
SEMINAR ON FISHERIES EXTENSION

Cochin, 8-10 December 1980

TECHNOLOGY GENERATION AND TRANSFER FOR
MARINE FISHERIES DEVELOPMENT

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The importance of technology transfer through education, training and extension programmes in the marine fisheries sector has been stressed from time to time in the successive Five-Year Plan proposals, in the reports of Parliamentary Committees and other reviewing committees; and more recently by the National Commission on Agriculture.

The Central Marine Fisheries Research Institute has always attached considerable importance to extension activities and in recent years they have formed an integral part of its research and development programmes. Transfer of technology through training, demonstration and extension programmes are given high priority in the current programmes of the Institute.

The Institute was started at a time when the country was facing acute shortage of proteinous food and a strong research base was very much wanting to lend adequate scientific support for various development plans to augment marine fish production. Over the past 33 years the Institute has steadily grown from strength to strength and it has now become a premier national facility for marine fisheries research and development. The research programmes undertaken by the Institute are inter-disciplinary and are intended to provide technologies and data base to various departments/organisations of the Centre, maritime States, the industry,

Agricultural and other Universities and the individual fisherman and fish farmer for the ultimate objective of fisheries development.

Notable impact on capture fisheries

As a result of the efforts of the Institute drawing attention to the extent of the exploited resources, new and additional untapped resources and the scope for increasing production by extending the area of fishing operations to non-traditional grounds, notable impact has been made on the overall development in capture fisheries in the recent years. The State Governments and the industry have progressively increased the mechanised fishing operations in the northwestern region, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Union Territories. Substantial increase in the catches of tunas, catfishes, perches, pomfrets and elasmobranchs has been witnessed after introduction of nylon gill net fishing for these species. Penaeid prawn catches in Kerala and non-penaeid prawns in Maharashtra have steadily increased during the 1970s and along the east coast both these groups have registered sharp increase in recent years. The recent introduction of purse-seines in Karnataka based on research information on pelagic resources made available by the Institute enabled the State to double its catches of mackerel and oil sardine. Purse-seines are already in operation in Kerala. Other maritime States are contemplating introduction of purse-seines for increasing the production from capture fisheries.

The Institute's estimate of potential resources in the seas around India and its findings on the pelagic, oceanic, deep-water and demersal resources (both conventional and non-conventional) assumes added significance in the context of exploration and utilization of the Exclusive Economic Zone.

Breakthroughs in coastal aquaculture

Aware of the importance of coastal aquaculture for augmenting fish production and for improving the rural economy,

the CMFRI launched research programmes in the early seventies to develop appropriate low-cost technologies for the culture of marine organisms. Within a short time major breakthroughs were achieved in several fields. For the first time, an indigenous technology for pearl culture was developed in 1973. Open sea mussel culture showing its great potential for increasing production followed this. Techniques for breeding and culture of almost all commercially important penaeid prawns were developed during 1974-77. Valuable results have been obtained in the culture of lobsters and crabs. Intensive surveys have been undertaken since 1975 to evaluate the availability of seed and potential seed grounds along the coasts for culture. Culture of fin fish initiated in the 'fifties has been considerably strengthened and extended to farming studies on mullets, pearlspot, sand-whiting and eel. Simple techniques for seaweed culture have been developed for commercial-scale propagation. The Institute has also taken up integrated programme in crop-livestock-fish farming.

1. Fin fish culture

Many species of fishes such as milkfish, mullets and perches are suitable for culturing in the low-lying areas and impounded brackish water. The work carried out by CMFRI at Mandapam and Tuticorin has shown that with proper management procedures production of milkfish in saline lagoon and ponds could be substantially increased.

The Institute has developed methods of culturing the eel, Anguilla bicolor in running fresh water. This species is abundant along the east coast and they breed in the open sea. The elvers ascend the rivers during the rainy season. Elvers are collected and reared in experimental culture tanks at Mandapam Camp. This species has given a production rate of 38 t/ha at the end of a period of 2 years.

Another species of fish, Sillago sihama is being successfully cultured at Mangalore. The species grows to about 200 mm in 7 months.

