Unit 1: Aquaculture – Basics and Scope

1.1.1 Introduction

Aquaculture remains a growing, vibrant and important production sector for high protein food. Global production of food fish from aquaculture, including finfishes, crustaceans, molluscs and other aquatic animals for human consumption.

The contribution of aquaculture to the total production of capture fisheries and aquaculture continued to grow, rising. Asia is in progressively dominant position in world aquaculture production. while China ranks first in world aquaculture production with 9.4 percent and India ranks second as world aquaculture producer with 7.1 percent by quantity (2008) .

The word "aquaculture" is defined by the Food and Agriculture Organization of the United Nations (FAO) as follows "Aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants.

Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture" (FAO 1997b).

Current aquaculture technology allows the commercial and viable production of a number of organisms through the management of their entire life cycles. The "seed" materials (larvae and juveniles) are produced under controlled conditions, starting from the maturation of broodstock, which eliminates the need for the collection of juveniles from the wild. Aquaculture involves a thorough understanding of the behavior, habitat and environmental requirements, reproductive biology, nutritional requirements, and larval and juvenile physiology of each species, as well as its susceptibility to disease under culture conditions.

Fisheries is a sunrise sector in Indian agriculture, with high potentials for diversification of farming practices, rural and livelihood development, domestic nutritional security, employment generation, export earnings as well as tourism. The possibilities extend from vast seas to high mountains with valued coldwater species. Untapped potentials exist in island systems from ornamental fishes to value added products. This sector provides employment

opportunity to 5 million fisher peoples from coastal villages, major river basins and reservoirs in the country.

India is endowed with coastline length of 8,129 km, 2.02 million sq km of Exclusive Economic Zone (EEZ) comprising 0.86 million sq km on the East coast, 0.56 million sq km in the West coast and 0.60 million sq km around Andaman and Nicobar Island and 0.5 million sq km of continental shelf with a annual catchable marine potential of 3.93 million tons. Besides, there are vast brackish water areas all along the coast line which are suitable for seafarming and mariculture.

1.1.2 Objectives of aquaculture

- ✓ Production of low cost protein rich, nutritive, palatable and easily digestible human food.
- ✓ Providing new species and strengthening stocks of existing fish in natural and man-made water-bodies through artificial recruitment
- ✓ Production of ornamental fish for aesthetic appeal.
- ✓ Effective utilization of aquatic and land resource
- ✓ Recycling of organic waste of human and livestock origin
- ✓ Providing means of livelihood through commercial and industrial aquaculture.
- ✓ Production of sportfish and support to recreational fishing.
- ✓ Production of bait-fish for commercial and sport fishery.

In aquaculture, there are three categories of waters, viz. fresh, salt and brackish. Fresh waters, generally abounding in the inland areas of a country, and the salt water of the seas and oceans, are characteristed by a wide difference in their salinities ranging from nil in the fresh water to nearly 35 ppt in the seas and ocean.

The salt content of fresh and sea water exercises a very selective influence on the fauna and flora that live in each type of water. As far as finfish and shellfish are concerned, the normal residents of each type of water are said to be stenohaline, i.e. they can withstand only a narrow variation in the salinities of their surrounding medium.

A carp is an example of stenohaline freshwater fish and a sardine or a mackerel may be cited as examples of stenohaline saltwater fish. Brackish water normally naturally occurs in estuaries, deltas of rivers, lagoons and backwaters, which everywhere in the world are under tidal regime. In such habitats the salinity of the water fluctuates widely between 0 to 35 ppt,

depending on the phase of the tide and volume of fresh water discharged through the river into the sea.

The finfish and shellfish that inhabit brackish waters are invariably euryhaline i.e. they can withstands wide changes in salinity of the surrounding medium. Examples of euryhaline fish are a mullet (Mugil cephalus) and mud-skipper, Periophthalmus and those of crustaceans are several species of penaeids (e.g. Penaeus monodon) and crab (e.g. Scylla serrata). There are finfish and shellfish which spend different phases of their lives in sea, estuaries and freshwater streams. Such animals are either anadromous or katadromous. Anadromous fishes are those that bread naturally in freshwater streams but spend the middle years of their lives in the sea, like salmon and shad. Katadromous fishes show the opposite kind of life cycle as in eel they migrate river to sea for breeding.

There are forms which restrict their migration between fresh water sections of the river and the estuary. Several species of palaeomonid prawns (Macrobrachium rosenbergi; M. vollenhovenii) are examples of shellfish which undergo such a life cycle. These forms breed in estuaries but spend the mid-years of their live in fresh waters. Then, there are forms which migrate back and forth between the estuary or a lagoon and the sea in different phases of their lives. A mullet (e.g. Mugil cephalus) or a shrimp (e.g. Penaeus mododon, P. notialis) are examples of finfish and shellfish which show such a pattern of migration.

