

# **RESEARCH ACHIEVEMENTS AND ACTIVITIES**

**CENTRAL MARINE FISHERIES RESEARCH INSTITUTE  
INDIAN COUNCIL OF AGRICULTURAL RESEARCH  
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## CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN

### ACHIEVEMENTS AND ACTIVITIES

The increasing demands of the growing human population for high quality animal protein food have attracted substantial interest in the sea as a source of food. Advances in marine science have indicated the great scope and prospects of production of drugs, pharmaceutical compounds and bioactive material from the marine organisms to serve man and to meet his vital needs. Besides, the expansion of our jurisdictional limit to 200 mile Exclusive Economic Zone to explore, exploit, protect and preserve the living and the non-living resources in our seas has thrown up great challenges in the ocean resource utilisation and management.

The Central Marine Fisheries Research Institute (CMFRI), since its inception (1947), has been devoting to research, education, training and transfer of technologies in support of development of the marine fisheries of the country. During the first two decades after independence of the country, when the marine fishing activity witnessed mechanisation and use of improved gears for harvesting the resources, the Institute focussed its attention to back up this development process through investigation on the life history of commercially important finfishes and shellfishes and on the fishery and production trends. In the next two decades the fishing in the inshore waters was intensified and extended to deeper waters of the inner half of the continental shelf and the Institute's research strategy was directed to study the population dynamics of the fishery constituting species, their characteristics influencing the yield capacities, understanding their adaptive parameters vis-a-vis the ecosystem and gathering information on deep-sea resources to support the development of deep-sea fishing in the country. It was also involved in developing technologies for culture of shellfishes and finfishes to augment the production.

Presently, the mandate of the Institute is to:

- conduct researches on the exploited marine fishery resources aiming at stock assessment, management and conservation,
- assess the under and unexploited marine fishery resources of the EEZ,

- understand the influence of variations in the environment on the availability/abundance of fish stocks.
- study the coastal ecology with reference to pollution and endangered ecosystems,
- develop suitable technologies for sea-farming of finfish, shellfish and other cultivable marine organisms,
- study the techno-economics of fishing and seafarming operations and related social aspects,
- conduct postgraduate teaching programmes leading to M.Sc. (Mariculture) and Ph.D degrees, and
- transfer technologies developed; to take up extension education and specialised training programmes and to undertake consultancy services.

To accomplish the above mandate, the Institute conducts researches on characteristics of exploited marine fish stocks; develops seafarming techniques; carries out exploratory surveys and assesses under and unexploited resources and undertakes to integrate the fluctuations of marine fish production with environmental characteristics and sea-dynamics. Besides, the Institute collects marine fisheries statistics and makes estimation of species-wise landings and monitors the landings on a continual basis from all along the country's coastline. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

To be able to effectively carry out these tasks, the Institute has set up a Regional Centre at Mandapam Camp and Research Centres at Minicoy, Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Kakinada and Visakhapatnam and 28 Field Centres. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities including computers and research vessels for carrying out research programmes and has been upgrading the same to meet the changing and additional requirements. The sanctioned staff strength of the Institute is: Scientists 200, Technical 445, Ministerial 172, Supporting 296 and Auxiliary 39.

## ACHIEVEMENTS AND RESEARCH ACTIVITIES OF THE INSTITUTE

### CAPTURE FISHERIES

#### Fishery Resources Assessment

One of the primary tasks of the Institute since its inception has been the assessment and monitoring of exploited fisheries on an all-India basis, to furnish estimates of marine fish production on region-wise, statewide, seasonwise and groupwise basis to help development, rational exploitation and management. For this purpose, the Institute has evolved a Stratified Multi-Stage Random Sampling Design which has been acclaimed by the FAO and recommended for adoption in other developing countries.

As recommended by the Planning Commission, the Institute has developed a National Marine Living Resources Data Centre (NMLRDC) with computer facilities for collection and dissemination of all living resources data with related oceanographic and other parameters. Suitable software packages numbering over 60 have been developed for processing and analysis of various data including statistical software for research workers.

