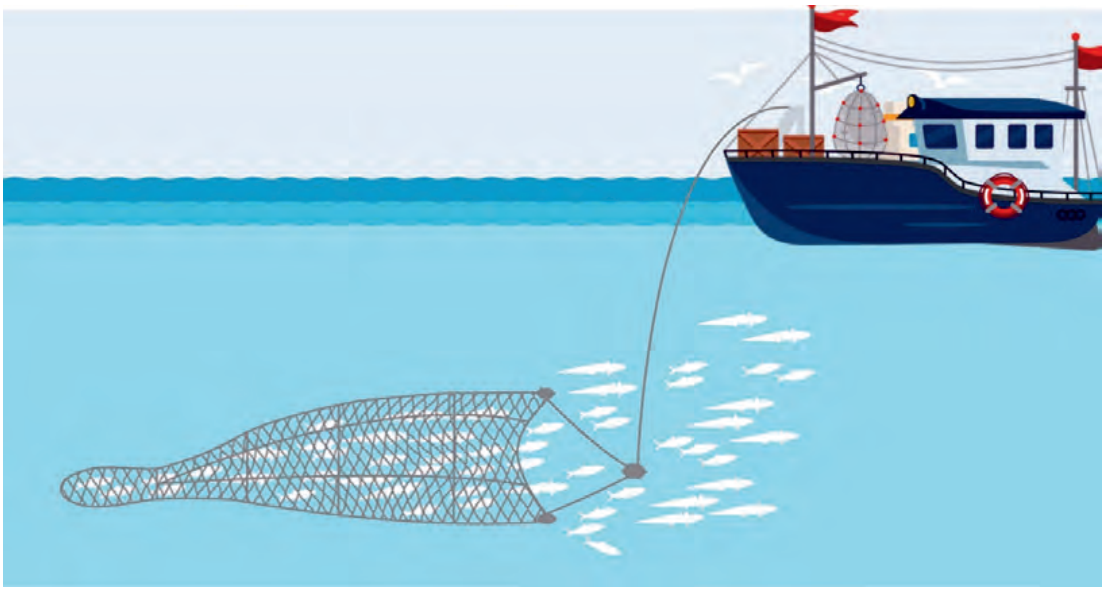

Figure 10.8. Bottom trawl fishing method.

Activity 10.6.

In a small group, discuss the differences that you can think of between the traditional and the modern fishing techniques. Make a list of major fishing methods and share your answers with the whole class.

10.7. Handling of fish and fish products

Fish is a highly perishable food/product requiring proper handling, processing and distribution

- Minimizing losses helps to improve productivity.
- Fish should be slaughtered in fishery abattoir equipped with the required facilities
- Fish should be eviscerated immediately after slaughter and preserved until consumption.

Figure 10.9. Local Fish market.

Brainstorming 10.1.

Tell your classmates the types of fish products that you know. What do you know about fish processing methods?

Fish Processing Methods

Fish processing refers to the processes associated with fish and fish products from the time fish are caught or harvested, from capture fisheries and/or aquaculture, to the time of the delivery of the final product to the end user. Fish and fish products deteriorate quickly. The easy deterioration in fish quality is because of the post-mortem (after death) biological changes that take place in the body of dead fish. The central concern of fish processing is to prevent fish from deteriorating Therefore, fish and fish products need appropriate processing procedures in order to prevent deterioration. Changes in fish quality often come in the form of unpleasant odor and microbial spoilage.

Stages of fish processing

Fish processing stages can be classified as preliminary and main stages depending on the extent of application of techniques and skills. Stages of fish processing are:

Preliminary Processing

This stage is also referred to as pre-processing stage. Preliminary processing of fish usually consists of grading, removal of slime, beheading, scaling, washing, cutting of fins, gutting and evisceration, slicing of whole fish into steaks and skinning. The process can also includes filleting, grinding of skinned fillets, meat-bone separation, or various combinations of these.

Main Processing Stage

Fish Preservation is the creation of unfavorable condition for the growth or survival of spoilage organisms. Ancient methods of preserving fish included drying, salting, pickling and smoking. All of these techniques are used today but the more modern techniques of freezing and canning have taken on a large importance.

This stage is mainly concerned with fish preservation processes. Microorganisms particularly the spoilage bacteria require appropriate

temperature, sufficient water and oxygen, and low acidic environment to reproduce and multiply. Thus, the various techniques used in fish preservation are based on the principles of interrupting these conditions as summarized in Table 10.1.

