REVIEW ON CAGE AND PEN CULTURE

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ABSTRACT

The paper deals with the various aspects of work done on cage and pen culture in India and abroad The need for these types of culture techniques in India is pointed out. The history of these systems is traced and the various species of fishes used in cage and pen culture are pointed out. Since clams, windowpan oyster, edible oyster, prawns and milk fish are compatible species, they are ideal for culturing together. The different factors governing the success of intensive culture are presented. The kinds of cages and pens installed are discussed with a note on their durability with reference to the materials used for construction The yield achieved in cage and pen culture and the advantages of these two systems are reported. The field problems in these culture methods are indicated. The economics of fish production, particularly the net profit in selected studies are pointed out for taking up these programmes in mass level.

INTRODUCTION

Fish farming is generally practised in stagnent waters where it is possible to maintain the culturable fishes under control in many respects. But the main disadvantage in such shallow waters is the poor stocking density. The brackish-waters are more advantageous and ideal for fish culture operations particularly employing cages and pens (Rajyalakshmi and Ravichandran, 1980; Sundararaj and Krishnamurthy, 1981). Because of several advantages over stagnant pond culture, the cage and pen farming practices have been widely adopted in many countries. The work relating to the cage and pen culture carried out in India and elsewhere are reviewed and discussed in this paper.

Historical Account

Compared to pen culture, cage culture is widely practised. Pen culture is practised in a commercial basis only in a few countries like Philippines. In India, particularly in Tamil Nadu pen culture is in progress in the brackish-waters near Killai, (Anon, 1982). Cage culture was first described by Lafont and Saveun in 1951. However it was widely practised traditionally for about a century in Kampuchea. Later it was spread to Far East. Thailand has been practicing it for many decades in running waters. Island of Java and Indonesia adopted this practice around 1904. Japan ventured into cage culture experiments around 1950 in brackishwaters and lakes. USA adopted this technique

in 1964. Finland, USSR and Canada are at present interested in this culture programme for commercial production.

Recent Research

Cage and pen culture practices are in progress nowadays in countries such as Hungary, Ireland, Norway, The Netherlands, Poland, Germany, Africa, Tanzania, Nigeria, Philippines, Malaysia and India in the different aquatic environments (Coche, 1979; Anon, 1979, 1980). Several research papers pertaining to this aspect were discussed in the FAO Technical Conference on Aquaculture held in Kyoto in the year 1976. Subsequently, a workshop was conducted in Philippines in which the engineering aspects of cage and pen culture were presented (Anon, 1979)

Construction of cages

In traditional culture, materials like bamboo and wood or planks are used in Kampuchea, Indonesia and Thailand. But in more intensive culture systems synthetic netting (Japan), rigid metal and plastic meshed materials (USA) are used. Polyamide nettings of different kinds such as dedron, nylon, capron or perlon are less expensive. For the construction of cages, wire mesh is used more owing to its advantages such as easy cleaning, resistance to corrosion, and free from damage. Cages with wooden frames are commonly used in Africa and Malaysia But in the United States, steel is commonly used (Collins, 1970). Knotless netting seemed to be more economical particularly for brackishwaters (Novotny, 1975). Coche (1979) made a thorough review on the constructional aspects of cages.

Species for cage and pen culture

As pointed out by Nash (1974) the total bioeconomic matrix is an index which is determined through various biological factors such as trophic efficiency, gregareous nature, fast growth rate or biomass production, survival rate, high fecundity, reproduction in nature and captivity, short reproduction cycle, disease resistance and inherent behaviour of fishes. Species which secure more than 60% in this selection can alone be used for cage or pen culture.

About 110 species of fishes are found suitable for culture in cages and pens. Among them species such as *Cyprinus carpio, Salmo gairdneri, Ictalurus punctatus, Oncorhynchus kisutchi, Salmo salar, Seriola quinqueradiata, Trachinotus carolinus* and *Tilapia nilotica* can be graded (Coche, 1978). In India, *Catla catla, Labeo rohita, Cirrhina mrigala, Ctenopharyngodon idella, Hypophthalmicthys molitrix, Cyprinus carpio* and *Channa* spp. are important particularly for freshwaters. On the other hand *Chanos chanos, Valamugil seheli, Liza macrolepis, Siganus canaliculatus, S. javus, Epinephelus tauvina, E. hexagonatus, Etroplus suratensis, Anadora granosa, Meretrix meretrix, Crassostrea madrasensis, Pinctada fucata, Penaeus monodon, P. indicus* and *Panilurus* spp. have been experimentally cultured in cages and pens in the coastal areas like Tuticorin, Mandapam, Chilka lake, Killai, Mulki and Kakinada Bay (Narasimham, 1980; Anon, 1978, 1981, 1982; James, *et al*, 1980 a, b; Venkataraman *et al*, 1980; Shanmugam and Bansam, 1980).

Slow moving and fast growing fishes like the estuarine grouper and the

quality fish *Lates calcarifer* have been given most importance. Of all the species cultured, common carp is the one which has been widely cultured in cages for its domestication, conversion and maximum production along with easy reproduction.

Stocking density

Stocking density is decided by the characteristics of the fish under culture and on the natural productivity and the rate of ration given and the water flow in the case of other fishes.

