Evolution of Fisheries and Aquaculture in India

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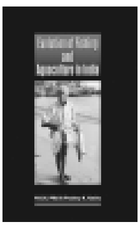

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Pipeline technologies - inland

Freshwater

Other freshwater aquaculture technologies which are in the experimental stage are considered as the pipeline technologies. These are:

Cage culture
Pen culture
Pearl culture
Running water fish culture

Cage culture

In India cage culture was first attempted for the airbreathing fishes like *H. fossilis* and *A. testudineus* in swamps (Dehadrai, *et.al.* 1974).

Natarajan *et al.* (1979) and Menon (1983) showed encouraging results with survival level ranging from 25% to 85% by raising carp fry in floating cages.

Cage culture has many advantages, *viz.*, large extent of larger water bodies can be utilized for aquaculture, which otherwise are not fully exploited for fisheries; high production per unit area can be obtained with high stocking density and intensive feeding; feeding and monitoring of stocks for growth and well being is easy; harvesting is simple, and cages can be dismantled and reused in other locations as per requirement, and there are possibilities of higher revenue generation from unit water area (Anon., 2000a).

Cages are circular, cubic or rectangular basket like strictures (Fig. 30). These may be floating at the surface or just submerged or set at the bottom and enclosed at the bottom as well as on the sides by bamboo mesh, metal screens or netting (webbing) material.

Seed production and rearing in cages

In nursery phase of cage culture, spawn or early fry are reared to fingerlings in 2-3 months for stocking in grow out cages or other systems, by adopting high density stocking with supplementary feed.

Fig. 30. Circular and ractangular cages

The fingerlings of carps can be raised on a commercial scale in cages of 5 m^2, with a depth of 1.5 m. In situations where nursing of fry in ponds is not feasible, cages can be used.

Grow-out production systems

Fish production in grow out cages largely depends on the stocking density, species, inputs like supplementary feed and management. The number of fishes that can be stocked in a cage depends on the productivity of the water body, rate of circulation, fish species, quality and quantity of feed supplied. The initial size of the fish to be stocked depends primarily on the length of the growing season and the desired size at harvest.

Carp fingerlings for stocking in 16-26 mm mesh cages should be of 10-15 g to expect a final size of 500 g in a rearing period of 6 months. When natural fish food organisms are limited for high density rearing in cages, supplementary feeding contributes to the production. In carps, feed is provided at 4-5% of fish biomass per day until the fish attain 100 g size and the ration is reduced thereafter to 2-3%.

Pen culture technology for floodplain wetlands

The floodplain wetlands are commonly known as *beels, mauns, chaurs* or *pats* in various states of India. Though there is a great potential for more than 1,000 kg ha^{-1} production from floodplain wetlands, an average production of only 120-300 kg ha^{-1} is recorded. Most of these systems are weed choked and are less productive. Efficient use of popular gears is not practical in such water bodies. Till recently, the mainstay of fish production from these waters was through capture fishery. Shift to culture based fishery has yielded better results in recent years. For this practice, the requirement of quality seed can be met by raising them in pen. The grow-out activity can also be undertaken in pens.

The pen may be square, rectangular, oval, elongated or horseshoe shaped

Fig. 31. Pens in the beels of Assam

depending upon nature of banks, land and water depth (Fig. 31). For better management, the pen area should be 0.1 – 0.2 ha. The pen consists of thick bamboo frame, split bamboo or cane screen covered with nylon net lining. Most of the wetlands are infested with unwanted flora and fauna and so, deweeding, eradication of unwanted fauna and liming is essential prior to fixation of the pen(s).

Grow-out for carps and prawn

The selection of fish species depends upon the productivity and the flora and fauna. The species combination of indigenous and exotic carps with giant freshwater prawn (*Macrobrachium rosenbergii)* is proved to be successful, although, culture of *M. rosenbergii* alone is more profitable. The stocking density varies according to species combination, *e.g.* monoculture of carps – 4000-5000 ha^{-1}, carp + prawn culture 3000-4000 carps and 10000-20000 prawn ha^{-1}, and for monoculture of prawn, it may be as high as 30000-40000 ha^{-1}. Most of the floodplains are rich in natural food and so, supplementary feed is required only in special cases like monoculture of prawn. Pen culture can be done round the year, avoiding monsoon months. The culture period may vary between 4 and 6 months. Therefore, it is possible to take two crops in a year. The range of fish yield for carp culture is 4-5 t $ha^{-1} yr^{-1}$, for carp + prawn it is 2-2.5 t $ha^{-1} yr^{-1}$ and for monoculture of prawn it is 1.3 t $ha^{-1} yr^{-1}$.

Raising the fingerlings of carps and prawn

The fry (size : 10-15 mm) @ 5 m^{-2} may be stocked in pen. The composition may be *C. catla*–200, *L. rohita*-150, *C. mrigala*– 100 and grass carp -50. The rearing period would be nearly 3 months to get fingerlings of 70-80 mm. For a pen of 100 m^2, 3 kg of lime, 30 kg of cowdung should be applied before stocking. Depending upon the water salinity, lime may be applied every month. The commonly used feed may include mixture of rice bran and oil cake in equal quantity. However balanced feed may also include fish meal, vitamin and minerals. Prawn feed should contain 35-40% protein. In the first month the feed may be applied @ 5% of body weight of stocked fry, and in the second and third months it may be 4 and 3% respectively. The feed may be supplied twice a day *i.e.* in the morning and evening. Harvesting may be done when the water level is low.

