

Methods of coastal aquaculture

Pond culture

Many species of fish and shrimp are grown in earthen ponds. This is the most popular system of aquaculture particularly in the developing countries. Proper site selection, designing and construction of ponds is necessary for successful operations.

Site Selection

- Selection of site is generally based on species to be cultured and technology to be adopted. However, some factors are common to all sites such as, agro- climatic conditions, access to hatcheries/ seed centres, roads and communication, access to markets, protection from natural disasters, availability of skilled and unskilled labour, public utilities etc.
- All available meteorological and hydrological information needs to be collected. Soil characteristics, quality and quantity of available water, ease of filling and drainage, especially by gravity, are basic considerations.
- Land elevation and flood levels have to be ascertained. The maximum flood level in the last 10 years and the highest astronomical tide should not be higher than the normal height of the dikes. It will be advantageous to select land with slopes not steeper than 2 percent. The area should be sufficiently extensive to allow future expansion and preferably be of regular shape to facilitate farm design and construction.
- Among other important general factors be considered are the existing and future source of pollution, developmental plans for the neighborhood areas and legal and social aspects of farm establishment. The possible effects of the discharges of the farm on the environment needs to be considered. This can greatly influence the attitudes of the local communities to the proposed farming and hence their future cooperation.
- Sites generally available for the coastal pond farms are tidal and inter-tidal mud flats in protected areas of near estuaries, bays, creeks, lagoons and salt marshes. If the ponds need to be supplied water through tidal flow and information on tidal amplitude at the site is essential.
- Data on high tides and low tides need to be collected from tide charts available of the nearest port. The elevation of the land relative to the tides is important to decide on the type of ponds to be constructed (whether tidal fed or pump fed) and amount of excavation necessary for constructing the ponds.
- The construction of ponds in areas reached only by the high spring tides would require excavation, leading to high cost of construction. For tidal fed ponds sites with elevation of between 0 and 140 cm relative to tides is necessary. However, if tidal energy can be replaced with other forms of energy the above limitation would not apply.

8.2 Cages

- Rearing fish in cages is a traditional practice in some Asian countries. It appears to have originated in Kampuchea two centuries ago. It has spread to other places in more advanced form recently.
- Salmon in Norway, yellow tail in Japan and groupers and sea bass in Hong Kong, Vietnam and Singapore are grown in cage farms.
- Cages offer great opportunities for aquaculture in open waters of the seas. In recent years cage aquaculture has become a major source of aquaculture production, particularly of high value fish like salmon, trout, sea bass and groupers. Several types and designs of cages and cage farms have been developed and commercially used.
- Majority of the cages consist of a floating unit, a framework and a flexible mesh net suspended under it. The floating unit can consist of empty barrels, Styrofoam polyethylene pipes, or ready made pontoons of plastic or metal.
- The buoy units are often built into a framework. The framework can be made of impregnated wood, bamboo spars, galvanized scaffolding or welded aluminum bars. Nylon is commonly used for net, but weld-mesh or even woven split bamboo is also used. Cage flotillas provide safer working conditions and enable storage of feed on site, as well as installation of automatic feeders.
- Reasonably sheltered areas, with sufficient water movement to effect adequate mixing and aeration are selected as sites for cage farms.
- The occurrence of typhoons, hurricanes and cyclones in the area and the vulnerability of the sites are also major considerations in the design of cage farms. Polluted sites are generally avoided.
- In cold climates, areas that receive safe heated water effluents are preferred, as higher water temperatures generally improve growth and productivity.
- Unused feed and fish faeces fall from the bottom of floating net cages on to the floor of the water bodies. Accumulated wastes decompose and cause oxygen depletion or generation of methane or other toxic gasses under anaerobic conditions.
- Cages also increase deposition of silt on the bottom of the site. It is therefore necessary to have enough movement of clean water below the floating cages. Carrying capacities of the areas should be determined to avoid overcrowding of cages.
- The most sophisticated design of cages is used in cage farms of Norway where salmon are grown extensively. Cages of size 100 to 500 m³ are used. A simple unit holds a net of four

vertical sides and is rectangular in cross section. The more popular ones are circular in cross section.

- There are many ways of arranging cages in a cage farm. Where possible, it is preferable to moor cages to a jetty with direct access to a quay, in order to facilitate work and reduce labour cost.
- However, environmental and site conditions may require them to be located farther away from the coast, in which case a work boat will be needed for access. Cages should be installed on the sides of a central walkway to facilitate day to day work on the farm.
- Feed dispensers are installed above each cage; in others, manual feeding is done. Mooring blocks have to be sufficiently heavy and are usually made of concrete with heavy galvanized bolts.
- Most of the presently available cages are designed for use in protected bays and fjords. In order to utilize more open waters and high seas, special cages with a flexible rubber framework have recently been developed.

8.3 Pen culture

- Pens and enclosures are transitional structures between ponds and cages. They are used for culture of yellow tail in Japan, milkfish in the Philippines and salmon in Norway.
- The success of pens for culture depends on the hydro-biological conditions of the site. The design of the structures is based on adequate knowledge of water quality, floods, waves and currents and prevalence of predatory animals.
- Pens are formed by net barriers to partition off areas of an open water body, such as intertidal areas of the sea, bays or lagoons.
- Different designs of enclosures have been constructed. Generally the enclosure is formed on one side of the shore and on the other three by a wall of nylon netting hung from pole driven into the bottom.
- In many such enclosures, concrete or stone walls are built on each side where it joins the shore or provide adequate support to the nets.
- Around the rest of the perimeter, heavy posts of impregnated timber or concrete piles are driven into the bed extending for about 2m out of water all times.
- Net barriers may be hung from steel cables stung between the poles or the concrete or steel piles. To prevent the lateral movements of these piles some are anchored to fore and aft, to large anchor blocks using strong steel cables.

- The nets are generally made of knotless nylon netting material. In some cases, two walls of netting are used, the outer one to protect the enclosure from floating debris and to prevent escape of fish if the inner wall gets damaged.
- However, if two walls of netting are used it may create hindrance to free flow of water. The net barrier is fixed by a rope along the sea bed for 1m, until it terminates in a lead line. The net is embedded in the sand or silt at the bottom. As a further precaution to prevent fish escaping heavy rubble is piled up at the bottom around the pen.