Aquaculture, also called **fish farming, fish culture**, or **mariculture** is an approximate equivalent in fishing to agriculture—that is, the rearing of fish, shellfish, and some aquatic plants to supplement the natural supply. Aquaculture is one of the most resource-efficient ways to produce animal protein and has helped improve nutrition and **food security** in many parts of the world. Limits to **wild fisheries**, environmental changes, the nutritional benefits of seafood, and trends in global seafood markets underscore the need to increase marine aquaculture production. Aquaculture can take place in the ocean, or on land in tanks and ponds. Marine aquaculture produces primarily oysters, clams, mussels, shrimp, salmon, and other marine fish.

POND CULTURE

The majority of freshwater fish are raised in **ponds**. Water taken from a lake, river, well or other natural source is channelled into the pond. The water either passes through the pond once and then it is discharged, or it may be partially replaced so that a certain percentage of the total water in a system is retained. Pond systems that yield the highest fish production only replace water lost through evaporation and **seepage**. Fish farming ponds range in size from a few dozen square metres to several hectares (ha). Small ponds are normally used for **spawning** and **baby fish** production, while larger ponds are used for the **grow-out period**. Production ponds larger than 10 ha become difficult to manage and are not very popular with most producers. Ponds are usually located on land **with a gentle slope**. They are rectangular or square-shaped, have well-finished **dikes** and do not collect **run-off water** from the surrounding **watershed**. It is important that sufficient water is available to fill all the ponds within a reasonable period of time and to maintain the same pond water level. Ponds are **to be drained** completely when **the fish are to be harvested**.

FISH LIFE CYCLE

Juvenile fish [**NOVELLAME**]go through various stages between birth and adulthood. They start as eggs which **hatch** into **larvae**. The larvae are not able to feed themselves, and carry a **yolk-sac** which provides their nutrition. Before the yolk-sac completely disappears, the tiny fish must become capable of feeding themselves. When they have developed to the point where they are capable of feeding themselves, the fish are called **fry (AVANNOTTO)**. When, in addition, they have developed **scales** and working **fins**, the transition to a juvenile fish is complete and it is called a **fingerling**. Fingerlings are typically about the size of fingers. The juvenile stage lasts until the fish is fully grown, sexually mature and interacting with other adult fish.

HATCHERY

When the eggs hatch in the **spawning ponds**, the **fish fry** are collected and transferred to **nursing ponds** for further rearing. In **fish hatcheries**, the eggs are hatched in simple aluminium troughs placed in running fresh water. In this way the eggs are kept in motion artificially, to imitate what the males do while guarding the eggs.

Hatching takes place in 18 to 20 hours after spawning at a water temperature of 25-32 °C. The newly hatched fry first remain in the nests and are removed to nursery ponds with a scoop net after 6 to 9 days. Each female produces 2,000 to 5,000 fry, depending on its body weight.

Carp spawning can occur naturally in outdoor ponds or artificially in a fish hatchery using induced spawning methods.

The fish larvae can be raised to fingerlings within a period of about one month. The most common practice is **to rear fry in nursery ponds** for about a month **and transfer them to grow-out ponds where they will**

reach market size. Stop feeding the fish for at least one day before breeding, harvesting or transporting them. The stress from these events causes the fish to excrete waste, which makes the water turbid. In general, fry can be starved for 24 hours, fingerlings for 48 hours and adult fish for about 72 hours. This enables the fish to digest the food completely before stressful events.

Harvesting the fish

As in any other type of farming, the final phase in the fish farming cycle is the harvest and possible sale of the fish. When most of the fish are big enough to be eaten or sold, harvesting can start (usually after 5 to 6 months). There are two ways to harvest fish: either take out all the fish in the pond at the same time, or **selectively cull** fish from the pond throughout the whole year. In the latter method, usually the larger fish are taken out and the smaller fish are left in the pond to keep growing. It is, of course, possible to combine these two methods by taking out large fish as required and finally removing all the remaining fish at once.

Post-harvesting

Fresh fish spoils very quickly. To prevent contamination of the fish, proper hygiene must be ensured. Contamination can come from people, soil, dust, sewage, surface water, manure, or spoiled foods. Poorly cleaned equipment, domestic animals, pets, vermin or un-hygienically slaughtered animals can also be the cause. To prevent spoilage of the harvested fish, either the bacteria present in them must be killed, or their growth must be suppressed. Different methods exist to suppress bacterial growth.

Salting

This is an inexpensive method when salt is cheap, as no electricity is necessary and storage can be at room temperature. Fish quality and nutritional value are reasonable after salting. Storage life is long.

Drying

Also an inexpensive method as no electricity is required and little equipment is needed. Dry and/or airtight storage is required. Quality and nutritional value are reasonable if storage is good.

Smoking

Inexpensive, little equipment and energy needed, but fuel must be available. Quality and nutritional value are reasonable.

Fermentation

This method is often inexpensive, but the fish taste and odour are radically changed. Storage life varies depending on the product. Nutritional value is often high.

Canning

This is a fairly expensive method because it is labour intensive and requires plenty of energy, water and equipment, such as tins or jars with lids, sterilisers and canning machines. Packaging is expensive. Storage is easy and possible for long periods (below 25 °C). Quality and nutritional value are good.

Cooling and freezing