

# CMFRI - India's premier facility in marine fisheries research



The Central Marine Fisheries Research Institute (CMFRI), the largest of India's eight national fisheries research institutes, assists and advises policy-makers in fisheries governance and in sustaining marine fish production. Six decades of R & D in marine fisheries by CMFRI have led to impact on many fronts.

The Institute began in Madras (Chennai) on 3 February 1947. It was known initially as the Central Marine Fisheries Research Station. It was shifted to Mandapam Camp in southern Tamil Nadu in September 1949 and finally to its present headquarters in Kochi, Kerala, in July 1971.

CMFRI has three regional centres (Mandapam, Veraval and Visakhapatnam) and seven research centres (Mumbai, Mangalore, Karwar, Kozhikode, Vizhinjam, Tuticorin and Chennai) with 10 research divisions and a total sanctioned staff strength of 938 (scientific 189, technical 330 administrative 150, supporting 263 and auxiliary 6). The Institute currently has 111 scientists, 306 technical hands, 142 administrative staff and 225 supporting staff.

### CMFRI's Mandate

- To undertake basic, strategic and applied research in marine fisheries and mariculture.
- To monitor and assess the fisheries resources of the Exclusive Economic Zone (EEZ) and to understand the stock and its dynamics in relation to environmental and human interventions.
- To develop and commercialize hatchery and production system



*Headquarters of the CMFRI at Kochi.*

### Prof Mohan Joseph Modayil, Director, CMFRI, Kochi

Prof Mohan Joseph Modayil took over as Director of CMFRI in 2000. He was earlier Professor and Head of the Department of Fisheries Resources Management at the College of Fisheries, Mangalore where he served for 30 years. He holds a first class M Sc degree in Marine Biology and Fisheries, a Ph D in Bioscience, and a D Sc in Aquatic Biology and Fisheries.



Prof. Modayil has served in many capacities in India and abroad. Development research being his passion, he was co-coordinator of many international projects sponsored by the UK's ODA (later DFID) and the IDRC in India and Thailand, Philippines, Malaysia, West Indies. He was also as a consultant for IFRTO in the Islamic Republic of Iran.

During the past seven years, Prof Modayil has been instrumental in modernizing the infrastructure of the Institute at its headquarters and at its 10 research centers. He has served on many national committees of the Ministry of Agriculture, and the Ministry of Environment & Forests. He is an elected fellow of the Zoological Society of London and an International Council Member of the Asian Fisheries Society, Philippines. He has to his credit more than 100 scientific publications in national and international journals and has edited 12 books. He can be contacted at [mohanjosephmodayil@gmail.com](mailto:mohanjosephmodayil@gmail.com).

technologies for finfish, shellfish and other commercial marine organisms in coastal and open seas.

- To build up a database on marine biodiversity, and carry out research on fragile marine ecosystems for their conservation and restoration.
- To undertake research on utilization of potentially beneficial marine organisms.
- To act as a repository of information on marine fishery resources with a systematic and analytical database for policy interventions and to carry out research on the social and economic costs and benefits of marine fisheries.
- To conduct front line demonstrations and training to develop human resources for R&D in capture fisheries and mariculture.
- To create awareness and provide training and consultancy services.

#### **Facilities**

The headquarters has a **modern library** that conforms to international standards and practices, with subscriptions to over 400 journals and periodicals, and 14 Internet cubicles. **The Marine Biodiversity Museum** at the headquarters showcases the unique biodiversity of marine life in the Indian coastal region. It is one of the largest of its kind in Asia with over 1 500 exhibits exclusive to the Indian seas. Its collection of hard corals from Indian waters and ascidians is unique.

**A central laboratory** was established in 2006 at the headquarters. It uses the latest equipment — such as a bomb calorimeter, automatic tissue processor, refrigerated microtome, trace metal analyzer, ultra freezer, refrigerated centrifuges, spectrophotometers, cryostat microscopes, etc. **An aquarium** with 40 species of ornamental fishes collected from different parts of the



*The CMFRI Museum (above and below).*



country has been established at the headquarters. CMFRI is the pioneer in developing breeding technologies for marine ornamental fishes.

The marine fish farms of the Institute are located at the following places:

**Mandapam Camp:** A fish farm of 3.8 ha area and a lagoon of 227 ha are available for mariculture activities.

**Tuticorin:** A fish farm with a water spread of 2.5 ha.

**Narakkal:** The 4 ha *Krish Vigyan Kendra* (KVK) Campus at Narakkal has four shrimp farm ponds each of 0.1 ha, besides an open wild watershed of about 2 ha.

**Chennai:** A shellfish hatchery functions in an area of 1.5 acres at Kovalam near Chennai.

**Calicut:** An area of 1.22 ha has been partly developed into a fish farm of five ponds, each of 0.25 ha. It is now being fully developed into a modern hatchery system of five broodstock ponds of various sizes and hatching & rearing facilities.

The wet laboratories and hatcheries facilities include onshore hatchery-cum-culture facilities at Visakhapatnam and Calicut. Three bivalve hatcheries have been set up at Tuticorin – one each for pearl oyster, edible oyster and clam – and a shrimp hatchery at Mandapam. A Marine Research Aquarium has also been commissioned in Calicut.

