MARINE FISHERIES INFORMATION SERVICE

No. 75
SEPTEMBER 1987

Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

CULTURE OF FIN FISHES ALONG THE COAST OF TAMIL NADU

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Introduction

Countries bordering the Indian Ocean have had a long history of experience in the cultivation of aquatic organisms and thus form important centres of aquaculture in the world. In India too such traditional culture practices have been well established in many maritime States. While in many states, these have undergone rapid development, in Tamil Nadu the coastal aquaculture remained largely at subsistence level almost as it was in the distant past though the potentials for its development are great. Small-scale experiments at various centres have demonstrated the possibilities of successful salt water fish farming.

As early as in 1911, Hornell proposed the possible conversion of various types of coastal areas like lagoons, mudflats and hypersaline channels for fish production. Possibilities for coastal fish farming have been revealed by the pioneering works of Tampi (1960), Chacko and Abraham (1962), Evangeline (1967) and Nair *et al.* (1974) with the culture experiments carried out at Mandapam. In recent years the research centres of Central Marine Fisheries Research Institute and the Fisheries Department, Tamil Nadu have made series of attempts in different parts of the State to improve the existing culture practices in the country and to develop new indigenous techniques to establish fish farming on scientific and modern lines. Considerable progress has been achieved in this direction. Mention has to be made to the works of Dorairaj *et al.* (1980), James *et al.* (1980a, 1980 b), Marichamy and Rajapackiam (1982), Marichamy *et al.* (1980), Venkataraman *et al.* (1980) and Shanmugam and Bensam (1980) which were carried out in the marine environment. The problems and prospects of salt water fish culture in Tamil Nadu were reviewed by Tampi (1967, 1969, 1972), Krishnamurthy (1972), James (1980) and Srinivasan *et al.* (1980). In the coastal aquaculture sector, the main objective is to achieve high production through improved culture practices involving selective stocking and intensive culture including the practice of polyculture, and development of hatcheries for high priced species. The present account compiles the information now available with regard to resource potential, site development, methods of culture and

management techniques and examines the scope for large scale expansion of this sector.

Resources

Tamil Nadu possesses the essential basic resources of water, land and cultivable species required for immediate development of mariculture. A variety of marine fishes possessing high reproductive capacity, short larval development, fast rate of growth and physiological features to adjust to wide changes in the environment are available along the coast of the state. The sources for the collection of seed of most of the important groups have been studied and the potential grounds identified (Renganathan and Ganapathy, 1949; Panikkar *et al.*, 1952 ; Krishnamurthy, 1972). Tampi (1973) while listing the fry collection centres and seasons of collection, estimated that a total of at least ten million fry and fingerlings of *Chanos* could be collected from coast of Tamil Nadu in a year More recently, the Central Marine Fisheries Research Institute carried out a project on the survey of seed resources of southeast coast of India. The fisheries department of the state had organised special collection drives in certain years besides the regular fry collection centres. All these have revealed the potential and possibilities for better exploitation, eventhough a quantitative assessment in terms of effort expended is yet to be prepared for a more precise picture.

Fig. 1. The CMFRI fish farm at Karapad, Tuticorin.

Among the culturable marine fishes the milkfish *Chanos chanos* is widely selected and the best period for large scale collection of their fry is generally the summer months March–July, although a secondary spawning of this species during September—November has also been reported in some parts. Next to milkfish, mullets constitute a group of great importance in coastal fish culture, particularly the species *Mugil cephalus, M. waigiensis, M. seheli, Liza parsia* and *L. macrolepis*. They occur in the same habitats along the coast with *Chanos* fry and have a peak season during northeast monsoon period. The potential grounds for the collection of fry of these fishes are the areas of Pulicat, Ennore, Adayar, Muttukad, Kadappakkam, Marakkanam, Cuddalore, Parangipettai, Killai, Thirumalaivasal, Tranquebar, Nagore - Nagappattinam, Point Calimere, Muthupet, Adirampatnam, Theedai lagoon in Mandapam Camp, Chinnapalam creek of Pamban islands near Mandapam, Valinokkam, Tuticorin, Pullavahi, Palayakayal, Pinnakayal, Tiruchendur and Colachel. Besides these promising species, culture of the pearl spot *(Etroplus suratensis)*, bhekti *(Lates calcarifer)*, threadfins *(Polynemus indicus, Eleutheronema tetradactylum)* and *Anguilla bicolor bicolor* has gained importance in recent years.

Fig. 2. Harvesting the cultured fishes after draining.

