STATUS OF COASTAL AQUACULTURE IN INDIA - THE PRESENT TREND AND FUTURE PROSPECTS

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ABSTRACT

Aquaculture is being viewed as the only alternative to augment fish production due to over-exploitation of nature. The world demand for fish in 2000 AD is expected to be 130 million tons against the present production of about 100 million tons. In 1991-92, India has exported 171,820 million tons of marine products. India is endowed with rich natural resources in the coastal zone with ample scope for the development of aquaculture. The technology for culture of mud crab, sea weeds, edible oyster and sea cucumber has also been developed. But the commercial farming of these has not kept pace with the demand because of the lack of awareness of, and the information needed to divert the attention of people from the lucrative business of shrimp culture. Though great advances have taken place in India in the technology involved in culturing pearls with the pearl oyster *Pinctada fucata,* it has not attracted potential entrepreneurs and is awaiting development of suitable locations in Gulf of Mannar, Andaman and the Nicobar islands.

INTRODUCTION

The world fishery production which was estimated at 3.5 million tons in 1956 increased to 76 million tons in 1975. But no singular increase in production was recorded since then. This has been ascribed to over-exploitation, pollution *etc.* indicating the signs of stagnation as evidenced from the recorded production of 97 million tons in 1988, with the concomitant increase in consumption in consonance with the exponential growth of world population. The stagnation in the wild catch and the widening gap between supply and demand necessiated the diversion of attention towards growing selected aquatic organisms under controlled conditions, *i.e.* aquaculture which has assumed great importance in recent years as a means of augmenting the production from water resources to fill the gap between demand and supply. The role of coastal aquaculture in integrated rural development and in augmenting and complying with the protein demand of the world has also been recognised.

Shrimp with its unique taste, high nutritive value and therefore persistently in demand has received the importance in the world market. The shrimp landings of the major producing countries are estimated at 2.6 million tons *per annum* which is inadequate to meet the existing demand. Aquaculture of shrimp has been successfully undertaken in most of the Southeast Asian countries. India by virtue of its strategic location in the Indian Ocean, possesses the richest shrimp resources in the world with more than 50 varieties. Though India is having a vast stretch of coastal land for farming, much attention has been paid only recently. As far as the other commercially important species like mud crab, oyster, clams, seaweeds, pearl oyster, sea cucumber, lobster, *etc.* are concerned, concentrated efforts have not taken place as in the case of shrimps and also the development of commercial aquaculture of these species has not taken place due to lack of awareness, information and diversion towards the lucrative shrimp culture.

SHRIMP CULTURE

Status of shrimp farming in the world

The world cultured-shrimp production is estimated at about 903,000 tons from 1 million hectares. The contribution from Asian countries to this production is nearly 85%. China is the major producer of shrimps followed by Thailand and Indonesia. *Penaeus chinensis* is the dominant species in China and this amounts to about 200,000 tons from an area of 180,000 hectares. Indonesia produces about 150,000 tons and Thailand 153,000 tons. *Penaeus monodon* is the major species of culture in Indonesia and Thailand.

Status of shrimp farming in India

In the recent past, the world market for shrimp has expanded touching nearly US$ 6,500 million in which the contribution of India is about 0.8%. For about 300 years, the farming of fishes and prawns in the coastal waters of India has been confined to a small extent of the water areas in the states of Kerala and West Bengal. Great strides have been made now in the expansion of prawn culture in India. The perfection of technology for shrimp culture helped in the development of shrimp farming which paved the way for increase of production. India stands fifth in the cultured shrimp production estimated at about 40,000 tons. Shrimps have contributed 76,080 tons worth of Rs.975.43 crores (70.8%) out of the total sea food export of 171,820 tons worth of Rs.1375.89 crores in 1991-92.

Depending on the type of culture practiced in India, shrimp culture can be classified into three categories - traditional, scientific extensive and semi-intensive farms. About 1.2 million hectares of brackish water area is available in India of which only around 68,000 hectares are now under shrimp farming. The main species of culture are *Penaeus monodon* and *P. indicus*.

Traditional farming is carried out in about 50,000 hectares in West Bengal (33,815 hectares), Kerala (13,000 hectares) and Karnataka and Goa (3,025 hectares). Around 15,000 hectares are under scientific farming in states like Tamil Nadu (250 hectares), Andhra Pradesh (6,000 hectares), Orissa (7,075 hectares) and Maharashtra (1,800 hectares). In the scientific farming, about 14,800 hectares are following the extensive system and 200 hectares are under semi- intensive system in Tamil Nadu and Andhra Pradesh.

