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MARINE CAGE FARMING IN INDIA: RECENT INITIATIVES

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In the simplest term a cage is nothing but an enclosure in the water body whereby the juveniles of aquatic animals are kept, fed and grown to marketable size. However, in practice it is very complicated in its structural, engineering, social and biological aspects. The cage culture was initiated in Norway during 70s and got developed into a high tech industry, particularly for salmon farming. Similarly the cage culture has spread to South East Asian countries and developed well. The major advantage in these countries is that they have large, calm and protected bays to accommodate the cages safely against natural bad weather conditions. Compared to that, India is endowed with very few such areas and the sea conditions are hostile at least during certain periods making the safety of structures uncertain. Added to the above, the Government of India or its maritime states have no water leasing policy for commercial open sea cage farming or any other mariculture activities in the sea. All countries are interested to sell the cage related products which are suitable for them and may not be suitable to Indian conditions and are reluctant to transfer technologies suitable to Indian conditions.

Under these circumstances and lot of debate over the past three decades in the country, Central Marine Fisheries Research Institute (CMFRI) has initiated open sea cage farming as an R&D effort during 2006-07 with the support from Ministry of Agriculture, Government of India. An indigenous cage of 15m diameter was launched at Visakhapatnam with primitive mooring techniques and stocked with 9000 nursery reared seabass seed of 50 g size. After 45 days the cage developed technical problems, drifted and hit the coast, and most of fish got escaped into the sea. However, the cage and nets were salvaged and analysed for several related issues. The juveniles retrieved had reached 150-350 g size which was observed to be really good in terms of growth performance for seabass. With this valuable "setback" a new cage with further modifications in design and mooring was launched in December 2007. Considering the previous experiences, importance was given to structural stability and safety of the cage. In this endeavor, Indian Institute of Technology (IIT), Kharagpur, West Bengal was consulted and got collaborated in engineering aspects of the cage. As a preliminary trial, only 1400 seed of seabass with average 15 g size were stocked. Despite criticism from different corners, the cage withstood all the tests and boosted confidence in the team. The fish were harvested in the 3rd week of April 2008 and was provided with valuable data. Along with good growth (600-1200 g), the survival was 75%. Apart from seabass the harvest also constituted 4 kg *Penaeus monodon* and few lobsters, leading to further diversification in cage farming. Although the harvest was minimal, it has provided further leads in expanding and diversifying the technology further.

The volume of the 15 m cage is about 850 m^3 and at the rate of minimum of 25 kg/ m^3 production, the potential production rate of seabass is about 20 t in about 6 months after preliminary nursery. During nursery phase from 3 cm up to 50 g size, 90% survival was obtained.

As a consequence of the above and for easy maneuvering, recently 6 m diameter cages were designed mostly to cater the needs of small farmers. The mooring and other aspects were also suitably modified. Its volume is about 175 m^3 and production potential is about 4-5 t of fish.

Further impetus was given by the participation of National Fisheries Development Board (NFDB) in the demonstration of open sea cage framing by sponsoring

6m cages, one cage Sutrapada in Gujarat, 2 at Vasai in Maharastra, 2 at Mangalore in Karnataka, 2 at Cochin Kerala, 2 cages at Pulicat in Tmil Nadu, one cage each at Nellore, Kakinada and Baruva in Andhra Pradesh and one cage near Balasore in Orissa, thus totaling 14 cages. Apart from these there are 12 cages including one 15 m, three each at Visakhapatnam in Andhra Pradesh, Mandapam in Tamil Nadu, Karwar in Karnataka and Vizhinjam in Kerala.

The demonstrations covering almost all the maritime states, spreading different environmental and social conditions are in progress at the above places. For demonstration in some places, non- availability of seed hampered the work and has to wait for the season and in places where it commenced, had encountered some of the teething local engineering and social problems and need restart after the current monsoon season.

At Veraval the spiny lobster *Panulirus polyphagus* seed stocked in January 2009 were harvested in May 2009 with very good survival and growth rate. At Vizhinjam and Pulicat, *P. homarus* seed were stocked in January/February 2009 and harvested in May 2009. At Vizhinjam lobsters were reached up to 300-400 g size and the harvest was about 250 kg and sold at the rate of Rs1000/kg. Similarly 6000 seed of seabass of 10 g stocked in December 2008 had reached 750-1200 g by May with better survival. Due to some local miscreant mischief most of fish escaped and only 1200 fish weighing about 800 kg were retrieved. However, these demonstrations convinced many farmers/ fishermen the potential benefits of cage culture and they came forward in many places to undertake the cage culture with their total inputs except cages, in the ensuing season. This is the most welcome social awareness and goes a long way in making further progress in open sea cage farming. After overcoming the engineering and social problems the biological issues like seed and feed are very important,