At Narakkal farm, polyculture of mullets, pearl spot and prawns has given good production rates. Similarly fish and prawns are cultured in salt pans at Tuticorin. At Mandapam techniques for culturing mullets, milkfish and perches in pens have been developed. At Vizhinjam experiments are in progress for culturing tuna bait fishes such as anchovies in enclosed wells.

The Institute has developed methods for induced breeding of mullets using pituitary extracts and hormones and similar experimental work on milkfish is in progress.

2. Marine Prawn culture

The recent technologies developed in marine prawn culture were the fruits of sustained and intensive researches carried out in the field laboratories of CMFRI particularly at Narakkal, and at Tuticorin, Mandapam Camp, Kovalam and Kakinada.

At Narakkal, breakthroughs were achieved in the spawning and rearing of larvae upto stocking size under controlled conditions, of almost all commercially important prawns such as Penaeus indicus, P. monodon, Metapenaeus monoceros, M. dobsoni, M. affinis and Parapenaeopsis stylifera. One of these species, M. dobsoni, has been successfully "domesticated" and viable eggs liberated by the cultured prawn have further been reared to stocking size.

Recently, the laboratory has evolved the technique of 'unilateral eyestalk ablation' for enabling prawns to mature consecutively. For mass production of prawn seeds hatchery techniques are being developed here.

The techniques of mass culture of several species of diatom, the brine shrimp Artemia salina and zooplankters which form the food of larvae and juveniles of prawns have also been developed.

At Mandapam and Tuticorin methods of culturing prawns and fishes together have been studied to get optimum stocking rates and for obtaining better yield. At Kovalam, success has been achieved in the breeding and rearing of P.semisulcatus. At Kakinada, the feasibility of culture of P.monodon in salt pan reservoirs has been worked out.

The Institute has evolved proper techniques for improvement in traditional prawn culture, selection of farm site, construction of farms, preparation of field for stocking, and scientific prawn farming.

As a result of these technologies, it has been shown that improved methods of culturing selected species of prawns with proper management would result in production rates of 1000-1500 kg/ha/annum.

3. Pearl culture

The technology for production of cultured pearls and farming of pearl oysters were developed indigenously for the first time in India by CMFRI at Tuticorin in 1973. ~~The raft culture method was introduced to rear pearl oyster.~~ The important species cultured is Pinctada fucata. The surgery is performed in the shore laboratory and the operation consists of grafting a piece of mantle in the gonad or hepatopancreas region of the oyster, followed by the implantation of a spherical shell-bead nucleus.

Although cent per cent success has been achieved in certain batches, the average production is about 60-70%. Multiple production of pearls in individual oysters has been achieved. The size of nucleus employed ranges from 2mm to 7 mm diameter depending on the size of the oyster and the choice of single or multiple implantation. The rate of deposition of nacre is high in the tropical seas and hence the duration of post-operative culture is considerably reduced, requiring only 3 months to 18 months for the range of 3 mm to 8 mm pearls for maturity. The shell beads required have been produced from the conch-shell wastes. The surgical tools have been fabricated indigenously.

4. Culture of edible oysters

Intensive work on the culture of edible oyster, Crassostrea madrasensis is being carried out at Tuticorin Research Centre. The techniques of oyster farming consist of collection of spat by using different spat collectors and growing them to adult stage by methods such as rack culture, long-line culture and tray culture. For collecting the spat, materials such as lime-coated tiles, oyster shells strung on galvanised wire, empty coconut shells and rubberised coir mats are being tried. It has been demonstrated that the farm oysters have better growth rate and healthy condition, and give higher yield when compared to those growing in the wild.

5. Mussel culture

The techniques for mussel culture were developed at CMFRI Research Centres at Calicut, Vizhinjam and Madras. Two species namely Perna indica (Brown mussel) and Perna viridis (Green mussel) occur in the country. The experiments conducted at Vizhinjam on the culture of brown mussel follow the suspended or raft culture method using ropes. The seeds of mussel are collected from the natural beds and transplanted to these ropes.