Shrimp farming is being carried out mostly in a traditional way in the Bheries of West Bengal, Pokkali fields of Kerala, Gazani lands of Karnataka and Khazan lands of Goa. Shrimp culture practice in paddy fields (pokkali) of Kerala locally known as 'chemmeen kettu' and 'Bhasa-badha' fishery of West Bengal contributes the largest share in India's shrimp production from sources other than the capture fisheries.

The paddy fields which are used alternatively for prawn culture and paddy cultivation are locally called 'Gazani' lands. Paddy cultivation in these fields begins at onset of the monsoon when the fields get desalinated due to heavy freshwater influx and lasts up to the end of September or early October. Preparations for prawn culture are made after paddy cultivation by clearing of the bottom, construction of bunds and erection of sluice gates. The preparations are made after a brief exposure of the fields to the tidal influence. Stocking is carried out during high tide when the estuarine water with seeds is impounded in the fields. *Penaeus indicus, P. monodon, Metapenaeus dobsoni* and *M. monoceros* are the major species which enter along with the tidal influx. The culture period is 4 to 6 months. At the end of February or early March the harvest begins and is usually carried out during full and new moon periods, using a bag net fixed towards the outer side of the sluice. During final harvesting the entire water in the farm is drained and the left over prawns are collected by bag and scoop nets. These autostocked traditional farms are having severe limitations of low production, poor quality and growth, uneconomic varieties and predator menace. The production in these farms varies from 200 to 500 kg/ha per period of 4-6 months duration.

In Tamil Nadu and Andhra Pradesh, adaptation of scientific methods in the extensive farming has

yielded good results with a production of 0.5 to 2 tons/ha/crop. A record production of 10 tons/ha/crop has been achieved by some private shrimp farmers in the Tuticorin area of Tamil Nadu in the semi-intensive type of culture. Hundred percent export oriented satellite shrimp farming units are coming up fast all along the coast. Many reputed companies like Shriram group, Spencers, MRF Tyres, Spic, S & S Industries, etc. have entered this field and few are having a tie-up with the established firms in Taiwan, Thailand, Singapore, Phillippines and Japan.

Vast areas of Government lands are available for lease and the land leasing policies of various maritime states differ with each other. The main hurdle is getting the allotment. The lease of land is a tiresome and time consuming procedure. Though 60% of the lands is allotted for fishermen and small farmers, the number of those who apply for allotment is too small because of high cost of input.
The Marine Products Export Development Authority (MPEDA) of the Ministry of Commerce, Government of India is spearheading the development of shrimp farming in India. Farmers are provided with all technical assistance starting from site selection till harvest. MPEDA also conducts short-term training courses and provides subsidy for hatchery and farm development. The imported feeds are given a concessional customs duty of 25% *ad valorem*.

The world import of shrimp has increased from 4 to 7 billion US$ in the last 5 years and is expected to touch 10 billion US$ in the next 5 years. The stagnation in wild catch of shrimps has prompted an aquaculture race among the Asian and Latin American countries to bridge the widening gap between supply and demand. India is endowed with rich natural seed resources of shrimps in the sea and a vast stretch of coastal land for farming. It is proposed to bring 35,000 hectares of new area under farming by the year 2000 AD, during which time it is expected that 100,000 hectares will be brought under farming. Days are not far off for India to achieve the distinction of a leading shrimp producer in the world with the rapid development that is taking place in the shrimp farming sector. India is moving ahead towards the blue revolution. The memories are still in the minds of people who made the green revolution a great success. Appendix 1, shows the details of Indian marine products export until 1992.

HATCHERY

The development of hatchery technology and establishment of hatcheries precede the massive development of commercial production as evidenced in the case of leading shrimp producers China, Thailand, Indonesia and Taiwan. The availability of wild seeds is seasonal and undependable. Also the influence of various natural, eco-physiological and anthropogenic factors on the wild stock make it unreliable for scientific farming. About 20 hatcheries have been established in India and only 10 are under full fledged operation. The total estimated production is 200 million tons against the expected demand of 2000 million tons. Many more hatcheries are coming up but the non-availability of wild spawners due to ruthless over-exploitation has become a major hitch in their operation.

FEED

The nutritionally balanced, environmentally friendly, and economically viable artificial feed is the major operational input which determines a sustainable and successful development of aquaculture. The artificial feeds need to be designed and manufactured in order to provide all the nutrients in adequate levels and balanced proportions to promote optimum growth. The estimated requirement of feed in the year 2000 AD is around 250,000 tons *per annum*. The indegenous production is very less when compared to the demand. The Government of India allows the import of feed from overseas feed manufacturers. Higashimaru Feeds (India) Ltd., a feed mill promoted by MPEDA with Japanese collaboration near Cochin has commenced its production in 1992. Though local feeds are also available, it is not preferred by most of the farmers, because of poor

quality and low food conversion ratio. Many collaborative feed mills are proposed to be established in the near future to meet the growing demand and to avoid escalation of price.

