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REVIEW OF RESEARCH

PRESENT STATUS AND FUTURE SCOPE FOR FISH PRODUCTION IN CAGES AND ENCLOSURES IN INDIA

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ABSTRACT

The paper highlights the role of intensive fish husbandry system in cages and enclosures in the overall fisheries development of the country. This system of fish culture in widely dispersed aquatic ecosystems in India has yielded stimulating results, though there are some immediate constraints. The pressing problems of cage size, shape and material, diseases and parasites, and location of operational sites have been discussed. Such intensive culture systems have numerous advantages over the traditional pond culture.

KEY WORDS :*fish production , shape and material, diseases and parasites.*

INTRODUCTION

India has large habitat resources avail- able for aquaculture. There already exist 28,000 km of river length, extensive anastomosis of irrigation canals, 1.6 million ha of available water area by way of ponds, tanks, etc., and 1.5 million ha of potenlial water area for fish culture. These resources occupied with 3 million ha of reservoirs, 2 million ha of brackishwater area and 6,100 km of coast line offer polential sites for such intensive culture.

The last decade has witnessed a considerable expansion of aquaculture in India. Broadly classified, 3 culture systems are currently used for aquafarming, viz. embanked pond enclosures, pens and cages. Considering the number of conslraints of pond culture syslem in terms of shortage of ground nurseries, problems of retrieval of stock, predation, pollution, loss of water through seepage and cost of fertilization of waters, the recent trend has been to turn to intensive fish husbandry systems in cages, enclosures, raceways etc" which utilize 'lesser space, circumvent the environmental limiting factors andminimize cost of capital investment leading to higher fish production. The paper projects the present status of such intensin culture systems in India, highlights the problems encountered and lays stress on the future trust of research in identified areas.

PRESENT STATUS

Cage culture

In Indian freshwaters, the fish species raised in cages are essentially cyprinids . comprising Indian major carps (Catla catla, Labeo rohifa and Cirrhinus mrigala) , exotic common carp (Cyprhius carpio) and silver carp (Hypaphtlwlmicluhys malitrix). Cat- fishes of the families Bogridae (MySfus seellghaia), Siluridae (Ompok bimaculalllS), Anabantidae. (Anabasfes udineus) and Heteropneustidae (Heteropneustes fossilis) have also given encouraging results when cultured in cages, especially the last 3 air- hreathing species. Cage culture of mun'els (Channidae), viz. Channa punctatus, C. nlarulius and C. striatus, has also been occasionally tried.

Prior to 1973, except for the work of Kulkarni (1969) who reared fertilized eggs of Indian major carps ill fioating cloth tanks ("apas) little was known about cage and pen culture. During the last decade, culture of different fish species in cages was actively pursued. The species selected for cage culture, lim no logical conditions, types of cages, construction material, cage dimension and feed formulation varied very much in the experiments SO far conducted in different ecosystems (Tables 1 , 2). A critical appraisal of these results is made.

Cyprinids offer excellent potential for this type of culture. They grow rapidly, have high surviva1 rate, accept artificial pelleted feed and adapt to high produc- tion densities. The production of common carp in cages is 30 times more than that obtained in its monoculture in stagnant ponds. In cage culture experiments carried out at Allahabad (Table I) mono- culture of the Indian major carp C. mri/iala gave much higher production (16 kg/m') than its polyculture with two other species (2 kg/m'), viz. Catla eotla and Labeo rohila.

Culture of air•hreathing fishes, viz. A. testudinells, C. pUllctatus and C. striatus in bamboo cages also gave high produc- tion in Assam (Thakur, 1975).

Fingerlings of common carp and C. catla have been successfully raised in cages. The stocked fry showed survival rates of 90-97.5 % and attained fingerling size (100 mm) in about 2 months as com- pared to the normal 3 months. These results indicated that with further refinement, this technology can give the neces- sary'boost to the carp fingerling production in the country for seedling the waters under aquaculture. The prescnt capacity of ' the fish seed farms in the country is sufficient to produce only 4 % of the total need of the country (Natarajan et 01., 1979)

Cage cultural in brackish water, lagoons and lakes has largely remained confined to prawns. Stray experiments were conducted on the edible crab Scylla serrala and the milkfish Chanas chanas. In a series of net cages installed in Ennore estuary, Madras, the post• larvae of Penaeus il/dicus gave 1.250-2,880 kg of P. indicus and 1.450 kg/ha of post-larvae of P. manadan (Maheshwari, 1984). In the Vizhinjamfarm, the highest production and survival was obtained at a stock- ing rate of over lI/m' in floating cages. In fixed cages, the highest production was obtained with a stocking density of 10/m'. These results compare favourably with the production rates of prawn in Japan (2,000 kg/ha/6 months), even through the recovery was only 38 %. In the only experiment reported, the crab (S. serrata) seeds (45- 55 mm) were stocked @ 4 crabs/ component/cage of 16 compartments fixed in brackishwater of Tuticorin. Eye-stalk- ablated crabs showed a rapid growth of 57 g/month. In chelate and dactylopodite- removed crabs, the growth was slow with average weights of 20 and 29 g/month respectively. In a culture of spiny lobster (Panu/irus homarus) in cages suspended in coastal waters ofTuticorin at the end of 8 months, the maximum growth was 210 g(av.-165 g) and survival rate 57.5 %.