The annual production rate was estimated as 150 tonnes/ha as compared to natural production of 4 tonnes/ha.

At Calicut, the technique of culturing green mussels in the open sea has been developed successfully. The average production per rope of 7 metres length is about 80 kg of mussels and it has been estimated that the yield/ha for a period of 5 months is about 235 tonnes. A system of mussel culture using submerged rafts suitable for rough sea conditions is under development at Madras.

6. Seaweed culture

The culture experiments on seaweeds are carried out from the Regional Centre at Mandapam Camp. The cultivable seaweeds are agar-yielding plants like Gracilaria and Gelidiella species and algin-yielding plants such as species of Sargassum and Turbinaria.

The method of cultivation of Gracilaria edulis, the fast growing species with minimum of seed material has been standardised. Culture experiments have been done by introducing fragments of seed material in the twists of coir ropes which are fabricated in the form of 5 x 2 metre size nets. These nets are then tied to wooden poles fixed in the coastal waters. The plants reach harvestable size after 80 days of growth.

Experiments have shown that other species of seaweeds such as Sargassum could also be cultured economically. There is increasing demand for seaweeds for the manufacture of agar-agar and algin which used to be imported previously.

7. Culture of other organisms

Apart from the technologies developed in the above mentioned major areas of mariculture, the Institute has also developed techniques for the culture of spiny lobsters and crabs. Experiments on the culture of clams and cockles are also in progress. The possibilities of culturing sponges, holothurians and marine turtles have also been explored.

Impact of these technologies for rural development

These recent technologies have had the desired impact on the maritime State Governments/coastal rural population. /and Pearl culture technology and seaweed culture are industry oriented. A pilot project on pearl culture has been started by the Kerala Government.

As a result of technologies developed in prawn culture there is an intense awareness among coastal rural population to take up scientific prawn farming. The coastal rural people are taking up mussel culture to increase their income and the industry is also evincing keen interest for processing mussel meat for export.

In general, many of the maritime States are now coming forward to develop coastal aquaculture and integrated farming for augmenting fish production in their state.

Future thrust in mariculture research

Future programmes of the Institute in mariculture will have major thrust on the following aspects:

1. Efficient methods of seed collection, conditioning and transport to ensure supply of seed of desired species during different seasons.

2. Development of hatcheries for large scale production of seeds of fishes, prawns, mussels, edible oyster and pearl oyster and developing a low cost technology for such hatchery production.
3. Development of designs for construction of farms and low-cost farm implements.
4. Genetic upgrading of cultivable organisms.
5. Physiology, nutrition and fish pathology and disease control of cultivated organisms.
6. Monitoring pollution and physiological stress; pollution control in areas where culture operations are undertaken.
7. Technology for efficient methods of harvesting; post-harvest technology for quality control, product development and utilisation.
8. Developing integrated system for crop-fish-livestock farming to ensure maximum possible utilisation of land and water areas during all seasons towards raising the living standards of coastal rural community.

Strong information base

As one of its major objectives, the Institute collects, compiles and disseminates all-India marine fish production data based on an internationally accepted sampling system; the major traditional marine fisheries have been studied intensively; new fishing grounds and resources have been explored and charted; and stress has been given to oceanographic investigations for obtaining synoptic pictures of environmental parameters that influence distribution and seasonal abundance of various fisheries.

In recent years, several breakthroughs have been achieved in the culture of finfishes, prawns, oysters, pearl oyster, mussels and seaweeds. The Institute has developed economically viable technologies for mariculture which are easy for adoption by fishermen, small farmers and coastal rural population.

The sustained research development activities of the Institute over the past three decades have resulted in building up a strong information base and this is contained in the numerous publications of the Institute, which may be listed as follows (Total Numbers/Volumes issued so far are indicated in paranthesis):

1. Indian Journal of Fisheries - Official Journal of the Institute of fishes (24)
2. CMFRI Bulletin - On Major groups/such as oil-sardine, mackerel, prawns, Bombay-duck and on exploratory fishing, primary productivity, exploited fishery resources, mussel farming, etc. (29)
3. Special publication-on selected topics of interests (6)
4. Marine Fisheries Information Service - Technical and Extension series (22)
5. CMFRI News letter (10)
6. Extension pamphlets - on various technologies (24)
7. Annual Reports and other special scientific reports on sponsored projects (15)
8. Proceedings on Symposia and Seminars
9. Monthly exploited fishery data provided to all State governments and Industry.
10. Scientific and technical papers in Journals published in India and abroad (1600)
11. Proceedings of Summer Institute, Workshops, Training Programmes etc.

