Product Development and Seafood Safety

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An Overview of the Opportunities in Mariculture in India*

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Introduction

India is one of the few countries in the tropical belt which has not adequately utilized the great opportunities provided by maricultural entrepreneurship. A cursory look at the statistics on the aquaculture production in India reveals interesting data. The area under shrimp farming extends to around 194,000 ha with an average annual production of over 100,000 tons. There are over 260 shrimp hatcheries with an installed capacity of over 11 billion larvae. Currently only 200 of these hatcheries are functional, producing about 7 billion larvae per annum. The feed mills number about 33 with an installed capacity of 150,000 tons. Aquaculture provides direct employment to over 0.3 million persons and ancilliary employment to around 0.7 million others. The maricultural production of shrimps during 2002 was about 115,000 tons and that of scampi through freshwater culture 30,000 tons (MPEDA). The share of culture in the total export of fishery products is around 58 %.

Mariculture in India is presently targeted around shrimp culture only. Most of the shrimp farms (90%) have farm sizes below 2 ha. Farms of size 2 to 5 ha are about 6 % and large farms of sizes >5 ha are only 4 %. The total production of farmed shrimp including scampi from India during the last year was about 145,000tons. The only remarkable shift in the trend was during the past couple of years when new initiatives in bivalve farming emerged as an alternative. During the last year about 1300 tons of marine green mussels and over 350 tons of edible oysters were produced along the south west coast of India. The biodiversity utilization index for mariculture for India is just 0.23, the lowest among our immediate neighbours. All these present a dismal picture of the present scenario in spite of great opportunities.

The coastal aquacultue in India is industrialized only in the case of the shrimps. However there are many species groups which could be cultured commercially. Mariculture technologies are ready for commercialization in many cases while in some others, large scale field trials are yet to be carried out due to many reasons. Technologies ready for commercialization include pearl oyster culture , mussel culture, oyster culture, Sea Bass culture, seaweed culture and marine ornamentals. Rural / artisanal mariculture with livelihood opportunities include mussel farming, oyster culture, crab fattening, lobster fattening, mullet and *Chanos* growout.

Species grown on commercial scale include *Penaeus monodon, P.indicus,* and *P.semisulcatus.* Species which are ready for commercialization include *Pinctada fucata* (Pearl oyster) *Gracilaria edulis* (Seaweed), 5 species of marine ornamentals, *Lates calcarifer* (Sea Bass), and *Portunus pelagicus* (swimming crab). Species grown on artisanal scale are *Scylla tranqebarica and S. serrata* (Mud crab), Mullets (Mugil, Valamugil), *Etroplus suratensis* (pearl spot), *Chanos chanos* (Milk fish) *Perna viridis* (Green mussels) and *Crassostrea madrasensis* (Edible oysters). Almost all of these except shrimps, pearl oysters, marine ornamentals and swimming crabs depend on wild supply of seed. Hatchery technology has been developed in many species, but not scaled up and field tested. Currently research work is under way at Central Marine Fisheries Research Institute for

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development of hatchery technologies for lobsters, mud crabs, Groupers, Sea cucumbers, Cephalopods, Sea horse, other ornamentals, Abalone, Whelks, and Clams. Details of potential mariculture opportunities are summarized below.

Seaweed culture

There are over 60 commercial species of seaweeds in India, of which *Gracilaria edulis* is most suited resident sp. *Gelidiella acerosa* is a very fine species with high quality agar output, but the grow out of this species is not satisfactory. *Eucheuma* sp. is a very important and viable potential exotic species. Rope culture/ net culture methods have been developed for many species of seaweeds. In the case of Eucheuma, production of 4 to 30 times mass of seed material could be obtained from field trials. 3 fold production yields Rs.9000/ha/y /crop. Two crops are possible in a year.

Shrimp farming

Penaeus monodon and *Penaeus indicus* are the most dominant players. There are over 0.17 million ha presently under cultivation. The production was over 113700 tons during 2000-2001. Cultured shrimps contribute to 58% of shrimps exported, valued about 4000 crores INR annually. Traditional methods of stocking and grow out yields about 100 kg/ha/y. Improved traditional method yields about 500kg/ha/y. Modified extensive method – 1.5 to 2 tons/ha/crop. 60% cultured shrimps are from Andhra Pradesh. Semi intensive farming yields 3 to 4 tons/ha/y. Shrimp culture is now regulated by the guidelines of the Aquaculture Authority.