Pen culture

Ox-bow lakes, the water hodies associated whh river basins, are important inland fisheries resources in the Indo' Gangetic plain. In experiments conduct- ed in pens installed in an ox-bow lake in Muzaffarpur (Bihar) C. catla, L. rahila and C. mrigaTa, stocked in the ratio of 5 : 4 : I with an average size of 100 g, achieved in 6 months when all these fishes registered remarkable growth of over I kg pen culture experiments at Killai back- waters on P. manadan gave production of 250 kg/ha of P. il/dicus. The lower yield obtained than in saline ponds at Adyar (514 •kg/ha/5 months) and Porto Novo (335 kg/ha/34 months) was due to low tidal emplitude and sandy nature of the area. Culture of P. manadan, on a pilot scale, in ChUka lake gave a record produc- tion of 100 kg/ha/2 months with 50 % survival.

Natarajan el 01. (1984) recorded very high production rates of 92.4 tonnes/ha/ year for the blood clam Alladora granosa in Kakinada Bay, 120-150 10nnes/halYear for the backwater oyster Crassastrea madrasensis at Tuticorin coa.st, 18010nnes/ ha/year for Perna indica in the open sea at Vizhinjam and 480 tonnes/ha/year for P. virdis in Goa. Such high productions speak of the immense potential and scope that pen culture offers. Pens were tried as an allernative for nursery ponds to- wards carp seed production. A bamboo enclosure of 250 m', fixed in the littoral areas of Poongar swamp yielded advanced fry and fingerlings of C. mrigala and Lubeo fimbriatlls @ 1.27 million/ha in 90 days (CIFRI, Barrackpore, 1979). Similar results were obtained in Tungabhadra reservoir (Swaminathan and Singit, 1984).

The growth characteristics of the euryhaline species, viz. Chanos chanos, MugU sp., Siganus canaliculatus, Etroplus sllratensis and Carank sp., in a pen of 100 m' installed in the Pullavathi brackish- waters, E , SIIratens;s showed the highest monthly growth (52,5 g) followed by MIlgil sp. (36.5 g), Carank sp. (34.0 g), S. canaliculatus (33.0 g) and C. chanos (31.0 g). The maximum growth of E. suratensis was attributed to its herbivorous habi!. Encrustations of algae Polysiphonia, Ectocarpus and Entermorpha on the pens provided a good food source for the species. The poor growth of C. chanos was ascrib,d to the poor net phytoplank- ton content, and of other species to tbeir stenohaline nature, feeding habits and high stocking density.

PRESENT CONSTRAINTS ON TECHNOLOGY DEVELOPMENT

Cultivation offishes in cages and other enclosures installed in stream), rivers, lakes, reservoirs, ox-bow lakes, estuaries, bays and coastal areas hwe given stimulating results, yet there are a number of problems which need immediate attention. Some of them are described in the follow- irig paragraphs.

Cage material and dimension.

Synthetic net cages, thougb good and lasting, were pr.one to turtle and crab attack. and quite often gave way resulting in the escaping of stacked and reared material. Studies at Allahabad vitiated that placement of cages, away from the enibankmonts provided ample protection from crab .attacks, and that the nylon net cages couldbe strengthened by reinforcing with 75 mm wide nylon tapes at all the seams and at intervals of 70 cm where double stitching with nylon threads were given, In split bamboo cages some portions get crumbled Soon after their submergence in water. At Allahabad, the bambo frame was fixed with iron nuts and bolts which provided easy assembly, dismantling and transport of sucb frames to the work site. Galvanised iron-mesh and conduit pipe frames proved 1 ght and sturdy but poor galvanising resulted in rusting of wire meshes, No amount of enamel or water-proof paint was able to save the meshes from erosion once rusting started. Vinyl-coated wire mesh, as used and recommended by Swingle (1971), is yet to become popular in this country.

The cage should not be too large. Coche (1976) recommended 20 m' as the upper limit with 5-10 m' preferred. In India the emphasis has been on cages of 1- 4 m' size but cages as large as 60 m' have also been used with varying degrees of success. This probably is due 10 the specific conditions prevailing at a particular place.

