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GENERAL CONSIDERATIONS OF MARICULTURE POTENTIAL OF ANDAMAN AND NICOBAR ISLANDS

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1. *Base-line study of mariculture potential*

The rapid survey carried out at selected centres in the Union Territory of Andaman and Nicobar Islands during January-April 1978 was a base-line study to understand the potential of the islands for development of mariculture. Mariculture is assuming greater importance for increasing sea-food production and providing employment opportunities on the mainland of India and, to extend this development to the island territory, basic data on the species resources and environmental conditions are essential. The present survey, though indicative in nature, is the first to be made in that region with this specific objective and has thrown some light on its mariculture potential.

2. *Island ecosystem and possible types of culture*

The sea-locked Andaman and Nicobar Islands are in the tropical rain forests zone, with an annual rainfall of about 380 cm precipitated through nine months in a year during both the south-west and north-east monsoons. They are also subject to swift winds and gales of cyclonic weather commonly prevalent during the change of monsoon. Some of the islands are also subject to sea erosion. The islands are mostly grouped and are also moderately indented. As a result there are numerous bays, lagoons, creeks and inlets with varying depths and different substrata which are optimal for several types of mariculture operations. Ideal situations exist for raft culture and cage culture in the bays. Shallow lagoons are suited for pen culture. The water bodies in the creeks and inlets with the adjoining land area can be used for development of prawn/fish farms.

3. *Mangrove ecosystem*

The mangroves of the Andaman and Nicobar Islands are one of the well preserved ecosystems in the world and are very extensive. These should be preserved against human interference. The flora and fauna of the mangroves have been studied during the survey. Rich resources of juveniles of penaeid prawns, crabs and finfishes such as grey mullets and milkfish occur here. The productivity of mangroves is high. The mangroves form the nursery grounds for the coastal species of fish and shellfish and sustain natural production of these species. Some of the mangrove areas which can be considered for mariculture of prawns and fish are at Mayabunder, Rangat, Henry Lawrence Is., Neill Is., Chiriyatapu, Chippighat, Wandoor, Wright Mayo, Kimios and Spiteful Bay. Areas in the upper reaches of the creeks can be utilised for developing aquaculture farms without disturbing those on the sea front which protect the coastal zone against sea erosion. The 'tambak' type of farming as practised in Indonesia may be adopted in the mangrove ecosystem.

4. *Prawn culture*

The banana prawn, *Penaeus merguiensis*, is the most important commercial species among the prawns in the islands, although more than 20 species of penaeid prawns have been recorded. Presently banana prawn is caught by stake nets at Wright Mayo, Chauldari, Diglipur and other centres. *P. merguiensis* is closely related to the white prawn *P. indicus* which is the common species of prawn farming in the mainland of India. The technology of farming of *P. indicus*, as developed for the coastal brackish water areas on the mainland can be easily adopted for the banana prawn. Post-larvae and juveniles of this species for stocking can be collected from the mangrove areas.

5. *Crab culture*

Three species of portunid crabs *Scylla serrata*, *Portunus pelagicus* and *P. sanguinolentus* occur in the Andaman and Nicobar Islands. Of these *S. serrata* which grows to large size is collected and sold in the market. This is a good candidate species for culture. Young crabs can be collected from the mangrove areas and creeks

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for stocking. The technique of culture of this species has recently been developed at the Central Marine Fisheries Research Institute.

6. *Lobster culture*

Six species of spiny lobsters, *Panulirus homarus*, *P. ornatus*, *P. penicillatus*, *P. versicolor*, *P. polyphagus* and *P. longipes* have been recorded during the survey. It is significant that *P. longipes* which is a commercial species in the lobster fishery of Australia has been recorded in the Andaman and Nicobar Islands. The puerulii and juveniles of lobsters can be collected by suspending special types of collectors in the sea and these can be reared to marketable size. The Central Marine Fisheries Research Institute has developed methods by which growth rates faster than in nature can be obtained in culture and the young ones grown to table size in much shorter time.

7. *Pearl culture*

Pinctada margaritifera, the black-lip pearl oyster, is a resource of considerable importance for pearl culture in the islands. The species is known for the production of fine steel-black pearls under culture. There is scope for augmenting the resource through intensive spat collection employing methods practised elsewhere in the world. Ideal ecological conditions are present for pearl oyster farming in the islands. Mayabunder, the islands of Ritchie's Archipelago, Hut Bay and Camorta are some of the potential centres for pearl culture. Although the gold-lip oyster *P. maxima*, which is the most valued species for pearl culture, was not collected during the survey, the possibility of its occurrence, based on geographical distribution of the species in the Indo-Australian archipelago, has been indicated. This species can also be considered for transplantation from the neighbouring areas on the eastern bounds of Andaman Sea. The wing shell *Pteria penguin* could form a supporting species for pearl culture.