12. Krishi Vigyan Patrika - Mariculture series (English & Malayalam) (6)

Transfer of technology

In order to demonstrate the techno-economic feasibility of coastal aquaculture/seafarming and on aspects of small scale capture fisheries, the CMFRI has taken up a number of projects on technology transfer. These programmes are profitably utilised by maritime States, Universities, development agencies, the industry and individual fish farmers. These may be briefly mentioned as follows:

Operational Research Project

The Institute has taken up an Operational Research Project on 'Blending sea farming with traditional capture fisheries' at Kovalam, a fishing village near Madras. This village has 175 families comprising 975 fishermen. The objectives of the project are to train the fishermen in the methods of mariculture of fishes, prawns, and molluscs so that these could be undertaken along with traditional capture fisheries. This has created among the fishermen of the village, a sense of involvement and participation in the sea farming techniques evolved by the CMFRI and has demonstrated the scope for overall improvement of socio-economic conditions of the area. The Integrated approach to blend culture fisheries with capture fisheries for rural development is a new concept in marine fisheries sector in the country.

Demonstration projects

After having developed appropriate technologies in the culture of various species, the techno-economic viability of intensive culture is demonstrated to interested fish farmers and entrepreneurs through the following demonstration projects:

1. Demonstration Project on pearl culture at Tuticorin.
2. Demonstration Project on edible oyster culture at Tuticorin.
3. Demonstration Project on mussel culture at Calicut.
4. Demonstration Project on seaweed culture at Mandapam.
5. Demonstration Project on intensive prawn culture at Cochin.

Pilot Projects

The Institute has rendered technical assistance to the Government of Kerala in organising and implementing a pilot project on pearl culture.

Sponsored Projects

CMFRI undertakes sponsored projects funded by private and public sector agencies. A Sponsored Project on "Elver resources survey and eel culture" and another on "Assessment of fry resource of cultivable penaeid prawns at selected centres in Kerala and Karnataka", both financed by the Marine Products Export Development Authority have been implemented. During 1978-79 the Institute was participating in the Co-operative Intensive Prawn Farming project jointly undertaken by Kerala Government, MPEDA and CMFRI. This project was intended to demonstrate the economic viability of intensive prawn culture to the industry and fish farmers in the Ernakulam District.

Inter-Institutional Projects

The Institute maintains close liaison, co-ordination and co-operation with other institutes in the ICAR, Government of India and other organisations in implementing its research programmes

as well as extension programmes. The following are the inter-institutional projects undertaken:

1. Fish and prawn feed development for intensive culture - This is being implemented at Cochin (with CIET).
2. Product development and quality control of molluscan product at Cochin and other centres (with CIET).
3. Operation of conventional and experimental Dol nets being implemented at Bombay and Veraval (with CIET).
4. Improvements in gear and methods of lobster fishing being implemented at Cochin, Mutton and Tikoli (with CIET).
5. Economics of marine fisheries in the Calicut area (with IASRI) has been undertaken. This project will suggest ways and means to improve the socio-economic condition of coastal fishermen and rural community and also study the impact of changing fishing pattern in the area.

Lab-to-Land Programme

The Lab-to-Land programme organised by the ICAR during the Golden Jubilee Year was implemented at the Institute's level from the beginning of 1979. The appropriate technologies developed by the Institute on various aspects of coastal aquaculture were considered ideal for transfer to the fishermen and farmers in the coastal sector. During 1979, 302 families were involved under this programme as follows:

- 122 families of the Harijan Society at Valappu, Ernakulam District for intensive prawn culture.
- 15 families of marginal farmers in Quilon District for prawn and fish culture.