Stocking density

The stocking density followed on cage and pen culture in different ecosystems vary widely. The. optimum stocking densities for different species are yet to be worked out. C. cat la, L. rohita and C. mrigaia kept in bamboo cages showed no significant differences in growth in different stocking densities. However, Common carp showed significant growth in lesser density in bamboo cages than in net cages. Similarly, no significant differences in growth were objerved when Macrobrachium moicolmsonii and M. idae were raised in cages installed ih a seasonal canal. The stocking densities for prawn grown in cages varied from 3 to 251m'. Food ration If fish are to be kept in high density culture a suitably. formulated pelleted feed has to be provided. Maximum growth was obtained with Indian major carp when poultry feed with 24 % crude protein was provided to the fingerlings (CIFRI, Barrackpore, 1973). Pelleted feed of soya bean, rice polish and groundnut-cake (1: 1:1) fortified with 20% NaCl, 1% vitamin B-eomplex and 1 % terramycin is a very good feed. There is a need for feed pellets with better consistency, uniformity and stability providing the nutritional requirement of the cultured species. By improving the pellet quality and by adjusting the daily ration to the specific needs of the fish and by fractioning its distribution~ conversion values of less than 2 could be obtained with fish densi- ties of 300-350/m' (Coche, 1976). The mechanization of feed distribution by automatic and demand feeders is becoming more and more important. Division of daily ration into several smaller rations plays a significant role in cage culture.

Diseases and parasites

Crowding and supplemental feeding often causes diseases. The two commonly encountered bacterial organisms are Chondrococoue co/wnnaris and Aeromonas liquefuciel1s. These can be controlled by feeding tetracycline-incorporated feed. Fungal (Soprolegnia sp.) attacks, often causing heavy mortalities of major carp fingerlings in cage, could be overcome by treating the fish with 3 % NaCl and 1 ppm of KMnO4,. In floating cages installed in fresh as well as saltwater, salmonids are infected by gram-negative .bacteria, Vibrio anguillarum, causing vibrio disease, Treat- ment of diseases is much simpler in cages than in ponds because. of early detection and close control. Smaller cages can be dipped in containers having the desired chemical for control of disease. The cages should be more than 2 m above the benthic sediments ' to reduce the iucidence of fish parasites and to avoid the bottom deoxygenated zone.

Locntioll and mooring

The location of cages should be such that there is proper flow of water through the cage material to optimize production. The rivers, especially in northern India, are subjected to heavy water-level fluctuations. During summu because of low river level it is dtfficult to find a place having suitable depth and water current; In monsoon months, the rivers keep on effervescing and the cages moored or set afloat are to be shifted to suitable locations. 'Similar problems are encountered in small impoundments' where the water level is drastically diminished in summer as in Gulariya reservoir to 4.5 ha from the full reservoir level of 300 ha.

Wind and wave action

Damage to cages through wind and wave action is a serious problem both in off- shore installations and in cages set afloat in small irrigation impoundments usually devoid of sheltered areas. A case in point is Gulariya reservoir where split bamboo covers had to be all round the nylon cages to mitigate the high wind and wave action. This also prevented cages from attacks of turtles and crabs.

Predation

Predation on the net cages is circum- vented hy enclosing the cages with a large•meshed predator net made of nylon gill netting, the distance between the 2 nets being /.5 m (Lindbergh, 1976). The predatory gastropods of Cymalium sp. cause large-scale mortality in pearl-oysters cultured in cages (Jayabaskaran et al., 1984). The predatory birds like cormorants, eagles, pelicans, storks and cranes feed on the fish in the pens when water level is low in the lagoon. The bird menace can be checked by covering the pens with large-meshed nets and by scar- ing the birds by using crackers (Mariehamy el al., 1982).

Folliing

Fouling of various degrees occurs in net cages. In cages used for culture of spiny lobsters barnacles and moll uses on the tray, posing problems for the lobsters to move about and occupy the tubes. The tray, its holding ropes and PVC housing get infested with simple ascidians, sponges, edible oysters and barnacles, and requires periodical cleaning (Lal Mohan, 1984). In a study on milkfish culture in' net enclosures, the barnacle Balanus amphitrite settled on a large number of poles but not on the nylon webbing. Nevertheless, the webbing got damaged when it rubbed against the barnacles attached to the palmyra poles.

The algae often get deposited on the net affecting the free flow of water in the pens. Periodic cleaning of cages of algae, mussels, barnacles, etc. which, by reducing water enchs Dge, influence the fish growth negatively (Milne, 1972). Use of copper salt on synthetic fibre reduces fouling by 50% (Brett, 1974). This problem is not severe in freshwater cage culture. (Tatum, 1974) recommended adding 30 Mugil cephaius/m" of cage in brackishwater culture. Tiiapia nilotica is also effective in removing the growth of algal colonies on cage walls.

FUTURE SCOPE

Intensive culture systems-offer immense scope and potential to increase fish production. The productivity through intensive culture is much higher than that of pond culture for comparable in- puts and area (Pantulu, 1976; Coche, 1976). Cage culture eliminates loss of stock due to flooding, seepage, evaporation losses and the resultant need for water replacement, dependence on soil characteristics, contamination of pond by agricultural chemicals and pressure on land resources. It also has the merits of easy and ecollomical control of predators and diseases, compiete harvest of fish production and cutting down on the cost of preservation and transportation since they can be located in water ways and water areas near urban markets. The limitations of these intensive systems are: difficult operation in rough surface water, high dependence on supplemental feeding and increased risk of poaching.

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