As could be seen from the literature, the stocking density is considered for every one m^3 of water in intensive systems rather than per m^2 area. The minimum stocking density reported in cage culture is 10 fish/m^3 as in the case of *Seriola quinqueradiata* in Japan (Fuj ya, 1976) and the maximum density is 813 fish/m^3 in the case of *Salmo gairdneri* in USA (Hoplain, 1977).

The vast range of variations found in the stocking densities followed are due to several factors in different aquatic conditions and also based on the nature of the fish. An optimum density for every species has to be maintained for better production. This will help the public to follow a better rewarding technology.

Feed

Supplemental feeds having more than 40 percent of protein are considered as ideal pelleted feeds and are used in the intensive culture particularly in Israel. The ration and protein percentage should be kept within the power of assimilation of the cultivable species. It is 40% for fish and 30% for prawns. Usually, for preparing pellets, trash fish, fish meal, wheat flower, rice bran, soyabean, vitamins, minerals, plant matter such as *Ulva* and *Enteromorpha* and decomposed mangrove leaves are used.

Production

As per the information furnished by Eng and Kah (1978), the fish production in cages is found to be less at a stocking density of 10 fish/m^3. A maximum production of 173 kg/m^3 has been reported by Collins (1972) for *Ictalurus punctatus* at a stocking density of 360 fish/m^3.

Information on the fish production in pens is scanty. Among the different countries, Philippines is known for its pen culture. During 1970, 1,50,000 milk fish were stocked in pens of 38 ha area and the yield was 700 kg/ha/ 5 months which was 3.5 times higher than the natural catch from the lake of similar unit area. Further tilapia cultured in pens of 1000 ha area, yielded 150 tons/ ha/yr.

In India experiments on *Penaeus monodon* and *P. indicus* made at Killai backwaters have given an yield of 250 kg/ha and 300 kg/ha respectively and the low yield has been attributed to low tidal amplitude and sandy nature of the area (Anon, 1982). Further, compared to the prawn yields reported from saline ponds in Adyar (514 kg/ha/ 3 months) and Porto Novo (335 kg/ha/ 3-4 months), the yield observed in pen at Killai is less The pilot scale culture of *P. monodon* in Chilka lake at 50/m^2 density and the recorded production of 1000 kg/ha/2 months with a survival of 50% suggest that the prawn farming in pens has got a good scope.

In Kakinada Bay, the blood clam, *Anadora granosa* was cultured in submerged pen at a density of 100 nos/m^2 and the yield was 385 kg/ha/5 months with a survival of 88·6%. This yield is also an impressive one.

When common carp was grown at a stocking density of 10/m^2 in pen at CIFRI the yield per 20/m^2 was 32 kg/5 months accounting for a calculated production of 38.4 tons/ha/yr (Anon, 1981). Compared to the monoculture yield of common carp in a stagnant pond, the production was about 30 times more.

Nursery pens installed in reservoirs when stocked with hatchlings of mrigal and *L. fimbriatus* at the rate of 26 lakhs/ha and 20 lakhs/ha showed a overall survival rate of 27.8% (Anon, 1981).

The production rate of fish achieved, employing floating pens is tremendously high as could be seen from the production or production / m^2 / day When this rate of production is calculated/ha and compared with the productivity of *Penaeus Japonicus* (44 tons / ha / yr) in Japan, clams (92.4 tons/ha/yr) at Kakinada; *Crassostrea madrasensis* (120–150 tons ha/yr) at Tuticorin coast; *Perna indica* (180 tons/ha yr) in the open sea at Vizhinjam, and *Perna viridis* (480 tons/ha/yr) at Goa would vividly indicate the perfectness and its scope for culture all over the world.

Problems of cage and pen culture

Due to high stocking densities, diseases are prone to occur. In estuarine grouper, gill fluke and isopod parasites are commonly noticed. Red boil disease caused by *Vibrio anguillarum* is one of the most serious diseases observed in cage reared freshwater fishes. Cages and pens also face problems like fouling of net, durability of platform, theft, pollution, red tides, net cutting by crabs and unexpected storms and floods.

Various degrees of fouling in different kinds of net cages have been reported by Cheah in the year 1974. According to him nets of 38 mm mesh were fouled in 2 months and those with 25 mm and 7 mm mesh were fouled in 2 weeks and 1 week respectively. Hence, he suggested that selection of nets with bigger meshes would avoid fouling.

Economics of cage and pen farming

The economic aspects of cage and pen farming have been dealtwith only in selected studies. The economics worked out for a pilot project on grouper in Malaysis showed a net income of 24.9%. / The percentage of net profit depends on the type of the culture. In the different trials of cage culture the net profit varied from 42.3 to 129.0% as pointed out by the above authors. It is reported in the FAO technical conference held at Japan in the year 1976 that in cages and pens, the maximum expenditure in the total cost of production is for pelleted feeds with 55% protein It has been reported that the percentages of profit for 50,000 catfish cultured in cages, raceways and fenced enclosures for a period of 160 days were 76%, 75% and 64% respectively. On the other hand a better return of 104% was realised in the case of milk fish culture. If herbivorous and zoo plankton feeding fishes are employed in ecosystems of high primary production, the feed cost could be minimised.

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