Freshwater pearl culture technology

In India, while pearl production from marine oyster started in the early seventies (Alagarswami, 1974), studies on cultured pearl production from freshwater mussel started only recently (Janaki Ram, 1989). The Central Institute of Freshwater Aquaculture, Bhubaneswar has taken the lead to develop the technologies pertaining to different packages of practices of freshwater pearl culture (Fig. 32), which need to be disseminated to the farmers and entrepreneurs (Janaki Ram and Tripathi, 1992).

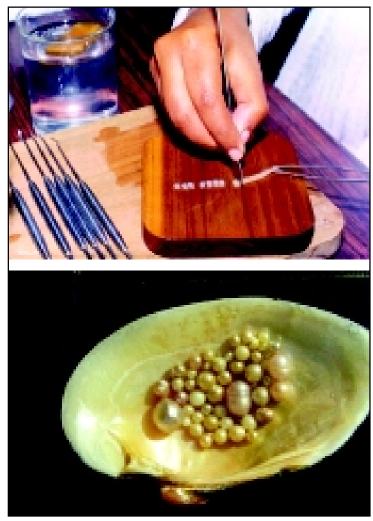

Fig. 32. Freshwater pearl culture

Freshwater pearl culture is akin to cash crops of land based agriculture, and the technology is privy to a very few countries in the world, *viz*, Japan and China. Freshwater pearl culture is advantageous in terms of commercial scale availability of natural stocks of pearl mussels in easily accessible localities, even in non-maritime regions, wider area of farming, operational easiness of management of freshwater culture environment, absence of natural fouling, boring and predatory organisms and overall cost effectiveness of operations. Realizing the potential and scope of inland pearl culture, a package of practices for producing cultured pearls from common freshwater mussels *Lammelidens marginalis*, *L. corrianus* and *Parreysia corrugata* has been developed (Anon., 2000a).

The process includes :

i) Collection and conditioning of native pearl mussels
ii) Surgical implantation of mantle grafts and appropriate nuclei in the internal organs of the mussels

iii) Post-operation care of implanted mussels
iv) Pond culture of implanted mussels in specially designed culture units for 12 months

The pearl products developed at the CIFA includes:

i) Shell attached half-round and designed pearls
ii) Unattached non-nucleated oval to round pearls and nucleated larger round pearls and alternate nuclear material.

In addition to producing regular, free, round cultured pearls, irregular non-nucleated pearls and pearl images (up to 1.0 cm) have also been produced successfully, which are drawing attention of several entrepreneurs.

Running water fish culture

In recent years there has been a greater realisation that availability of land for construction of ponds for aquaculture is becoming less. Thus, India need to utilise its available water bodies for maximizing fish production. The country has a considerable 0.19 m km of rivers and irrigation canals (Anon, 2000). Some part of these running waters can be brought under running water fish culture. At present some battery ponds are being used in hilly areas of the country particularly in the eastern and northern Himalayan regions and the Nilgiri hills in south India for culturing cold water fishes like trouts. In this system the water from hill streams/ rivers are made to flow through a series of dug-out embankment ponds constructed along the course of the stream/ river using diversion canals/ pipes. This helps maintain a mild water flow through the culture ponds. Screens of fine meshed nets are erected at the inlet and outlet of the ponds to prevent the entry and escape of organisms to and from the ponds.

Raceways can be constructed by partitioning a slow flowing river or irrigation canal into a series of rearing areas using screens made of split bamboo mats (*b a n a*) or nets or a combination of both. Such screens are erected from bank to bank with the help of bamboo or wooden poles. The raceways have the advantage of maintaining very good water quality since it is a flow- through system. However, in spite of a good potential in terms of water spread area availability, running water aquaculture is not being practiced in an appreciable scale at present. While the management of battery ponds is similar to that of still water ponds, that of raceways is more towards cage culture with near total dependence on artificial feeds and amenability to very high stocking densities. The issues and expected impact of these technologies are summarized in table 41.

Table 41. Issues and expected impact of pipeline technology

Pipeline Technology	Issues	Expected impact
Pen culture	Suitable only for shallow and marginal areas of larger water bodies like reservoirs and floodplains. Control on entry of weed/unwanted fishspecies/organisms in pen is difficult. Risk of damage to pen material is high. Reduction in water level limits the culture period. The life of pen is 3-years, which increases the cost of production.	In situ raising of stocking material, particularly in reservoirs and floodplains would provide quality seed to enhance fish productivity. Reduces fish seed transportation losses.
Cage culture	High cost of cages suitable for larger waters like reservoirs and floodplain lakes. Viable for culture of highly priced fishes only due to high initial and recurring expenses. Research information on culture of these species is very limited. Non-availability of balanced supplementary feed is a serious constraint. Disease outbreak is very common due to highly intensive cultural practices. Require intense watch and ward.	Intense aquacultural practices can be adopted in medium and large water bodies. Solves the problem of quality seed in medium and large waters to enhance fish productivity. Reduces fish seed transportation losses.
Pearl culture	Non-availability of skilled manpower for surgical tranplantation. Dependence on nature for stock of mussel. Highly specialised technology, may not be suitable for the poor. Need for a species with high nacre deposition like the species available in China and Japan. High duration crop with uncertainity about the quality product.	Being a cash crop, high returns per unit area are possible. High export potential. Integration with fish culture would enhance returns. Can be cultured in large waters to exploit their production potential.
Running water fish culture	Restricted to upland lakes and area in the vicinity of reservoirs and canals. Being a feed-based system, high investments are needed, so, not suitable for poor.	Can harness untapped prodution areas.