8. *Oyster culture*

The edible oyster, *Crassostrea madrasensis*, has been collected from a number of centres. There is also the rock oyster *Saccostrea cucullata* resource in abundance. The former species is of importance in oyster culture. Several sites around Port Blair can be considered for oyster farming. Spat collection will have to be established by using techniques already developed for *C. madrasensis* on the mainland.

9. *Mussel culture*

The green mussel *Perna viridis* occurs in Chippighat near Port Blair. Animals of large size have been collected indicating the growth potential. There is a possibility for mussel farming if the resource could be developed through spat collection.

10. Turbo *and* Trochus *resources development*

Turbo marmoratus and *Trochus niloticus* are two important species of gastropods exploited for their commercially valuable shells in demarcated zones in the Islands and shell fishing is controlled by rules made under the Andaman and Nicobar Islands Fisheries Regulation, 1938 (Regulation 1 of 1938). Exploitation appears to be intensive and there is need for management of the resource based on biological principles governing their reproduction and growth and a better monitoring system. Sea-ranching should be attempted for both the species, after developing appropriate artificial seed production techniques, to restore and improve the wild stocks.

11. *Abalone culture*

The tropical waters are not the best for abalone production, as compared to the temperate and sub-tropical waters where the species resources are rich and also the animals grow to large size. *Haliotis* sp. is occasionally collected for edible purposes by the Nicobarese. The possibility for culture of this species needs to be established.

12. *Giant clam culture*

The giant clams or the holy water clams *Tridacna crocea*, *T. maxima* and *T. squamosa* have been collected during the survey. Some of the reef flats are virtual *Tridacna* beds with a large resource. The Nicobarese relish the meat of giant clams. Elsewhere, *e.g.* in Gilbert Islands and Papua New Guinea, tridacnids (*T. gigas*) is considered suitable for mariculture. The possibility of *Tridacna* culture in the Andaman and Nicobar Islands has to be explored.

13. *Culture of grey mullets and milkfish*

Several species of grey mullets, including *Mugil cephalus*, and milkfish *Chanos chanos* have been recorded from the estuarine region and mangrove ecosystem. Fingerlings and juveniles have been collected from several centres. There is a distinct potential for taking up mullet and milkfish culture in the mangrove and swampy areas and this would form a major programme of mariculture in the Andamans. Milkfish culture is very important for the islands, both to increase supply for human consumption and as live bait for skipjack pole-and-line fishing and bait for tuna long-line fishing.

14. *Bait fish culture*

The fisheries development programmes of the Union Territory include introduction of pole-and-line fishing for tunas around the Islands on the pattern of the skipjack fishery of the Lakshadweep. The potential tuna resources of this area have been estimated to be high. Bait fish availability is a critical factor for the success of pole-and-line fishing for the surface tunas. Thus tuna fishery development in the islands is linked up with finding adequate resources of the right species of bait fish and employing appropriate techniques for capture, holding and transportation of live bait. Many species of forage fishes are available in the islands. These can be evaluated for their suitability as live bait and cultured in pens or cages in the lagoons and bays.

15. *Culture of perches*

Perches (groupers and rock-cods) are an important resource in the islands. These can be grown under cage culture in the bays, feeding them with low-value fish by-catch of trawlers.

16. *Seaweed culture*

The alginophytes *Turbinaria, Sargassum* and *Padina* are the dominant seaweeds in the islands. The agarophytes *Gracilaria, Gelidiella* and *Gelidium* appear to be poorly represented. Potential exists for the culture of alginophytic algae using the immense seed material. The edible seaweed *Halimeda peltata* has been recorded and this species can be cultivated. The lagoons of John Lawrence Is., Corbyns's Cove, Navy Bay and Chiriyatapu in the Andaman group, and Sawai Bay, Katchall East Bay and Spiteful Bay in the Nicobar group appear suitable areas for seaweed culture.

17. *Sea-cucumber and sea-urchin culture*

Beche-de-mer production has become an established export-oriented cottage industry in the Andamans. There is a good potential of sea-cucumbers of species *Holothuria atra, H. scabra* and *Actinopyga mauritiana* on the reef flats among the algal growth. A brief experiment on the culture of *H. scabra* at Port Blair has given encouraging results as to the possibility of collection of juveniles for stocking and growth. This has to be pursued further for taking up farming of the economically important species of sea-cucumbers, particularly *H. scabra,* on the extensive tidal reef flats of the Islands.

Among the sea-urchins, *Tripneustes gratilla* which grows to large size on algal beds in shallow waters may be a candidate species for farming using simple methods of collecting the young ones and rearing them on algal beds.