Among the pelagic resources, stock assessment studies were made and MSY levels for resources such as oil sardine, mackerel, Bombay duck, tunas and anchovies were estimated and the resources which are likely to yield further production were pointed out. The tuna resources both in the coastal waters and in oceanic regions were studied in detail. The Institute organised a National Tuna Conference in 1989.

Stock position, and the exploitation pattern of different demersal resources such as sciaenids, pink perch, elasmobranchs, silver bellies, flat fishes and goat fishes in the coastal areas upto 50-70 m depth have been studied. The resources which would yield additional quantities and the areas have been indicated. Attention has been drawn to the decline in the catches of certain resources such as cat fish, "Ghol", "Koth", "Wam" etc. and the possible reasons for the same.

The prawn fisheries in the inshore areas have been closely monitored. The impact of increasing fishing pressure, night trawling, reduction of mesh size and government regulations such as ban on trawling have been studied in detail with reference to the major shrimp stocks. The prawn fishery by large trawlers in the northeast coast has been closely monitored and it has been suggested that further introduction of large trawlers in the region would lead to overfishing. Similarly, in the traditional sector also the impact of operation of mini purse seines, trammel nets and mini trawlers on shrimp resources have been critically assessed.

The economics of operation of different craft and gear combination in both mechanised and non-mechanised sectors from different centres along the coast have been studied and the major parameters influencing the cost-benefit aspect of these operations have been identified.

Hydrographic, primary and secondary production levels are continuously monitored from different Centres in the inshore areas to understand the possible relationship between fluctuations in the availability or abundance of fish stocks and the environmental characteristics.

#### Management of exploited fishery resources

Researches at the Institute have revealed that exploitation of fisheries resources in the 0-50 m zone has reached the optimum level (2.2 million tonnes per annum) and the research needs in this situation are essential to address the fishery dependent and fishery independent factors for suggesting viable management measures. For further increase of production from this zone, the imperative need to diversify the fishing activities to the underexploited resources such as anchovies, carangids, ribbon fishes, tunas, billfishes, pelagic sharks, perches, threadfin breams, prawns and crabs, squids and cuttlefishes has been suggested. Setting priorities, the research efforts are on:

- intensifying studies on biological and population characteristics; behavioural and interactive modes of multispecies; bioeconomic and bioecological modelling for stock assessment and estimation of total allowable catch from different zones;

- studying the biotic and abiotic factors responsible for fluctuations in abundance and their relationship leading to predictive-model proposition;
- application of remote sensing data to forecast Potential Fishing Zones and their verification;
- studies on economics of operation of fishing units and socio-economics of fishermen communities.

#### Exploitation of fishery resources of the EEZ beyond 100 m

The revalidation of potential fishery resources in the EEZ has indicated that out of 3.9 million tonnes of estimated fishery resources, about 2.2 million tonnes are available from the inshore waters upto 50 m and about 1.7 million tonnes in the rest of EEZ. While the inshore region has been exploited at near optimum levels the region beyond 50 m depth is virtually unexploited or underexploited.

The estimated potential of major resources in this zone are 7,42,000t of pelagic resources of which 4,01,000t is from 50-100 m and rest from 100-200 m. Among the four major regions of India, S.W. coast accounts for the highest potential of 245,000 t, N.W. coast 161,000 t, SE coast 61,000t and NE coast only 46,000 t. In the seas around Lakshadweep, the estimated potential is 63,000t and that of Andaman Nicobar Island 139,000 t. Important groups are anchovies, carangids, ribbon-fishes, tunas and pelagic sharks. Anchovies is a promising resource especially from the Gulf of Mannar. An additional 200,000t of carangids are expected to be harvested from the southwest coast, off Gujarat and N.E. coast. Tunas and related species have a potential of 100,000t in Andaman Nicobar Islands, 50,000t in Lakshadweep sea and 50,000t along mainland coast. Pelagic sharks have a potential of 15,000t off N.W. coast and 29,000t off S.W. coasts.