Experimental culture of sandwhiting *Sillago sihama* has indicated that it is a good species with good potential. The other cultivable species are *Elops indicus, Therapon* spp., *Epinephelus* spp., *Siganus* spp., *Megalops cyprinoides* and *Tilapia* sp. The occurrence of fingerlings of *Sillago sihama* in good quantities in May and October in the tidal reaches of Pillaimadam area near Mandapam has been reported by the scientists of Central Marine Fisheries Research Institute (James *et al.*, 1980 c). Several collection grounds of elvers in the river mouths along the southeast coast have been located.

The potential coastal waters available for culture in the State, estimated to be 0.080 million ha include estuaries, creeks, canals, tidal flats, backwaters, brackishwaters, lakes and saline swamps besides the productive space in inshore waters for open sea farming. The most important consideration is the location of the site in relation to the tidal amplitude. The tidal amplitude is poor in most parts of the State and therefore the location of the farm should take maximum advantage as regards the level of the ponds and supply channels. Availability of a source of freshwater would be an added

advantage in controlling wide variations in salinity and temperature. The soil of the pond has a direct bearing on the productivity of the ponds. A clayey soil rich in organic matter encourages the growth of various micro-organisms which become the food of fishes. Such soil is impermeable to water and can be used to form a firm, leakproof bund which is not easily eroded by wave or tidal action. The vast tidal mud flats available in Valinokkam, Tuticorin, Pullavahi, Palayakayal and Pinnakayal are such grounds in Tirunelveli District available for immediate development, and already farming works are in progress in certain spots.

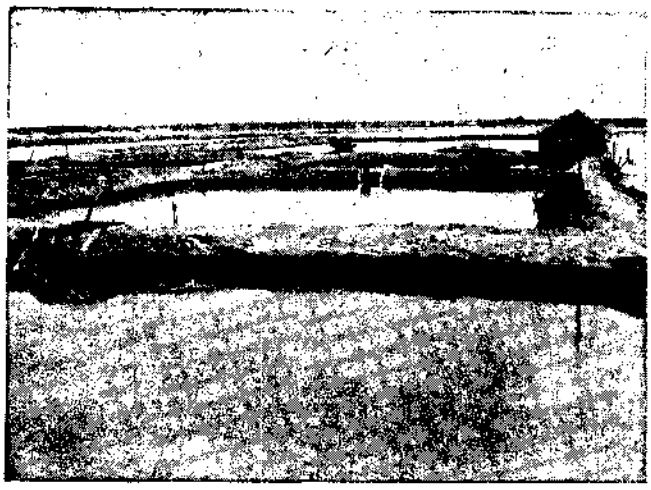

Fig. 3. Fish culture ponds in salt pan area at Veppalodai, Tuticorin.

Besides the development of such derelict areas for coastal aquaculture, another system of culturing also can be developed in salt pan reservoirs around Tuticorin and Manakudy. Some private farmers have already initiated culture projects in these areas.

Varma *et al.* (1963), Nair *et al.* (1974) and Marichamy *et al.* (1980) have described the optimum hydrological factors required for the different culture systems. According to them the salinity of the rearing media in the range 10–40 ‰ would be ideal for the fast growth of various fishes. Higher and lower pH are detrimental to the health of fishes and the optimum value would be around 8.00. Dissolved oxygen content at the level of 3.5 ml/l and above is the required condition.

Present status of culture practices

Mariculture of fin fishes can be broadly classified into two categories *viz.*, extensive and intensive methods, chiefly according to the ecosystem and species selected for culture. Extensive fish farming consists of just holding, growing and harvesting fishes in impoundments, whereas intensive culture involves selective stocking of the ponds with fish fry obtained from natural sources or hatcheries and raising them under controlled conditions. The extensive system of culture is represented by the traditional coastal aquaculture practices of the country, such as 'Bheries' of Sunderbans in West Bengal, 'Pokkali' fields of Kerala and 'Gazan' of Karnataka. In Tamil Nadu, the existing system of culture practices followed in low saline salt pan reservoirs of Tuticorin and Manakudy, though not prominant, may come under the extensive category. Realising the great scope for salt water fish farming, a series of experiments are now being carried out at different places of the State.

Intensive culture practices vary widely. Floating rafts with net or cages are preferred for the culture of large sized fishes like *Lates calcarifer, Polynemus* spp., *Epinephelus* spp. and *Caranx* spp. The Fisheries College, Tuticorin has started a project on this and the work is in progress. In places where the coastal currents are poor, net enclosures and pen impoundements in shallow regions of the coastal zone are other choices of mariculture. Preliminary experiments have been carried out at Mandapam Camp and Tuticorin by the Central Marine Fisheries Research Institute with different species. Combined culture of compatible species of fin fishes is gaining considerable importance as a means of effective utilisation of all the available ecological niches of the culture system. The mullets, milkfish and prawns together were profitably cultured in ponds. The growth and survival rates were good in the combination of mud crab *Scylla serrata* and *Chanos chanos* in ponds. The period of culture varies from 8–10 months. The development of coastal fish farm including the site selection, pond construction, water characteristics, farm management and results have been described by Marichamy *et al.* (1980).