Seed source

It is well known that availability of seed in adequate quantities is one of the major constraints in the development and expansion of mariculture. The increasing exploitation pressure on the wild stocks of many major marine fisheries has led to over exploitation and consequent decline in their catch and hence the only sunrise sector to augment seafood production is through marine farming. Though seed production technologies have been developed for many marine finfish and shellfish species, many of these technologies have not been scaled up to commercially viable levels. The hatchery seed production of many high value marine finfishes and shellfishes is complex and expensive due to the high costs involved in the establishment of broodstock and hatchery facilities and also to the complicated larviculture procedures involving culture of proper live feeds, their nutritional enrichment, feeding protocols, grading, water quality maintenance, nursery rearing and disease management. The production of seed of the concerned species by development of commercially viable technologies is essential for development of sustainable mariculture practices, many of these technologies are still in the emerging state and may take several years for standardization on a cost effective level. Since marine food production from the capture sector is not increasing, marine farming has to be developed and expanded urgently and it is not advisable to wait for the standardization of seed production technologies for all the concerned species. In this context, the concept of capture based aquaculture (CBA) can be considered as the mid way between fishing and aquaculture and requires to be developed into a sustainable commercial activity for augmenting seafood production. CBA is the practice of collecting 'seed' material – from early life stages to adults – from the wild, and its subsequent growing in captivity to marketable size, using aquaculture practices. As hatchery technologies remain to be perfected for many species, fish farmers have to depend on 'seed' available from the wild. CBA has developed due to the market demand for some high value species whose life cycles cannot currently be closed on a commercial scale. CBA is a world-wide aquaculture practice and has specific and peculiar characteristics for culture, depending on areas and species. The species/ groups that can be harvested as wild juveniles include shrimps, milkfish, seabass, mullets, pomfrets, groupers, red snappers, koth, lobsters *etc.* It is generally considered that further development of marine aquaculture is possible only by the increase in mass production of juveniles in hatcheries. But it remains a fact that much of world's coastal aquaculture can still be expected to come only from the supply and availability of capture-based juveniles.

CMFRI has developed several technologies for the seed production of marine invertebrates such as pearl

oysters, edible oysters, clams, green mussel, pelagic crab (*Portunus pelagicus*), shrimps and sand lobster (*Thenus orientalis*), and several species of ornamental fishes, which are technically very advanced with more complications than fin finfish. Development of the above technologies was priority in the earlier years when there was no demand for marine finfish culture like in other countries. However in the current scenario, finfish culture has become a national priority. A large number of juveniles of high value finfish and shellfish are caught as by-catch in many of the non-selective bag type gears which are commercially operated in India. Considerable growth over fishing occurs and the catches of these juveniles are either discarded or sold at a very low price. If proper training and equipments are provided to the fishermen employing these gears, the juveniles can be brought in live condition and used for capture based aquaculture and the resources can be conserved and utilized for increasing production. In this context, it is high time that at least an artisanal level of capture based aquaculture should be promoted in India with sustainable management practices.

CBA seed resources

Several studies and observations by CMFRI indicated that dol nets of Gujarat and Maharashtra, shore seines of east coast, thalluvalai of southeast coast, Chinese dip nets of Kerala *etc* which are mostly operated between 2-10 m depth land juveniles/seed of high value species. These mostly fetch very low price and are dried. The species include seerfish, pomfrets, mackerel, koth, shrimps *etc.* Also, there exists a good fishery for live juveniles of different species of lobsters but very little are used for fattening. It is estimated conservatively that about one million of seerfish juveniles of 7-10 cm and two millions of mackerel juveniles of 5-8 cm land by shore seines in the month of April alone along the stretch of Visakhapatnam-Kalingapatnam. This is only an example and similar studies are initiated by CMFRI. If only a small fraction of these seed/juveniles are induced to be brought in live condition, they form very good source of CBA without affecting the ecosystem and livelihood of fishermen. It will be more lucrative for the fishermen at the same time contributing to several fold increase in the mariculture production. Juvenile yellow fin tuna are available in plenty in and around Lakshadweep waters which can be used for farming in cages, for which reasonably viable cage technology is available with CMFRI.

Feed

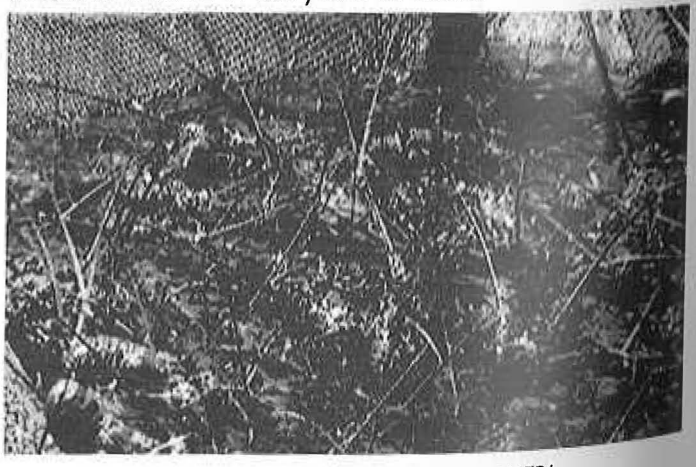
As on today there is no indigenous scientifically developed marine finfish feed. The development of feed is also very complicated and need to look into nutritional balance for carnivorous fish, conversion and cost effectiveness. The imported feeds for seabass are sold at Rs 80/kg. Under these circumstances CMFRI and CIFT under NAIP project have launched a feed "cadalmin-sailo feed" prepared from the non edible parts of tuna which is available in good quantities and almost discarded. The final cost may come to around Rs30/kg and the feed is well accepted by sea bass, Cobia, Red snapper, Lobsters, tiger shrimp, rainbow trout *etc* making it almost universal. Large scale field trials are in progress to evaluate and improve efficiency. CMFRI has also scientifically developed an exclusive feed for sea bass which may cost around Rs 45/ kg. Field trials are in progress to evaluate and improve the feed.