The potential yield of demersal fish resources is 6,25,100t from 50-200 m depth zone of which N.W. coast accounts for 3,78,600 t; NE coast 1,17,400 t; SW coast 92,300t and SE coast 36,800 t. Threadfin breams are most dominant with the bulk of the potential along NW, SW, Wadge Bank and NE coasts. In catfishes, the maximum potential is along

the NW, SW and NE coasts. Elasmobranchs are in abundance mainly off the NW coast. Bull's eye (Priacanthus spp.) can be tapped mostly along the west coast. Other resources are perches, croakers, lizard fishes, deep sea prawns and lobsters. Non-conventional resources such as Indian drift fish, black ruff, green eye and a variety of lantern fishes are yet to be exploited.

The development of deep-sea fishing for the exploitation of these resources has not so far been successful due to several constraints, one among them being inadequate information on quality and quantity of resources, their availability and abundance in space and time and economics of deep-sea fishing operation/business.

The research activities on these resources in the region would be directed to:

- understand the variations in availability and abundance of different pelagic and demersal resources
- estimate of stock sizes of above resources
- study the influence of oceanographic parameters on the availability and abundance of the above resources
- study the economic feasibility of different types of deep-sea/oceanic fishing and
- determine the management strategies.

#### Fisheries of the Island ecosystem

The Island ecosystems of Lakshadweep and Andaman-Nicobar enjoy special status in the EEZ because of significant fishery resources in the oceanic areas surrounding the islands. However, judicious exploitation of the resources without adverse effects on the ecosystem requires identification and quantification of the resources, exploitation strategy, infrastructure development and information on economic aspects. The island ecosystem also offers good scope for seafarming and sea ranching of several commercial marine organisms.

The thrust of research towards these are:

- monitoring and assessment of resources including tuna resources around the Islands;

- studying the impact of different fishing techniques such as pole and line fishing, long lining, purse-seining and drift gill netting;
- economics of operation of various types of fishing and for different resources;
- studies on the resource characteristics of tuna live baits in the lagoon and reef front and assessment of their stocks;
- assessment of ornamental fish resources;
- studies on mariculture of seaweeds, sea cucumbers and molluscs;
- sea ranching of pearl oysters, gastropods and other species of economical importance.

#### Participation of the Institute in the FORV Sagar Sampada cruises

Data on biological and non-biological characteristics in the EEZ of India were collected regularly in the cruises of Sagar Sampada numbering to over 108. Six dedicated cruises were completed in the eastern Arabian Sea for studying seasonal changes in the biological productivity and related oceanographic parameters in each 1° square area. So far 2880 stations were covered during the cruises of this vessel. Detailed studies were made on zooplankton biomass and component groups. The results of the various studies carried out onboard Sagar Sampada cruises were presented and discussed in the two National Workshops organised and conducted by the Institute in 1989 and 1994 at Cochin. The proceedings of the first Workshop was also published.

#### Conservation of marine resources and ecosystems

The Institute has always laid great emphasis on the conservation of resources, maintenance of ecological processes, preservation of biodiversity and sustained utilisation of resources. It has noted the non-judicious exploitation of resources by selective and destructive gears, exploitation of spawning population and young fishes beyond certain limits, destruction of non-edible faunal components in the fishing grounds; degradation of coastal habitats and fragile ecosystems such as coral reefs and mangroves. The Institute has therefore taken up mission-oriented investigations to assess the qualitative and quantitative composition of the resources that warrant conservation, protection and to suggest measures relevant to the species, region/state.



### Coastal zone management

The coastal zone forms an important base for artisanal, small-scale and other types of fishing. It also serves as a base for coastal aquaculture and several other agro-industrial activities. The multiple use of this zone, different development activities, human habitation and settlement often come into conflict and make it sensitive. In recent years, increasing pollution causes considerable environmental and ecological degradation in the zone. A comprehensive and integrated plan of management of the zone on the basis of reliable information on consolidation of all information and data collected so far on ecological parameters and resources in coastal water bodies, estuaries and lagoon systems; surveys on flora and fauna of coastal zone for evaluating biodiversity and conservation needs and the pollution and their effect on the resources and ecosystem is receiving the attention of the Institute.

### MARICULTURE

In order to augment production of finfishes and shellfishes through mariculture the Institute took up experimental studies since early 70s for the development of low cost technologies for the culture of marine prawns, edible oyster, pearl oyster, mussels, clams and seaweeds. Under the mariculture research programmes, emphasis has been given to perfect and standardise the technologies particularly those relating to brood stock development and induced maturation, hatchery production of seed, enhancement of per hectare unit production, propagation of techniques in different ecosystems along the coast and on transfer of technology.