Over the years, the enormous increase in the growth rate of aquaculture has been in response to declines in commercial harvests of wild stocks of fish and shellfish. Each type of the system of aquaculture has its own specific set of conditions and the total biomass production also varies from one system to the other. The selection of a particular aquaculture system is based mainly on the geographic location, type of water body, target aquatic species, availability of resources and skilled professionals, availability of seed of the target species at the desired time of stocking, apart from a set of different socioeconomic factors.

Among all the aquatic organisms used for aquaculture, fishes have the dominant share with respect to number of species and production in quantity and value. Fish culture may be undertaken in almost any kind of water (be it freshwater/brackish water/ seawater or sewage water). A single species of fish may be selected for aquaculture or different combinations of compatible fish species may be utilized in order to produce more biomass. Fishes may be stocked in traditional community ponds, without supplementing artificial food and not taking care of the water body.

1.1.3 Types of Aquaculture

Different types of aquaculture practices have been there as follows:

In order to get better return, however, modern aquaculture practices have relied on intensification wherein very high stocking density of fishes are maintained on artificial feed and the water quality and environmental parameters are monitored to remain in the optimal range required for high growth rate of the fish. Fish culture may also be integrated with different crops or animals farming system. For example:

1. Suitable species of fish may be cultivated in the rice fields having sufficient water required for fish survival and growth.
2. The bunds of ponds may be utilized for agricultural activities or animal farming

1.1.4 Scope for Aquaculture in India

The freshwater aquaculture systems in the country has primarily confined to three Indian major carps, viz., rohu, catla and mrigala, with exotic species: silver carp, grass carp, and common carp forming the second important group. Among the catfishes, magur (*Clarias batrachus*) has been the single species that has received certain level of attention both from the researchers and from farmers due to its high consumer preference, high market value and most importantly its suitability for farming in shallow and derelict water bodies with adverse ecological conditions. Recent years, however witnessed increasing interest for farming of *Pangasius* spp., especially in Koleru lake region of Andhra Pradesh due to its higher growth potential and ready market. Other potential species include *Labeo calbasu, Labeo gonius Labeo bata, Labeo dussumeri, Labeo fimbriatus, Barbodes carnaticus, Puntius pulchellus, Puntius kolus, Puntius sarana*, and *Cirrhinus cirrhosa*. Some of these species are being cultured at a very low level in different parts of the country, mostly based on wild seed collection. The freshwater air-breathing and non air-breathing species, *Channa marulius, Channa striatus, Channa punctatus, Channa gachua, Channa stewartii* have not been taken up for the aquaculture activities in serious way. With the technology available for seed production and culture of air breathing (*Clarias batrachus, Heteropneustes fossilis*) and non air breathing catfish like (*Wallago attu, Mystus seenghala, Mystus aor, Horabagrus brachysoma, Pangasius pangasius*), scientific organized catfish farming can be taken up in extensive and semi intensive way (Ponniah and Sundaray, 2008). The giant freshwater prawn, *Macrobrachium rosenbergii* has been the principal species, adopted both under monoculture and under mixed

farming of freshwater prawn production of about 43,000 tonnes in the country at present. However, *M.malcomsonii* and *M. gangeticum* have not been taken up in a big way

In the brackishwater sector, the aquaculture development is mostly contributed by shrimp, *Penaeus monodon* culture only. The other shrimp species like *Fenneropenaeus indicus, Fenneropenaeus merguiensis, Penaeus pencillatus, Marsupenaeus japonicus* and *Penaeus semisulcatus* are not cultured on a commercial level large-scale culture. Recently *Fenneropenaeus vannamie* culture is developing in India. The finfish species like the seabass (*Lates calcarifer*) and grouper (*Epinephelus* spp.), grey mullet (*Mugil cephalus*), pearl-spot (*Etroplus suratensis*), milk fish (*Chanos chanos*) which are promising and ideal for aquaculture has not been exploited. The potential marine finfish species are *Epinephelus malabaricus, Epinephelus coioides, Epinephelus tauvina, Epinephelus fuscoguttatus, Epinephelus polyphekadion, Cromileptis altivelis*, *Rachycentron canadum*, *Seriola quinqueradiata*, *Trachinotus blochii*, *Coryphaena hippurus*, *Psettodes erumei*, *Lutjanus argentimaculatus*, and *Pampus argenteus*. Mariculture is expected to be a major activity in the Indian coastal areas in the years to come. Given the wide spectrum of cultivable species and technologies available, the long coastline and favorable climate, mariculture is likely to generate considerable interest among the coastal population and entrepreneurs.

In the present era of food insecurity, aquaculture shows enormous potential to feed not only the ever increasing human population but also the aquaculture products can be utilized as a feed ingredient in the diets of different domesticated animals of high commercial value. The aquaculture sector has become a modern, dynamic industry that produces safe, high valuable and high quality products, and has developed the means to be environmentally sustainable Sustainable aquaculture is currently the need in India as elsewhere. Eco-friendly aquaculture in harmony with environmental and socioeconomic needs of the society has to be evolved.