Crab farming

Scylla tranquebarica and *S. serrata* are the candidate species. Essentially this is a grow out operation. Seed production techniques are still under trials. Seed(30 to 50 g) are grown in ponds to reach weights around 350g. Juveniles (150g) are grown in ponds to 500-600 g. Good feeding protocols yield 1 to 1.5 kg crabs in 8-9 months. Heavy cannibalism, low survival, poor seed availability are constraints. Yield depends on stocking density, survival and feeding strategies. Present market value is around Rs.300 per kg live weight.

Lobster fattening

Juveniles form 40 % of commercial landings. Value addition through farming is undertaken. *Panulirus homarus, P. ornatus,*and *P .polyphagus* are common species used for fattening. Less than 100g lobsters are stocked in 20 m^2 tanks and fed with molluscan meat. A weight of about 300g is reached in 5-6 months. Average yield is 150 kg in 25 m^2 tank. 100% net return is obtained. However, the present trend in taking up this activity is alarmingly intense, resulting in targeted capture of juveniles for fattening activity, thus endangering the sustainability of the stock. Large scale lobster fattening is a damaging and destructive activity and should not be promoted in the interest of sustainability of the wild stock.

Mussel farming

Wild fishery for mussels was to the tune of 14970 tons in 2000. CMFRI technology was now commercialized in the coastal regions of north Kerala. *Perna viridis* and *P. indica* are grown in off bottom culture. Mussel seed collected from the wild are used at the rate of 600 to 700g /m rope. Both longline and raft culture methods are used.

Average production of 12.5 kg per m of rope could be obtained in just 3 months of growth period. Production in 2002 was about 1300 tons from the Kerala mariculture sites. Presently mussel culture is carried out as a rural livelihood activity.

Edible Oyster culture

Crassostrea madrasensis, the Indian backwater Oyster is the species ideally suited for farming. A short

culture period of 5-6 months will yield market sized oysters from coastal mariculture sites. Seed source is from wild although hatchery seed production has been standardized. Rack and ren method, string method, stake culture, are all off bottom culture methods suitable for oysters. Presently this is a rural artisanal livelihood aquaculture activity. Production from farming in 2001was about 350 tons in Kerala.

Oyster farming

Pinctada fucata is the species currently used. Seed produced in the hatchery is transferred to nursery and after appropriate size is reached, the oysters are brought back to the laboratory for nucleus implantation. Nucleus is implanted in the lab by a delicate surgical procedure. The implanted oysters are taken back to the grow out area and held for a period of about 6 to 8 months after which the oysters are harvested and opened to remove the pearls formed. Rack, raft, longline culture systems depending on local situations are used. Technical skill is required for hatchery/lab. Culture period range from 3-4 months to 15 months depending on size of nucleus and nacre deposition. Presently, an institute based year round production programme is in operation through a revolving fund.

Clam farming

Anadora granosa, Paphia malabarica, Meretrix meretrix, M. csata, Marcia opima are all candidate species suited for culture. Hatchery seed production methods have been developed at CMFRI. 2-3 mm sized seed clams with an age of 2 months are shifted from hatchery to nursery and grown to 10–20mm size in the grow out area. Bottom culture method has been developed for culture of clams.

Stocking density ranges from 400/m^2 for 10mm to 300/m^2 for 20mm seed. 10mm mesh synthetic netting is used for cover. Grow out time varies from 5 to 6 months. Harvest is done by employing hand operated dredges.

Marine Ornamentals

Hatchery technology for clown fish and damsels has been developed by CMFRI and is being patented. Hatchery techniques for a few other species are being standardized at the research centres of CMFRI. Seahorse (*Hippocampus*) breeding techniques and hatchery rearing has been standardized at CMFRI. Commercialization is possible through technology transfer or consultancy mode.

Edible finfish culture

Grouper (*Epinephelus* several species): Induced maturation and broodstock development has been achieved in hatchery by CMFRI and patent registered. Breeding of groupers in hatchery and rearing of larvae in early stages have been achieved by CMFRI. *Lates calcarifer* (sea bass) hatchery production of seed in commercial scale was achieved by CIBA,Chennai. Hatchery techniques for milk fish and mullets are also being developed at CIBA, Chennai .