Success has been achieved in induced maturation and repeated spawning of Penaeus semisulcatus and on the transporting of nauplii of P. indicus to long distances. Sea ranching of P. semisulcatus at Mandapam has shown that this species is able to survive and get recruited in the commercial fishing within about 2 months period.

The Institute has succeeded in producing seed of Meretrix meretrix, M. casta, Anadara granosa and Paphia malabarica. The techniques of hatchery production of pearl oyster and edible oyster seed

were standardised and seed produced at Tuticorin hatcheries are being supplied to State Fisheries Departments and other agencies. Under the programme of technology upgradation, location testing and transfer of technology, pearl culture was carried out at Valinokkam Bay in Tamil Nadu and a total of 1849 pearls were produced.

For the first time in the country the Institute has succeeded in breeding and rearing of two species of sea cucumbers (Holothuria spp.) under controlled conditions, which are in great demand in the export market. The hatchery technique developed has enabled to sea ranch the young ones of these animals for increasing the natural population.

Seaweed culture work has been standardised at Mandapam and now it has been extended to Minicoy and other Lakshadweep islands. Mass culture of phytoflagellates has been perfected to meet the larval feed requirement at Tuticorin hatchery.

Basic studies on the physiology, reproductive physiology, endocrinology, nutrition and cryopreservation of gametes were carried out on the candidate species on which the Institute is developing the culture technologies. The investigations on nutrition of P. indicus have lead to the formulation of a commercial compounded feed, which has been taken up by the small scale fisherwomen for commercial production and supply.

## EDUCATION, TRAINING AND TRANSFER OF TECHNOLOGY

### Education

Under the Postgraduate programme in Mariculture the Institute organises M.Sc. and Ph.D programmes. Since 1980 a total of 62 M.Sc. and 31 Ph.Ds were produced under the educational programmes. The students who completed the courses under the programme are now engaged in the private/public sector undertakings and in the research/teaching institutes promoting mariculture in the country. So far these programmes were affiliated to the Cochin University of Science and Technology and recently they were transferred to the Central Institute of Fisheries Education, Bombay - a deemed University in Fisheries under the ICAR.

### Training programmes

Recognising the crucial role of training in marine fisheries development and transfer of technologies, the CMFRI has been offering need-based training within the purview of the Institute's mandate. The training programmes include subjects such as Fisheries Statistics and Population Dynamics, Hatchery Production of Prawn seed, SCUBA Diving and Seaweed Culture. An International Training on Pearl Oyster Farming and Pearl Culture sponsored by FAO/UNDP Regional Seafarming Development and Demonstration Project, NACA was conducted at the Tuticorin Research Centre during 1991.

In addition to the above, the Krishi Vigyan Kendra (KVK) and Trainers' Training Centre (TTC) also impart training in Mariculture and integrated farming to the targetted groups. Since 1989 KVK conducted 452 courses and 866 fishermen and 3919 fisherwomen participated. Among them about 30% belonged to the SC/ST.

### Transfer of Technology

Realising the importance of Transfer of Technology to the fish farmers and entrepreneurs the Institute took actions to demonstrate the technologies in respect of hatchery production of penaeid prawn seed, pearl culture and pearl production, edible oyster culture and seaweed culture. In these demonstrations, local fishermen and fisherwomen were actively involved.

Under a tripartite venture among CMFRI, MPEDA and MATSYAFED setting up of a shrimp hatchery at Mopla Bay in Kannur, Kerala was taken up. The hatchery was designed to produce 8 million post-larvae of the white prawn and commissioned in October 1990. Since its establishment, the hatchery has been regularly producing seed and meeting the local requirements.

Under upgradation, location testing and transfer of technology programme a pearl culture programme with the full involvement of local fishermen has been carried out at Valinokkam Bay, a coastal village in Tamilnadu. The fishermen taken in the project have been exposed to all activities of pearl culture.

On the request of the Tamil Nadu Fisheries Development Corporation, the Institute supplied 2,22,500 pearl oyster spat raised in Tuticorin shellfish hatchery of the Institute at a production cost of Rs.4/- per 100 spat.