Table 10.1. Techniques used in fish and fish products preservation.

Parameter to be controlled	Method used
Temperature	Chilling, Refrigeration, Freezing
Water activity	Smoking, Freeze-drying, Oxygen Vacuum pumping
Chemical control of microbes (pH)	Addition of acids
Physical control of microbes	Microwave heating, Ionizing

Types of fish products

Figure 10.10. Types of fish product.

Some fish products are cooked fish, frozen fish, dried fish, smoked fish, salted fish, canned fish, fermented fish, etc. See the details of each below.

Cooked fish: Products are most usually for immediate consumption and require no sophisticated packaging. The shelf-life can be extended for a few days by using refrigerated storage and the product should be covered to prevent contamination.

Frozen fish: Products have relatively long-term preservation, but the technique is relatively expensive in terms of equipment and operating costs. Thus, it is not recommended for the majority of small-scale fisheries**.**

Cured fish: Dried fish, smoked fish and salted fish products have reduced water content and this prevents the development of spoilage bacteria.

Canned fish: Products have much longer shelf life.

Fermented fish: Products are formed by encouraging the development of bacteria that increase the acidity of the fish so that pH of the fish products is lowered. Low pH discourages the growth of spoilage microorganisms.

Fermented fish: Products are formed by encouraging the development of bacteria that increase the acidity of the fish so that pH of the fish products is lowered. Low pH discourages the growth of spoilage microorganisms.

Activity 10.7.

In small groups, discuss fish and fish product handling methods. Report the summary of your discussion with other groups.

10.8. Diseases in Aquaculture

Microorganisms such as viruses, bacteria, water molds (fungi), and parasites cause diseases of freshwater fish in warm-water aquaculture. Some of these agents are obligate pathogens (require a host for survival in nature), but many do not require a host and can be found living in aquaculture waters. These microorganisms facultative agents are opportunistic and cause problems when the host's resistance is compromised.

The most common pathogens that affect aquaculture include:

Viral diseases: The most serious viral disease is channel catfish virus disease (CCVD). This is most commonly found in juvenile channel catfish during their first summer of life. Channel catfish virus is a herpesvirus that attacks swim-up fry to 10 cm fingerlings when water temperatures are 25 °C or above. Mortality due to CCVD can be acute and reach up to 90 percent, especially in densely populated tanks or ponds.

Bacterial diseases: Bacteria cause more infectious disease problems than any other group of pathogens in warm-water aquaculture. The motile aeromonad septicemia (MAS) is a common disease of fish, including salmonids, and other aquatic animals that inhabit freshwater, but MAS can also occur in brackish water. The motile aeromonads are a heterogeneous group of ubiquitous, mesophilic, gram-negative bacteria that are also a normal component of the microbial flora of fish (Lim and Webster, 2001).

Activity 10.8.

In small groups,

Study the major diseases of fish in the small scale fish farms in your locality and their possible control methods. If fish farms are not available in your locality, go to the school library and search the Internet for information on major diseases of fish in small scale fish farms.

Share your answers with the whole class.

10.9. Local knowledge in fish processing

Ethiopian consumers prefer for whole fresh fish. As a result, the bulk of the fish harvest from the lakes is sold fresh. However, frozen filets are increasingly being marketed in lakeside towns as well as in the capital city, Addis Ababa.

Smoking and drying is carried out only on some remote fishing locations. " Quanta ", which is a dried fish product, is largely available around Arba-Minch. The product is obtained by filleting the fish, cutting them into large strips and hanging them up on strings to dry for two to three days. The dry product can be packed in sacks for storage on the floor. Once packed, it can be stored for up to a month without substantial quality deterioration.

Drying is increasingly becoming a method frequently used to preserve excess catches. Dried fish is becoming more available in large consumption centres such as Addis Ababa and at the expatriate market.

Traders face major storage problems due to the shortage of basic cold chains or cooling systems. This results in significant losses. " Quanta " is generally prepared in poor hygienic conditions, insufficiently dried and stored on bare ground. This often significantly decreases the quality.

A B

Figure 10.11. Fish fillets hung for immediate sundry in Wagan wetland fishers' camp of Gambela region, Ethiopia (A) and fish smoking/frying (B).