18. *Conservation of endangered sea turtle resources*

The Andaman and Nicobar Islands are one of the most important nesting grounds for sea turtles. All sea turtles are totally protected by law under the Indian Wildlife (Protection) Act. Of the seven species of sea turtles found in the world oceans, four—the Olive Ridley turtle *Lepidochelys olivacea,* green turtle *Chelonia mydas,* hawksbill turtle *Eretmochelys imbricata* and leatherback turtle *Dermochelys coriacea* occur in the Andamans. All the species are declining rapidly, and *D. coriacea* is listed in the International Union for the Conservation of Nature (IUCN) Red Data Book for species immediately threatened with extinction. A programme of collecting turtle eggs from their nesting grounds, hatching them and release of the baby turtles into the sea has been taken up on the mainland of India. Similar programme should be initiated in the Andaman and Nicobar Islands. Adequate protection should be given to the nesting grounds of all the species of sea turtles, particularly to those of the leatherback turtle.

19. *Rehabilitation of endangered crocodile resources*

The saltwater crocodile *Crocodylus porosus* which is the world's largest living reptile growing to over 8 m is found in the Andamans and its population has dwindled to a few. Experts have estimated the population of breeding females to be about 80 in the Andamans, excluding the Jarawa Reserve. On the mainland of India, some States have taken up crocodile rehabilitation projects. A similar programme for the farming of the saltwater crocodile should be taken up in the Andamans, primarily with a view to increasing the wild population and secondarily for any economic gains after natural population is restored to satisfactory levels.

20. *Artificial seed production for mariculture*

Any commercial mariculture programme cannot completely depend on the seed available in the wild for stocking the farms. Artificial seed production should form a component of farming. Fish and shellfish hatcheries will have to be established at selected centres for the production and supply of seed. Hatchery techniques for penaeid prawns, pearl oyster and edible oyster have been developed at the Central Marine Fisheries Research Institute and these are under constant improvement. These could be adopted for establishing hatcheries in the Andaman and Nicobar Islands. Water quality is one of the critical factors in hatchery management. The clear blue waters of the islands which are not polluted, except in a very few areas where wood-

based industries have been established, can be used with minimum treatment in the hatcheries. Power generation and seawater pumping systems would need to be established for the hatcheries.

21. *Sea-ranching*

The protected bays and mangrove-lined creeks would provide the right environment for some of the sea-ranching programmes that could be taken up in the Islands. Production of juveniles on land-based hatcheries and their release into the sea has enhanced the natural populations of prawns and abalones in Japan. Similar programmes would be possible in the Andaman and Nicobar Islands for selected economically important species such as *Penaeus merguiensis*, *Turbo marmoratus*, *Trochus niloticus* and *Haliotis* sp. These programmes may be taken up by the State department to improve the natural resources. Hatchery development for seed production should be accelerated for successful sea-ranching programme.

22. *Use of Remote Sensing Techniques in site selection for mariculture*

Given the geophysical nature of the terrain and the problems of communication and transport, a good survey of all the islands for selection of sites for mariculture using conventional methods would be a difficult a task. Pictures of satellite imagery taken by remote sensing have become a very useful tool in understanding detailed geographical features of land and oceanographic conditions of the seas. This modern approach may be useful in identifying suitable sites for mariculture in the Andaman and Nicobar Islands.

23. *Infrastructure development*

Realisation of the mariculture potential of the islands would entirely depend on creating necessary infrastructural facilities. These would include land and farm development, shore establishments, energy and water supply, transport and communication, processing and storage and trade facilities. A planned approach to mariculture is necessary to take up integrated or closely linked up programmes to share common infrastructure facilities.

24. *Manpower development*

Manpower, at the managerial, supervisory and operative levels, will have to be developed for manning the programmes. Facilities for such training are available at the Central Marine Fisheries Research Institute. *Ad-hoc* training courses in prawn breeding and culture, pearl culture, oyster culture, musselfarming, finfish culture in tidal ponds, pens and cages, and seaweed culture are offered at the Institute. These could be availed of by the State department, public sector and also individual fish farmers of eligible categories.

25. *Fixing of priorities*

Development of mariculture in the Andaman and Nicobar Islands will have to be taken up in a phased manner and, therefore, it is necessary to identify the priority areas which have immediate potential. In their order, these would be : (1) pearl culture with *Pinctada margaritifera* resource for the production of steel-black cultured pearls ; (2) prawn culture for *Penaeus merguiensis* ; (3) fish farming for the grey mullets and milkfish and (4) seaweed culture.

26. *Need for pre-project surveys*

The general considerations for development of mariculture in the Andaman and Nicobar Islands presented here are based on a rapid survey conducted during a specific period and, therefore, are only indicative. Individual projects for development should take up fresh pre-project surveys in great detail. This Bulletin is intended to serve the limited purpose of indicating the overall potential of the archipelago for mariculture. In certain areas, the information presented is more than indicative and is of some critical value and could be used for planning mariculture development.