SEA WEEDS

Seaweeds are recognised as the medical food of the 21st century. Phyto-chemicals,mainly agar, carrageenan (agaroid), and algin are manufactured from seaweeds.

India has vast resources of seaweeds and luxuriant growth of several species of green, brown and red algae occur from Rameswaram to Kanyakumari on the southeast coast, Gujarat, Lakshadweep and Andaman and Nicobar islands. Sea weeds are also distributed in Bombay, Karwar, Ratnagiri, Goa, Vizhinjam, Visakhapatnam and in the coastal lakes of Pulicat and Chilka. Nearly 60 species among the 700 species of marine algae recorded in India are commercially important. The standing crop of all the seaweeds is estimated to be 100,000 tons (wet weight) comprising 6,000 tons of agar yielding seaweeds and 16,000 tons of algin yielding seaweeds. A joint survey by CMFRI and CSMCRI off the deep waters from Dhanuskodi to Kanyakumari revealed the occurrence of 100 algal species and the standing crop was estimated at 75,376 tons wet weight from 1863 km^2 area. About 15 tons of sea weeds valued at 353,000 Rps have been exported from India during 1991-92.

About 30 agar and algin producing seaweed industries are located in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Gujarat producing 75 tons of agar and 300 tons of sodium alginate annually. The red algae *Gelidiella acerosa, Gracilaria edulis, G. crassa, G. foliifera* and *G. verrucosa* are used for agar extraction and species of *Sargassum* and *Turbinaria* for sodium alginate. The seaweed industries depend on the natural resources for their raw materials. The demand for agar yielding seaweeds is increasing with the establishment of many agar and algin extracting industries.
Since 1964, many research institutes attempted to develop suitable technology for the cultivation of agar yielding seaweeds. These experiments revealed that *Gelidiella acerosa* can be cultivated on coral stones and *Gracilaria edulis, Hypnea musciformis, Acanthophora spicifera* and *Enteromorpha flexuosa* on long line ropes and nets. In 1983, viable technology for commercial scale cultivation of *Gracilaria edulis* was evolved by CMFRI using coir rope nets.

There is a good demand for certain seaweeds from foreign countries like Japan. The seaweed industries in India are not producing the required quantity of agar due to shortage of raw material. Many seaweed products have export potential. The bays and creeks present in the open sea shore along the east and west coast of Tamil Nadu, Andaman and Nicobar islands and stolls of Lakshadweep have immense potential for cultivation of seaweeds. Large scale culture of seaweeds are yet to be undertaken in India. The cultivation of seaweeds will not only augment the supply of raw material but also provide employment to the coastal people and help in the conservation of natural resources.

MUD CRAB

India occupies the second position with a production of 3,500 tons of mud crabs among the countries bordering the Bay of Bengal. *Scylla serrata, S. oceanica* and *S. tranguebarica* are the mud crabs available in Indian waters. Due to overexploitation the mud crab landings in Chilka lake and in villages around Kakinada have declined over the past few years. Live crabs weighing 300g to 1 kg and above are packed in bamboo basket and exported to Singapore, Malaysia, and Hong Kong and the quantity increased from 412 tons (1988-89) to 654 tons in 1990-91.
Although it is not cultured on a commercial scale in India at the moment, it offers extensive potential in mangroves along the east coast in Chilka lake, Sunderbans area, Kakdip, Namkhana, Kakinada coast, Dowleswaram, Rajamundry, Pulicat lake, Killai backwaters, Muthupettai saline swamps, Pattukottai, Nagapattinam, Punnakayal estuarine complex and Kerala backwaters (Vypeen, Neendakara and Kozhikode) for culture.

The available technology for seed production, as well as for farming in coastal ponds, pens and cages, is available.

LOBSTER

Panulirus homarus, *P. polyphagus* and *P. ornatus* are the three commercially important species available on the Indian coast. *P. ornatus* is the fastest growing species in Indian waters and forms a good fishery in Gulf of Mannar. Spiny lobsters constitute about 10% of the crustacean fishery in India with an average annual landing of 3,258 tons (1991).