The results of the culture operations carried out along the southeast coast of India in the marine environment are presented in Table 1. Variations with respect to growth, survival and production rates have been noticed and attributed to ecological and biological factors. Better results were attained in polyculture systems. Although the cultured species are euryhaline, the higher salinity retards the growth of the stock. Unfertilised ponds and the predation problems also cause poor production rate.

As regards eel culture, elvers have been found to grow fast under controlled conditions in running fresh water systems and attain marketable size at the end of one year. They feed on a variety of fishes and clam

Table 1. *Results of fish culture experiments carried out along the coast of Tamil Nadu*

Place	Culture System	Culture Methods	Species	Growth rate (mm)	Survival (%)	Production (kg/ha/yr)	Authors
Krusadai	Monoculture	Ponds	*C. chanos*	235-240/yr	—	—	Chacko and Mahadevan (1956)
	Monoculture	Ponds	*C. chanos*	240-250/yr	—	—	Menon *et al.* (1959)
Mandapam	Monoculture	Ponds	*C. chanos*	300 ,,	9-11	212-455	Tampi (1960)
Veppalodai	Polyculture	Ponds	*C. chanos*	333 ,,	50	192	Marichamy and Rajapackiam (1982)
			M. cephalus	420 ,,	20	362	
Tuticorin	Polyculture	Ponds	*C. chanos*	300-378 ,,	5	324	Marichamy *et al.* (1980)
			L. macrolepis	211-240 ,,	67	630	
			S. serrata	130-175 ,,	26	690	
Mandapam	Monoculture	Tanks	*A. bicolor bicolor*	23/m	98	22/m	Dorairaj *et al.* (1980)
Mandapam	Monoculture	Cages	*S. canaliculatus*	8.5 ,,	60	—	James *et al.* (1980b)
			S. javus	6.2 ,,	40	—	
			E. tauvina	25 ,,	75	—	
			S. sihama	10 ,,	—	—	
Mandapam	Monoculture	Pen	*V. seheli*	25 ,,	—	—	James *et al.* (1980a)
	Polyculture	Ponds	*L. macrolepis*	13 ,,	—	—	
			C. chanos	17 ,,	—	—	
			P. indicus	9.4 ,,	—	—	
			S. sihama	11.4 ,,	—	—	
Mandapam	Polyculture	Pen	*Mugil* sp.	18 ,,	70	—	Venkataraman *et al.* (1980)
			C. chanos	50 ,,	50	—	
Tuticorin	Polyculture	Pen	*C. chanos*	27 ,,	5-48	damaged	Shanmugam and Bensam (1982)
			Mullet	23 ,,	—	—	
Tuticorin	Monoculture	Ponds	*C. chanos*	44 ,,	318-857	—	Bensam and Marichamy (1982)

meat. A pilot project covering survey of elver resources, collection and transportation of elvers, exportation of live elvers and culture of eels was completed by the Central Marine Fisheries Research Institute with the financial assistance of the Marine Products Export Development Authority. A number of private fish farmers have already started small-scale marine fish culture along the coast of Tamil Nadu. The CMFRI has started projects for large-scale development of fish farming in 90 ha area at Muthukad and 500 ha in Theedai lagoon at Mandapam Camp.

Culture management

The results of the culture experiments are encouraging. The areas which require further research inputs have also been identified, particularly in respect to the development of hatcheries for large scale production of fish seed, nutrition of culture fishes, control of diseases and predators, induced maturation in captivity, methods of culture and coastal farm engineering. All these need-based intensive programmes have been started by the central and state fisheries departments located in different centres of the State.

Careful considerations on the following aspects are necessary before farming the sea edge such as (1) the topography and tidal regime of the area, (2) soil and water characteristics, (3) presence of required seed resources in the surroundings, (4) the fauna and flora as well as environmental parameters of the area and (5) legal regulations and the socio-economic conditions of the locality. Efficient farm management involves the preparation of pond, maintenance of water condition, fish population management, production and maintenance of natural food, supplemental feeding, control of pests and predators and effective harvesting.

The development of such sea-farming largely depends upon the effective transfer of the technology developed and this can be effected through training programmes, including demonstrations, special courses of summer institutes, consultancy services and regular courses of Krishi Vigyan Kendra, on such aspects of mariculture techniques regarding seed production, farm operations, simple harvest technology, farm management, marketing and economics.