30 fishermen families selected at Elathur for mussel farming.
15 fishermen families for oyster culture at Tuticorin.
20 fishermen families at Mandapam for seaweed culture.
50 Harijan families at Muttukkad for prawn culture.
50 fishermen families for mussel culture at Karikkattukuppam.

All the farmers were trained in scientific farming methods and respective technologies in a phased manner. Critical inputs are provided by the ICAR and the scientists of the Institute are providing technical assistance.

As a mid-term appraisal a workshop was organised in July 1979 and the farmers provided much needed feed-back information, discussed the constraints and problems and future course of action.

Training programmes

One of the objectives of the Institute is to effect transfer of technology through various training programmes organised at different levels. Training is imparted in the undermentioned areas of specialisation to candidates sponsored by maritime State Fisheries Departments, Agricultural Universities, developmental agencies such as the MPEDA and those from abroad sponsored through Government of India.

1. Training in marine prawn culture

This programme is usually conducted at Cochin and training is given on various aspects of prawn culture such as identification of larvae, post-larvae and juveniles of commercially important prawns, collection of spawners, breeding, rearing, stocking methods, scientific methods of prawn culture, etc. The course includes group discussion, field and practical

work besides lectures and demonstrations. Besides this, ad hoc training in prawn culture is given to students, in-service personnel, and staff of other organisations who require such training. During 1978 and 1979 about 50 officers have been trained which included two from abroad.

2. Training in pearl culture

A long-term trainer's training course of six months duration intended for officers from maritime State Fisheries Departments and a short-term course of 6 weeks duration in specific field of pearl culture intended for operative personnel are conducted at Tuticorin. About 10 candidates are trained in each batch. The officers trained in these courses are now working in pearl culture projects in Kerala, Tamil Nadu and Gujarat.

3. Training in edible oyster culture

The main thrust of this training programme is to transfer the technology of edible oyster culture to small scale and marginal farmers so as to propagate this field among them. Adhoc training course in edible oyster culture is also given to batches of students from Universities and Agricultural universities.

4. Training in under-water diving by SCUBA

Under-water investigation through diving with SCUBA received considerable importance as a result of the pioneering work done by the scientists of CMFRI during the survey of pearl oyster and chank resources off Tuticorin. Under this training programme scientists are educated on the principles and methodology of SCUBA diving and on methods of underwater survey of resources. Practical training is given on swimming, snorkeling and use of self-contained underwater breathing apparatus.

5. Training in fishery resource assessment and population dynamics

This is an important training programme in capture fisheries and the course of 6 weeks duration involves lectures and practical training on sampling techniques, statistical methods involved in processing and analysis of data and population dynamics for the assessment of fish stocks. The course is conducted at Cochin and usually about 12 candidates drawn from maritime States and Agricultural universities are trained each year.

Krishi Vigyan Kendra

The Krishi Vigyan Kendra for mariculture was established in 1976 at Narakkal and it is designed and devoted to impart need-based and skill oriented vocational training to fish farmers who intend to go for self employment. The KVK disseminates technical knowhow developed at the CMFRI on the culture of marine prawns, fishes and molluscs, ensuring a ready and regular flow of scientific and technical information from the laboratory to farmers. The duration of training to each batch ranges from 5 days to one month. So far 914 persons have been trained, which include 262 farm women and 303 members belonging to the Scheduled caste. Some of the trainees have taken up prawn culture in their own fields or derelict waters. The farm women who have been trained are now engaged in collecting prawn seed from the wild, thus utilising their spare time profitably. The KVK also organises mobile training programmes at other centres depending on the demands and needs of the fish farmers.

Centre of Advanced Studies in Mariculture

The Centre of Advanced Studies in Mariculture was

instituted at the CMFRI, sponsored by ICAR/FAO/UNDP. The main objective of the Centre is to catalyse research and education in mariculture for augmenting the fish production of the country. The objective would be accomplished by providing adequate facilities to carry out research of excellence in mariculture, improving quality of post-graduate education, enhancing competence of professional staff, developing linkages and collaboration with other institutions in the country and organising seminars and workshops.

