**CHAPTER NINE**

**9. BENEFITS OF FISHERIES AND AQUACULTURE**

9.1. Nutrition and Socio-economic Benefits

 1. Subsistence or artisanal fishing;

* + - * Provides a nutritious fish diet particularly to the poor society.
			* domestic or local consumption
			* income and employment
			* Fish is highly nutritious. It provides proteins, fats, vitamins and minerals
* Fish have less fat than red meats.
* Fish is a rich source of vitamins, particularly vitamins A, B1 (thiamin), B2 (riboflavin), B3 (niacin), D, as well as C (if eaten fresh)

 **2. Industrial and Recreational Fishing**

* the development of recreational fishing attracts tourists and thus generates a tourism industry which will also add to the national economy

**3. Employment opportunities**

* Generally, small-scale aquaculture projects provide more employment opportunities per unit
* of capital invested than larger farms

**4. Industrial-scale aquaculture**

* Small-scale aquaculture can often make a greater impact on local consumption, but maintaining regular supplies to distant markets can prove more difficult and expensive for small holders

**5. Participation of the local community**

The need for the participation of the local community in planning and implementation in rural development projects is a widely accepted ideally

**9.2. Role of aquaculture and fisheries**

* Aquaculture can affect human **food security as well as generating income.**

 aquaculture can benefit the livelihoods of the poor either through an improved:

* Food supply to achieve food and nutritional security,
* Employment and Increased income

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**Aquaculture and fisheries for the poor**

If aquaculture is to serve the poor, several guidelines should be considered:

*1.Increase funding for aquaculture for the poor*

This means more support should be given to extensive, traditional, inland, and small-scale aquaculture operations.

2. *Do no harm* to the food supply, income, or environment of the poor

3. *Strengthen existing aquaculture for the poor r*ather than designing entirely new projects

*4.Produce low cost products favored by the poor*

 *5. Produce for local consumers;* Products destined for export, or even for distant cities,

 are not likely to be consumed by the poor. Focus on products likely to be consumed by

 the local poor.

 *6. Encourage community production.* While much of commercial aquaculture is based on

 Privately-owned operations, community-based production in local ponds and lakes can be

effective in reaching the poor

7. *Monitor food security and related impacts;* It should not be assumed that just because an aquaculture project is in a poor area and produces low cost products the poor will in fact be the ones who get to consume the product. Test the assumption with field research.

 In general, assess aquaculture projects not only in terms of their economic and

 Environmental impacts but also in terms of their nutritional impacts.

**CHAPTER TEN**

 **PROCESSING AND PRODUCTS OF FISH**

**10.1. Fish Processing Methods**

**1. Post-mortem Changes and Fish Quality**

* Fish and fish products are fast deteriorating or perishable materials.
* 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.
* **Slime** is a mucous or thick sticky substance secreted by the skin cells of certain animals including fish.
* When fish is alive slime production adds to the survival of the fish by making its body too slippery to be caught by its predators.
* In fish the process of slime secretion becomes very active just after fish death often producing as much as 2-3% of the fish mass. Slime contains large amounts of nitrogenous compounds and these provide good nourishment for micro-organisms originating from the environment. Therefore, the slime spoils quickly: first giving an unpleasant smell to the fish, and second opening the way for further and deeper bacterial penetration into the fish.
* The post-mortem production of huge amount of slime by fish creates problems during processing and generally leads to fish spoilage. Therefore, fish and fish products need appropriate processing
* **Rigor mortis** is a condition in which muscle fibers become short and tight, causing fish to become rigid. This occurs as a result of complicated biochemical reactions that take place in fish muscle cells
* Compounds such ammonia, hydrogen sulphide, etc., are the final products of

Microbiological spoilage of fish, which produces an unpleasant and disgusting flavor. Although both autolysis and microbial decomposition cause the decomposition or breakdown of fish tissue, the former is caused as a result of enzymatic action whereas the latter is because of the action of microorganisms.

**Processing Methods**

F**ish 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 is a highly perishable food which needs proper handling and preservation if it is to have a long shelf life and retain a desirable quality and nutritional value. The central concern of fish processing is to prevent fish from deteriorating.

* Fish wastes (offal) generated from fish processing should not be just dumped into the environment.
* Fish wastes can be managed by converting them in to by-products (secondary products) such as fish oil and fishmeal.
* Fish oil is a healthy diet for human being because it contains the omega-3 fatty acids -that reduce inflammation throughout the body
* Fish processing procedures can be divided in to two major phases:
* preliminary processing
* the main processing stage
* **Preliminary processing** of fish usually consists of grading, removal of slime, beheading , scaling, washing, cutting of fins, gutting and slicing of whole fish
* **Main Processing Stage**

This phase or stage is mainly concerned with fish preservation processes

**a. Chilling, Freezing and Refrigeration**

* These are preservation methods that involve temperature control.
* temperature is decreased in order to reduce the metabolic activities that take place in the fish due to autolytic or microbial processes.
* Moreover, these methods make water less available for bacterial growth thereby slowing the growth of microorganisms.