Future lines of work

Mariculture has gained importance and as such the schemes relating to its development are included in the current five year plan. The employment potential in seafarming is enormous as Tamil Nadu is endowed with several protected bays, lagoons, vast estuarine and brackishwater areas which could be converted to fish farms. Developmental supports should be made available for converting these areas into fish farms. Farm engineering for marine aquaculture is a new field and it is essential to develop new designs and innovative techniques for constructing bunds, sluices and feeder canals to suit the local conditions. Continued investigations are needed for the development of low-cost technology for intensive culture of more suitable species in different ecological systems as well as the survey of seed resources in new sites. Formulation of suitable feed mixtures using low-cost ingredients with high conversion ratios will be another priority area of research for expansion of the industry. The methods developed in recent years have been largely empirically determined and can probably be improved. The methods of fertilization should be tailored to soil and water chemistry. Extensive experimental studies in using organic and inorganic fertilisers for enriching the ponds is a line of work to pursue. The practice of continuous stocking and harvesting with a year-round growing season as done in Taiwan will result in good yield. The venture of fish culture should be organised on co-operative basis at cottage industry level. A practical system to produce the seed of desirable species on a large scale under controlled conditions has not been developed so far. Improvement of present collection methods could be made based on the behavioural characteristics of the species. The use of scare-line in shallow tidal creeks would be the effective gear for good catches. Also, conservation measures should be introduced since a lot of *Chanos* fry are collected and spoiled by children in coastal villages without realising the immense value of this resource. Besides exploring the unexploited stocks, the ultimate solution must be the breeding of milkfish and mullets in captivity.

With such high seed production, there could be chances to export the *Chanos* fry and develop fry trading centres. Fish fry collection and fry trade can develop into a very profitable supporting industry. Government must make derelict marshy areas and coastal lagoons available to enterprising societies of fish farmers on long-term lease, besides the development of credit and marketing schemes. Provision of model farms and extension services by Government departments on modern scientific lines as technical guidance and training will promote this growing industry. Schemes on the pattern of Fish Farmers Development Agencies established in Tanjore District, should be set up for the implementation of fish culture in sea-base, involving local fishermen. Full support from Government in the beginning can be given particularly to train the fish farmers. Local fishermen may prefer this part-time avocation. The National Commission on Agriculture has recommended that maritime states should undertake a detailed survey of brackishwater fish farming and establish pilot commercial fish farms. Future work should be centred around this scheme for further extension.

Problems

The land leasing policies do not permit long term aquaculture practices. Credit facilities for commercial scale expansion are lacking. Constraints on technological inputs are many. Reclamation of saline water areas is an arduous task. Fast industrial advancements along the shore, particularly the chemical and fertilizer plants, may pose a problem with their discharges, and it would adversely affect the development of coastal aquaculture. The need for protecting aquaculture areas from the effects of pollution is stressed for the trouble free progress of culture projects. The preparation of inexpensive supplementary or complete feeds from locally available ingredients is another development

that is required for intensifying culture operations. Reliable techniques for the proper improvement of derelict lands and management of farming along the sea shore are other problems to be solved.

Remarks and conclusions

It is understood from our planning reports that if our brackishwaters are fully utilised, about 31 lakh tonnes of fish could be produced every year and about 28 lakhs people will be able to get employment opportunities. This will be increased if the edge of the sea is farmed for fish culture practices. The species used in culture system have high unit value, besides other benefits. Even if 10% of area of the available coastal lands is brought under culture by scientific methods, the production can be increased considerably.

Fish farming along the coast has a direct bearing on the coastal rural economy, in that it will provide opportunities for self employment, increase production of cultivable marine fishes several-fold, support a number of ancillary small-scale industries, provide material for export and bring about an overall improvement in the socio-economic conditions of coastal fishermen and farmers. The fishermen have plenty of leisure time during off season which could be effectively utilised in farming work. The mariculture system combining with traditional fisheries must be selected on consideration of several factors relating to the technical aspects of culture as well as socio-economic aspects of the fishermen community. Culture methods of proven techno-economic feasibility, developed by research institutes, have been transferred to some extent by different means like operational research projects and demonstration programmes in different parts of the country, including Tamil Nadu. Training programmes in coastal aquaculture have been developed through Krishi Vigyan Kendra of ICAR and the establishment of such centres in the State may benefit much. In the initial stages subsidies and loans will have to be provided as was done in the case of mechanised fishing. The service of the technical experts of the fisheries research institutes coupled with active participation of the planners, administrators, financial agencies and the fish farmers with the available basic resources is the urgent need for the rational development of farming the sea edge.

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