Broodstock development

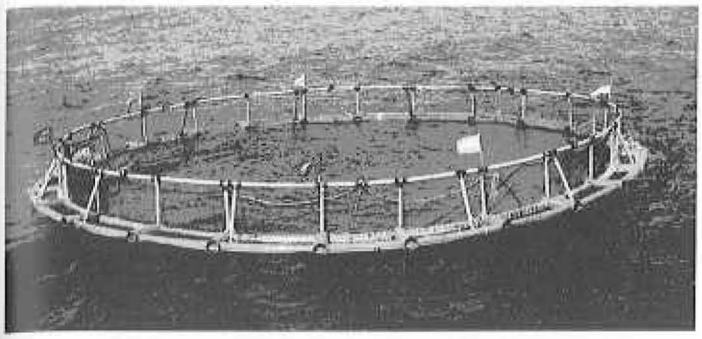
Taking advantage of the fast growth and high market value of marine finfish, CMFRI has initiated programmes on breeding of finfish such as the Cobia (*Rachycentron canadum*), Pompano (*Trachynotus* sp), Red snapper (*Lutjanus* sp) and groupers (*Epinephelus* spp) in the newly constructed modern finfish hatchery complex at CMFRI Mandapam Camp.

General Conclusions and Future Prospects

It is felt that with effective regulations and management practices, the capture based aquaculture offers good scope and potential for the artisanal and industrial sectors in the years to come.



Lobster harvest at Vizhinjam RC of CMFRI



Fig,1. 15 m cage moored in the off Visakhapatnam

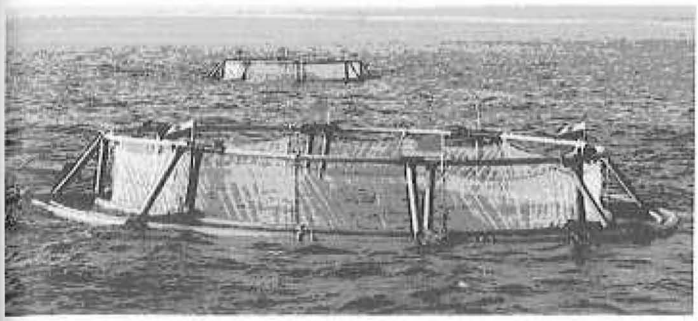


Fig2. Typical 6 m open sea cage moored in the sea

Fig 3: Lobsters grown and harvested from 6 m cage

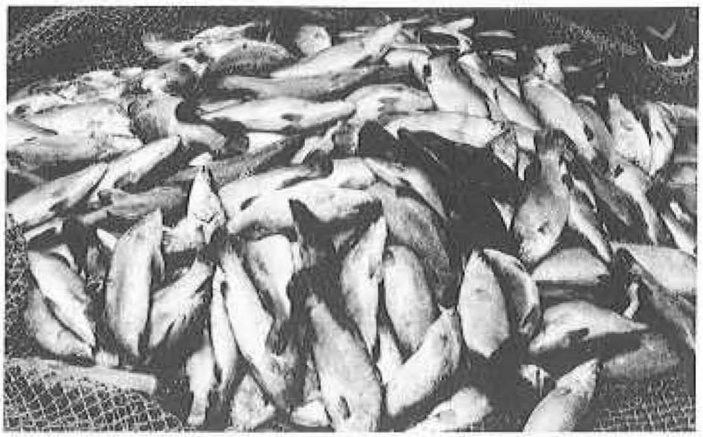


Figure 3 Harvested sea bass from the cage

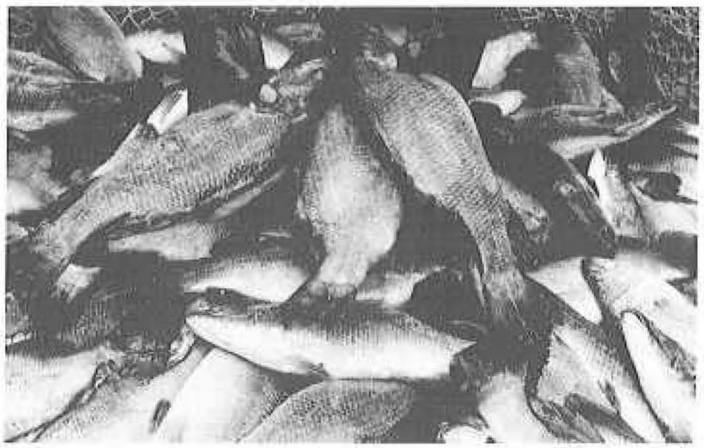


Figure 4 Good growth of sea bass from the cage at Vizhinjam

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