Mariculture sites along the Indian coast

Several aspects are to be considered while selecting mariculture sites. Environmental parameters are only one such aspect. Seed availability, access and other logistics, traditional rights and issues, handling and transport facilities, availability of ice, processing infrastructure, depuration facilities, access to market, assured prices are all important factors to be considered. CMFRI is in the process of preparing a mariculture Site Atlas in the GIS Platform for the entire Indian coast. This research output will be a source-location-process guide for planners, farmers, entrepreneurs and environmental monitoring agencies. The important areas along the Indian coast for mariculture activities are listed

below along with information on the candidate species.

Tamil Nadu coast: Shrimp, pearl oyster, cage culture of finfish, marine ornamentals, seaweeds, gastropods, sea cucumbers, seabass, swimming crabs.

Andhra coast: Shrimp, seabass, swimming crab, cephalopods

Orissa coast: shrimp

West Bengal: Shrimp, brackishwater farming

Lakshadweep and Andaman islands: Marine ornamentals, seaweeds, marine pearls, Grouper cage culture.

Okha Veraval coast: Marine algae, marine pearls, cage culture of finfish, marine ornamentals

Konkan coast:Shrimp culture, clams, seaweeds and marine pearls (Karwar bay) mussels, oysters, cage culture (Ratnagiri)

Karnataka coast: Mud crab, mussels, oysters, shrimp, pearlspot, mullets, chanos,

Kerala coast: Mussels, oysters, marine ornamentals, mud crab, Mullets, pearl spot, marine pearls (Kollam-Vizingam), Shrimp.

Constraints

Technical constraints

Incomplete hatchery /nursery techniques for several species(eg. grouper, mud crab, lobster, many marine ornamentals), poor seed availability, Inadequate packaging and transportation. Research needs in the fields of captive brood stock development, Genetic manipulation and selective breeding, induced breeding in hatchery, Seed collection techniques from nature, monitoring of culture sites for pollution, depuration and holding facilities, lack of demonstration farms, disease diagnosis and control, composite farming methodologies, improper economic analysis.

Economic issues

Uncertain techno-economic viability because of uncertain prices or marketing problems, poor creditworthiness of small farmers, No uniform models for working out economics/profitability No crop loan or insurance to crops. Mortgaging and collateral not available No linkages between subsidy and loan/ Unpalatable lessons learned from economic loss in shrimp culture/ High chances of loss / risk due to natural calamities, poaching, social unrest, riot.

Social issues

Common property rights, traditional rights over culture sites, low willingness to learn new skills among small fish farmers, issues of local labour, poaching, lack of common facilities like demo farms, storage, depuration facilities, exploitation by middle men, lack of direct marketing channels, lack of forward and backward linkages, social issues in partitioning of land(waterbody) use, addiction to subsidies and freebies, negative attitude to governmental initiatives.

Policy / legal issues

Leasing/licensing for farming, ownership, mortgaging Implications of CRZ and other regulations, demarcation of sanctuaries, fragile areas, mangrove and coral regions, breeding and nursery grounds, sensitive areas etc. prevention of encroaching, poaching, policy for creating private property in the open sea with assured protection, Passing of the aquaculture bill, creation of a single window agency for all coastal aquaculture initiatives, a mechanism for assured price to the farmer for his produce or a buy back arrangement by an agency, creating a marketing channel without middlemen.

Environmental issues

Need for EIA for all major farming activities,Impact of non-aquacultural activity in the vicinity, Industrial pollution, agricultural runoff, sewerage disposal, country toilets in the vicinity of the farming areas, Chances of heavy metal accumulation and high bacterial load in the farmed organisms, ground water use and salination,high organic discharges in certain culture systems,contrasting water use between farming practices in the same vicinity, danger of biodiversity, destruction due to monoculture, danger of exceeding the carrying capacity of the water body, disruption of fishing activities, transport, other traditional activities like coir retting, dredging.

The Future

There is vast scope for development of maricultiure in India. However, there are several issues to be sorted out before mariculture could become an activity of importance in the national contest leading to visible changes in the coastal productivity. Concerted and many sided actions at various levels are needed for converting this opportunity to reality.