The first batch of 10 M.Sc. students and 4 Ph.D. scholars are attending the regular courses from the middle of 1980.

Consultancy service

The Institute is regularly approached by small farmers, fish culturists, industry, development agencies and Government departments for consultancy on various aspects of capture fisheries, culture fisheries and environmental problems. In capture fisheries, it is usually on matters relating to introduction of large mechanised vessels, location of fishing ground, production and seasonal species composition, new resources that could be profitably exploited, economics of fisheries operation etc. On culture fisheries consultancy is rendered on suitability of areas or selection of sites for farming, farm lay-out and construction, farming methods and the economic viability of such operations. The industries which pose environmental problems consult the Institute for pollution monitoring and pollution control measures.

Education

Although research programmes of the Institute are mostly of an applied nature, basic research on complementary aspects of

capture and culture fisheries are also carried out mainly through research scholars and fellows who do post-graduate work. The Institute has been recognised by many universities as a centre of post-graduate research leading to M.Sc. and Ph.D. Degrees. Many of the scientists hold Ph.D. Degree and have been recognised as guides or supervisors of students carrying out research for Ph.D. degree.

The scientists also serve as members of advisory committee, panels, board of studies etc. of many universities and also take classes for M.Sc. and Ph.D. students in respective departments of the universities.

Towards transfer of technology at higher levels the institute conducts periodically Summer Institutes on important subject areas such as Coastal Aquaculture, Breeding and rearing of marine prawns, and culture of edible molluscs. The teaching staff in Universities and colleges are much benefited by this level of training to update and improve their knowledge.

Publicity

In order to publicise and project the technologies developed by the Institute and also its activities, various publicity media are utilised.

Popular articles on farm oriented research highlights are regularly written in different languages in leading newspapers and magazines in the country. The scientists of the Institute are invited by the different stations of All India Radio to give talks on recent technologies developed by the Institute and which are of immediate benefit to the farmers or fishermen.

The scientists participate in programmes such as rural science gathering organised by All India Radio. The Institute's activities are also projected in the T.V. programmes.

The Film Division, Government of India has taken a number of documentary and feature films on the technologies developed by the Institute. These are being exhibited throughout the country.

The Institute has regularly participated in Exhibitions, "Open House", and Fairs organised at All-India, State and Municipal levels or by individual Institutions. The Institute also organises Farmers' Day and Kisan Melas for the benefit of the farming community.

Facilities for training of Extension personnel

The Institute has well developed laboratory facilities at its headquarters in Cochin and in the various Research Centres. Field laboratories and farms have been developed at Cochin, Mandapam, Calicut, Tuticorin and Madras and similar facilities are being developed at other centres as well. The Institute has an excellent library with a present holding of over 50,000 volumes and periodicals. Part of the main library is housed at Mandapam Camp where the main Museum and marine aquarium are also located.

The Institute has acquired a sophisticated 107' Research Vessel for carrying out all types of fishery investigations in the seas around India. Other physical facilities such as smaller vessels, conveyance, and audiovisual equipments have been adequately developed.

The Institute has also proposed a Trainers Training Centre (TTC) in the Sixth Plan and will be an organised facility for training the trainers and extension personnel.

For a massive transfer of technology to artisanal and farming community in a proper manner the Institute has proposed a full fledged Extension and Fishery Economics Division during the Sixth Plan period. The proposed Division will have adequate scientific and technical staff and will be provided with all physical and equipment facilities for carrying out extension work.

Low-cost technologies for the small fisherman

The various technologies developed by the Institute have been outlined in the earlier paragraphs. Conscious of the fact that most of the fishermen and small farmers live below the poverty line in spite of various development plans in the marine fisheries sector and also bearing in mind the inherent conflicts between the fishermen in the artisanal Sector and those of the mechanised fishing sector, the Institute has strived to develop appropriate low-cost technologies for coastal aquaculture. These could be profitably undertaken by the fishermen along with the traditional capture fishery as evidenced in the progress of the Operational Research Project being implemented at Madras. This helps them to utilise the spare time and augment their income for improving their economic status.

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