A pilot-scale project for edible oyster culture was taken up with the involvement and partial funding by NABARD. Demonstration of different aspects of oyster culture, an exhibition, and a group discussion on shellfish farming, processing and marketing were organised in connection with the first Edible Oyster Harvest Mela held at Tuticorin. The cultured edible oyster amounting to 17 tonnes shell on weight were harvested from the Institute's farm and were supplied to the Integrated Fisheries Project at Rs.30/- per kg of meat.

Recognising that fisherwomenfolk play a crucial role in fisheries development and Transfer of Technology, CMFRI initiated an active programme in marine prawn farming for rural women of South Chellanam Village in Ernakulam District, Kerala. A society formed exclusively by fisherwomen was helped to set up a small scale industry for prawn feed production with bank loan. Women were trained in entrepreneurship development and group concept in technology adoption. Evaluation of the impact of this programme indicated improvement in income generation and empowerment qualities of programme participants.

Under the TRYSEM programme of the Government, 30 women in Ramanathapuram district of Tamil Nadu were given training for three months in seaweed identification and recipes preparation in collaboration with the Centre for women in Agriculture and Rural Development.

### **Sponsored Projects**

In addition to the Research Projects of the Institute financed by the ICAR, certain projects which are included in the priority areas are sponsored by other organisations with financial support. These projects are supplementary and complementary to the Institute's research programmes and help accelerate generation of new technologies or perfect the technologies already developed or their transfer to the field. The following sponsored projects are now progressing at the Institute.

- Pilot project on oyster culture - partially funded by NABARD
- Remote sensing applications in marine fisheries - funded by DOD
- Survey and assessment of marine ornamental fishes of Lakshadweep - funded by Department of Agriculture, Govt. of India
- Intensive seed production and sea ranching of sea cucumbers - funded by MPEDA
- Hatchery production of clam and ranching them in coastal waters - funded by MPEDA
- Genetic studies on marine penaeid prawns - funded by USIF
- Studies on the Biology and sea ranching of the sacred chank, Xancus pyrum with special reference to the protection of species in the Marine National Park of Gulf of Mannar - funded by Ministry of Environment & Forests, and
- Studies on mangrove ecosystem of Gulf of Mannar islands and their impact on larval recruitment of economically useful fishes and prawns - funded by Ministry of Environment & Forests.

#### PUBLICATIONS

The research results of the various projects carried out at the Institute are published in the National and International Scientific Journals and in the proceedings of the symposia/workshop/seminars. In addition to these the Institute has brought out the following publications:

1. Marine Fisheries Information Service, Technical and Extension Series - 133 Nos. issued
2. CMFRI Bulletin - 47 Nos. issued
3. CMFRI Special Publications - 60 Nos. issued
4. Proceedings of the First Workshop on the Scientific Results of FORV Sagar Sampada 5-7 June 1989, Cochin
5. Proceedings of the Second Workshop on Scientific Results of FORV Sagar Sampada 15-17 February 1994, Cochin - Abstracts.

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN

Fisherwomen's Empowerment in Chellanam Village, Ernakulam District

The Central Marine Fisheries Research Institute has successfully implemented the concepts of empowerment in the transfer of technology programmes in Chellanam fishing village, Cochin. The programmes are channelised through functional groups such as "Matsyamahilavedi" and "Chemeen Karshakavedi" organised under the programme with a view to securing people's participation for sustainable development.

Programmes implemented

I. Entrepreneurship development based on fisheries technologies

	<u>No. of women</u>
Prawn farming	8
On-farm prawn feed production	5
Fishing net making	30

II. Demonstration of group action in prawn farming

Total area	90 acres
No. of farmers	40

III. Training for self-employment

	<u>No. of farmers</u>
Prawn farming	150
Prawn feed production	50
Poultry	20
Mushroom cultivation	5
SC/ST trained in the above programmes	45

IV. Other activities

Training for peeling shed workers	- 25 women
Poultry	- 20 households
Smokeless chulas	- 100 "
Balwadi	- 25 children
Awareness campaigns	- 200 persons
Medical camps	- 200 "
Nutrition & Health education	- 100 "