**b.Drying and Smoking**

* Drying is a process of removing water from the food in order to inhibit the growth of microorganisms. Microorganisms such as bacteria and moulds need the water in the food to grow. Thus, drying effectively prevents them from surviving in the food.
* Smoking is done by exposing fish to the smoke from burning or flaming wood

**c. Salting and Pickling**

* **Salting** is the preservation of food with dry edible salt. Salting is used to inhibit the growth of microorganisms including most bacteria and fungi by creating a highly salty or hypertonic condition

**Pickling** is the process of preserving food by anaerobic fermentation in brine solution of salt in water) to produce lactic acid. It creates a pH less than 4.6, which is sufficient to kill most bacteria. Pickling can preserve fish foods for months

 In Canning, processed fish products are sealed or packed in airtight containers called

 cans. In caning a tight packing prevents microorganisms from getting inside. Canning

 provides a longer shelf life ranging from one to five years,

**10.2. Types of Fish Products**

* **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 recontamination.
* **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 thus prevent 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

**CHAPTER ELEVEN**

**11. FISH PARASITES AND DISEASES**

**11.1. Fish Immunity**

* The body defense of fishes are grouped into; **non-specific** (physical protection) and **specific** (mechanical and chemical) immune system.
* The non-specific defense system comprises the skin and scales, as well as the mucus or slime layer secreted by their skin epidermis.
* Nonspecific immunity is comprised of defenses that combat a variety of pathogens at one time rather than a single microbe.
* Fish skin and scale give primary protection by preventing direct entry of disease causing organisms into the fish body.
* Mucus or slime is important in trapping microorganisms and inhibiting their growth
* specific defense involves specialized responses to particular pathogens recognized by the fish's body.

**11.2. Major Fish Parasites**

* Fish parasites and diseases are more usually common in aquaculture or fish farming ponds than in the natural fish environments.
* This is because of the increased stress to the fish due to their confinement to small area

effects caused by fish parasites include;

* destroying fish tissue
* removing fish blood and cellular fluids
* Diverting part of fish nutrient supply and allowing secondary infections to develop in fish body.

**11.2.1. Protozoan parasites of fish**

* Protozoan’s are single-celled organisms, many of which are free-living in the aquatic environment
* no intermediate host is required for the parasite to reproduce (direct life cycle)
* Consequently, they can build up to very high numbers when fish are crowded causing weight loss, debilitation, and mortality.

E.g. ciliates, flagellates, myxozoans, microsporidians, and coccidians.

**A. Ciliates**

* Most of the protozoans identified by aquarists will be ciliates.
* These organisms have tiny hair-like structures called cilia that are used for locomotion and/or feeding
* common inhabitants of pond-reared fish
* The most common ciliated protozoa is *Ichthyophthirius multifiliis*
* The disease called "**Ich**" or "white spot disease" has been a problem in aquarium.

"Ich" is an obligate parasite and capable of causing massive mortality within a short time

**B. Flagellates**

* Flagellated protozoan are small parasites that can infect fish externally and internally.
* They are characterized by one or more flagella that cause the parasite to move in a whip-like or jerky motion.

**C. Myxozoa**

* Myxozoa are parasites that are widely dispersed in native and pond-reared fish populations.
* Myxozoans are parasites affecting a wide range of tissues

**D. Microsporidia**

* Microsporidians are intracellular parasites that require host tissue for reproduction.
* Fish acquire the parasite by ingesting infective spores from infected fish or food.
* A common microsporidian infection is *Pleistophora , which infects* skeletal muscle
* There is no treatment for microsporidian infections in fish
* Spores are highly resistant to environmental conditions and can survive for long periods

E. **Coccidi*a***

* *Coccidia are intracellular parasites described in a variety of wild-caught and cultured fish*
* intestinal infections
* Inflammation and death of the tissue can occur, which can affect organ function
* infection sites include reproductive organs, liver, spleen, and swim bladder

**11.2.2. Helmnthes (Worms)**

**1. Platyhelminthes (flatworm)**

**A. Monogenean Trematodes**

* Monogenean trematodes, also called flatworms or flukes
* commonly invade the gills, skin, and fins of fish
* The skin where the flukes are attached shows areas of scale loss and may ooze a pinkish fluid
* Gills may be swollen and pale,
* respiration rate may be increased, and fish will be less tolerant of low oxygen

**B. Digenean Trematodes**

* Digenean trematodes have a complex life cycle involving a series of hosts
* Fish can be the primary or intermediate host depending on the digenean species
* . They are foundexternally or internally, in any organ
* The best control of digenean trematodes is to break the life cycle of the parasite.
* Elimination of the first intermediate host, the freshwater snail is often recommended

**C. Cestodes**

* Cestodes, also called tapeworms, are found in a wide variety of animals, including fish .
* The life cycle of cestodes is extremely varied with fish used as the primary or intermediate host.
* Cestodes infect the alimentary tract, muscle or other internal organs
* Damages vital organs such as the brain, eye or heart.

**3. Annelids True worm- leeches**

* Leeches are occasionally seen in wild and pond-raised fish.
* They have a direct life cycle with immature and mature worms being parasitic on host's blood.

**11.2.3. Parasitic Crustacean**

* Parasitic crustacea are increasingly serious problems in cultured fish and can impact wild

populations.

* Most parasitic crustacea of freshwater fish can be seen with the naked eye as they attach to the gills, body and fins of the host.

**11.2.4. Bacterial disease**

* Bacterial diseases occur in cultured fish and are responsible for heavy stock mortality in Korea.

**11.2.5. Viral Diseases of Fishes**

Some of the fish diseases caused by viruses include infectious pancreaticnecrosis (IPN),

infectious haemtopoietic necrosis (IHN),etc

**11.2.6. Fungal (Mycotic) Diseases of Fishes**

**A. Saprolegniasis** is a fish disease caused by a fungus of Saprolegnia species. it affects skin and gills of freshwater fish and crustaceans.

**B. Branchiomycosis**

* This fungal disease that causes a gill rots and caused mainly by two species of Branchiomyces: *B. sanguinis and B. demigrans.*
* *To prevent the infection dense stocking* should be avoided in culture systems
* high concentrations of organic matter should be avoided and clean fresh water should be provided

**2. Nematodes**

* Nematodes, also called roundworms, occur worldwide in all animals.
* They can infect all organs of the host, causing loss of function of the damaged area