Commercial farming of *P. polyphagus* has been reported from Bhavnagar district of Gujarat. Pits which vary in size from 1.75 x 1.75 m to 21 x 7 x 1 m are dug out in the intertidal area for stocking juveniles of this species at a density of 20/m^2. Nylon mesh frames were used to cover the pits to prevent the escape of lobsters during tidal flushing. A remarkable growth from 30-35 g to 100-125 g in 10 to 13 weeks has been achieved. The juveniles procured for Rs.20/kg are sold at Rs.200 to 250 in live condition. Production as high as 4 tons was reported to have been achieved after 3 crops in a year. In Madras, *P. homarus* juveniles are captured in large numbers using trammel nets along with commercial size lobsters. In Gujarat, special stake nets called "Bandhan" are operated in intertidal areas to catch juveniles of *P. polyphagus*.

The technology for hatchery production of seeds of lobster species should be evolved to initiate large scale culture of lobsters in growout ponds. The available natural seeds can only be collected for small scale culture.

CLAMS

In 1981, a beginning was made in the export of frozen clam meat to Japan, and in 1990 exports reached 520.7 tons, valued at Rs.1.01 crores. With expansion of the market, the clam products are being exported to U.S.A., Australia, Malaysia, Singapore, Thailand, Kuwait, Belgium, France, Federal Republic of Germany, Italy, Netherlands, U.K., Spain and Switzerland. In the Ashtamudi lake in Kerala, a 20 hectare *Paphia malabarica* bed is significantly contributing to export of frozen clam meat from the country. Trial consignments of individually quick-frozen-meat of *Villorita cyprinoides* and *Meretrix casta* have also been exported recently. The world production of clams from aquaculture was estimated at 500,000 tons in 1990. Giant clams *Tridacna* occur in the Andaman and Nicobar islands and there is an untapped potential for the development of giant clam mariculture in these islands.

Clam culture on seabed is practised in several countries. In India it is yet to take off on commercial scale.

OYSTERS

The world production of oysters by cultivation amounted to 877,000 tons in 1990. The important oyster producing countries are Japan, Republic of Korea, France and China.

Among the four species of oysters of commercial value, *Crassostrea madrasensis* and *C. gryphoides* can be cultured. The complete technology for oyster culture has been developed by CMFRI. Vast stretches of sheltered backwaters, estuaries and bays along the Indian coast offer scope for the development of oyster culture in India. A major thrust is needed for commercialisation of oyster culture which is having export potential.

SEA URCHINS

The Japanese consider ripe sea urchin eggs as a delicacy. The eggs of sea urchins like *Pseudocentrus depressus* and *Hemicentrotus pulcherrinus* are valuable and tasty. In India, *Stonopneustes variolaris*, *Toxopneustus pileolus*, *Tripneustes gratilla* and *Temnopleusrus toreumaticus* are among the more than 50 species of sea urchins distributed in the shallow Indian waters. The sea urchins have not been exploited since they are not locally consumed. No attempt has been made so far to export the eggs. One kg of ripe egg costs about 200 US$. The Gulf of Mannar and Palk Bay, Andaman and Nicobar islands and also Lakshadweeep have vast re-

sources of sea urchin and could be considered for culturing some of the species for export.

SEA CUCUMBER

Out of 650 species of sea cucumbers recorded from various parts of the world, 200 species are distributed in India of which 75 inhabit the shallow waters. About 12 species of these have commercial value. The processed sea cucumbers are called Beche-de-mer, a Chinese delicacy. In 1989, India exported 51.5 tons of Beche-de-mer valued at Rs.1.23 crores. Beche-de-mer is exported to Singapore, where it is re-processed to some extent and exported to Hong Kong. Hong Kong is the foremost country in the world, importing 5,000 to 6,000 tons of Beche-de-mer every year.

CMFRI has achieved a breakthrough in 1988 in inducing sea cucumbers to lay eggs and the prospects of culturing the sea cucumbers in selected areas are bright. The hatchery produced seeds can be used for sea ranching to replenish the natural stock. Some farmers have already stocked juveniles of *Holothuria scabra* and grown them in enclosed areas. Perfection of technology will pave way for large scale culture of sea cucumbers to meet the growing international demand.

PEARL OYSTER

Six species of pearl oyster have been recorded in Indian waters. *Pinctada fucata* is known for its quality pearl. It is the species that contributes to the commercial pearl fisheries. The Gulf of Mannar in Tamil Nadu and the Gulf of Kutch in Gujarat are the two regions well known for pearl oyster resources. The Gulf of Mannar is having pearly oyster resources to support commercial fishery and it dates back to the 16th century.

The successful development of the cultured pearl production technology was achieved in 1973 by CMFRI (Alagarswami, 1974). The CMFRI and Tamil Nadu State Fisheries Department have made great strides in the technology of cultured pearl production from Indian pearl oyster *Pinctada fucata*. A pearl oyster farm has been established by Tamil Nadu Fisheries Development Corporation Limited near the shore of Kurusadai Island near Mandapam, adjoining Rameswaram island. This is a unique project in the country with tremendous potential for commercial production of cultured pearls.

Japan is the world's largest producer and exporter of sea pearls. India is importing cultured pearls worth of around Rs.20 crores annually. However, there is ample scope to develop and expand cultured pearl industry in the Gulf of Mannar and the Andaman and Nicobar islands. With the expansion and development of pearl culture activities there is a good future for export of marine pearls from India, besides curtailing imports.

FINFISH

The availability and relative abundance of milk fish *Chanos chanos* and grey mullets *Mugil cephalus, Liza macrolepis, Liza parsia, Liza tade, Liza cunnesius, Liza weigiensis* and *Valamugil scheli* have already been surveyed and potential areas have been identified. Traditional culture of marine finfish has been practiced in estuaries, backwaters, tidal creeks/inlets, mangrove swamps, lagoons on the coastal regions of Kerala, Karnataka, West Bengal and Goa. Milk fish and grey mullets are the two major groups cultured in traditional farms with an average yield of 800-2000 kg/ha.

The scope for an organised system of marine finfish culture in our country was realised early in this century. Coastal saline swamps, estuaries, backwaters, deltaic marshes and salt pans were developed for marine finfish culture. A fish farm was established in Hare Island area of Tuticorin in 1915. Marine finfish farming in Kerala was started in 1940 at Narakkal growing milk fish and grey mullets with an encouraging production rate of 1000 kg/ha/yr. Pioneering attempts and significant advances on marine finfish culture, involving milk fish and grey mullets at Mandapam, Tuticorin, Madras, Calicut, Narakkal and Mangalore, were made in coastal ponds by the CMFRI.

The grey mullets are cultured largely in West Bengal, Kerala and to some extent in Tamil Nadu and other maritime states. In brackish water areas, grey mullets are reared along with other species of finfishes.

The development of hatchery technology for large scale production of finfish seed, nutrition of cultured fishes, control and diseases and predators, induced maturation in captivity etc. would pave way for the commercial farming of finfishes in India. The available wild seeds could be collected and used for farming activities.

ORNAMENTAL FISH

Nearly 50% of the world trade is in marine tropical fishes due to striking colour varieties and beauty of these fishes. India has got the potential to supply international trade for another century from the still untapped areas of Andaman and Lakshadweep islands and Gulf of Mannar. It is estimated that about Rs.20 crores exports can be reached in a short span of 3 to 4 years.

CONCLUSION

India is having nearly 6,100 kms of coast line crowned with vast potential untapped lands for aquafarming. India has diverted only recently its attention in the development of lucrative shrimp farming which earns a considerable foreign exchange. With the tremendous efforts taken by MPEDA and Government Fisheries Departments, India is marching ahead towards a blue revolution. Concentrated efforts are still lacking as far as other commercially important species are concerned. It is the need of the hour to create an awareness among the aquafarmers to take up culture of other commercially important species like pearl oyster, edible oyster, clams, mud crabs, sea cucumbers, etc. With its strategic location in the Indian ocean and the vast potential lands and biological resources, India may become a major supplier of cultured species in the world market.

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APPENDIX 1.
Country wise export of Indian marine products.

Country	1990 - 91 Quantity (M.T.)	1990 - 91 Value (R.crores)	1991 - 92 Quantity (M.T.)	1991 - 92 Value (Rp.crores)
Japan	38,092	458.27	39,480	633.45
U.S.A	10,155	109.31	20,844	154.64
Spain	11,063	54.48	15,050	104.62
Italy	6,381	63.05	9,286	84.58
France	5,708	25.59	8,247	44.72
Hong Kong	15,137	17.21	22,106	40.07
Singapore	16,947	43.99	13,443	69.79
Greece	3,737	8.22	4,107	16.10
Belgium	1,907	9.50	2,955	20.13
Portugal	3,203	11.05	3,234	15.73
U.A.E	2,833	7.39	6,383	26.35
Netherland	2,650	15,23	2,773	19.86
Malaysia	1,350	5.05	3,068	13.92
Thailand	713	1.39	3,350	11.09
Canada	174	1.60	657	8.62
Germany	726	4.09	1,280	7.87
Australia	634	3.61	929	7.26
Kuwait	106	0.27	715	4.49
Sri Lanka	2,005	3.19	2,653	4.29
Others	2,354	11.08	3,162	10.52
Total	139,419	893.37	171,820	1,375.89