#### **Some recent achievements of CMFRI**

- Stock assessment, biodiversity and informed fisheries governance:**

- The Institute has developed, standardized and implemented the **Multistage Stratified Random Sampling Design** to estimate marine fish production along the Indian coast. District-wise, state-wise, gear-wise and species-wise production estimates have been made through this design continuously from 1947. It has developed and tested software for statistical analysis of marine fish landings. It has comprehensively studied the **highly migratory straddling stocks** of tunas and seerfishes. It has regularly monitored **marine pollution in coastal waters**, the hot spots of pollution and their effects on the marine ecosystem. The marine fisheries census 2005 conducted by CMFRI to **estimate fisherfolk population, craft, gear**, etc, serves as a database for policy-makers at the Center and the states.
- **Resources of sponges, corals and echinoderms** have been assessed. Evaluation of **genetic heterogeneity** in marine ornamental fishes like clown fishes and damsels is another achievement. In a pioneering study of the ornamental fish resources of Lakshadweep islands, 165 species were identified and the biology and stock of 40 species studied and documented in the publication “Marine Ornamental Fish resources of Lakshadweep”.
- **Optimum mesh size and fishing effort** have been determined for all major fisheries. Strategies for the conservation and management of overexploited, endangered and threatened stocks have been devised. **Potential fishing grounds** have been identified through onboard surveys in the EEZ of the country.
- Continuous monitoring of oceanographic parameters and estimation of **primary and secondary production in the**

**seas around India** led to charting on the abundance of the phytoplankton and zooplankton biomass and projection of potential yields.

- Communication tools for the Responsible Fisheries Extension Module (RFEM) have been designed, validated and disseminated.

#### b) Mariculture:

- **A breakthrough was achieved in captive breeding and hatchery production of slipper lobsters.**
- **A package of practices for culture of green mussel and edible oyster** was developed and commercialized.
- Packages of practices for **cultured marine pearl production** were developed and standardised. The Institute has for the first time developed a technology for land-based pearl production. Success has been achieved in producing large pearls of 5-8 mm size. A breakthrough has been achieved by developing a **tissue culture technology** for marine pearl production using the pearl oyster *Pinctada fucata* and abalone *Haliotis varia* for the **first time anywhere**. Technology for **sea ranching** of shrimp and molluscan seed produced in the hatcheries was developed and tested at Tuticorin and Mandapam.
- The Institute has achieved broodstock development, maturation, sex reversal, spawning, fertilisation and hatching of groupers such as *Epinephelus tauvina* and *E. polyphkadion*. Culture of seaweeds in open coastal waters has been successfully undertaken and its **feasibility demonstrated in the Gulf of Mannar**.
- The Institute has developed technologies for broodstock development, **breeding and larval rearing of marine**

**ornamental fishes such as the clownfish** (*Amphiprion chrysogaster*) and the one-spot damselfish *Chrysiptera unimaculata*. A second-generation seahorse (*Hippocampus kuda*) has been produced in captivity. The Institute has achieved a **breakthrough in the seed production and larval rearing** of the sea cucumber *Holothuria spinifera* which is in great demand for export.

#### c) Biotechnology:

The Institute has developed a quick and cost-effective **Duplex PCR Assay** to detect the White Spot Syndrome Virus. It has also developed a simple low-cost shrimp feed (*MAHIMA*) and facilitated the setting up of small-scale industrial units in central Kerala to manufacture the feed.

#### CMFRI's contributions

##### (i) Fish stocks assessment and resource management

The Institute has been continuously monitoring the status of fisheries exploitation as well as the ecological health of the stock. This is an enormous task considering that India has an EEZ of 2.02 million sq. km., 3 202 fishing villages and more than 3 000 fish landing centres spread across a coastline of 8 129 km; a multi-species, multi-gear fishery consisting of over 200 commercially important finfish and shellfish species; a fishing fleet comprising 58 911 mechanized boats, 75 591 motorised crafts and 10 4270 non-mechanised crafts; and over five million people who depend solely on fisheries for their livelihood, directly or indirectly.

CMFRI has been responsible for developing time-series databases on marine fish production from India's EEZ, as well as on biology, distribution, abundance, fishery forecasts of potential yield, stock assessment and management. The information thus generated has enabled management decisions by the Government. The Institute's exploratory surveys have helped

discover new and rich fishing grounds and paved the way for a vibrant seafood export industry. CMFRI can now explore deep-sea resources up to a depth of 400m along the southwest and southeast coasts.

The Institute has successfully addressed issues of ecosystem health, biodiversity conservation and coastal pollution. It has published stock estimates for nearly 50 species of finfishes. The potential estimate of marine fisheries resources in India has been revalidated to 3.934 million tonnes. The Institute's GPS-enabled database provides vital information on features of the ecosystem – such as biodiversity hotspots, threatened marine habitats, potential mariculture sites and pollution hotspots along the coast.

#### (ii) Transfer of technology

A number of public and private sector establishments in the country have relied on CMFRI know-how on environmental impact assessment, hatchery technologies, molecular diagnostics, and biotechnology. The Institute has so far earned Rs. 37 million through consultancy programmes.

Mariculture technologies developed by the Institute for the **culture of finfishes, pearls, mussels, clams, crabs, lobsters, sea cucumber, marine ornamental fishes, seaweeds** and other cultivable organisms in the sea have opened up avenues for entrepreneurship, higher production and more jobs. In the process, they have empowered women, improved the status of fisherfolk and stimulated fishing industry growth.

CMFRI has successfully developed and popularized hatchery technologies for commercially important marine organisms like prawns, crabs, lobsters, ornamental fishes, seaweeds and finfishes. The Institute has achieved a breakthrough in pearl oyster technology by developing a basic technique for tissue culture of pearl.

A global patent has been filed for this technology.

Culture of farmed mussels in the southwest coast has gone up from zero in 1996 to 10 000 tonnes in 2006-07, establishing the commercial viability of the technology. It is now getting immensely popular along the Malabar and Konkan coasts through self-help groups and entrepreneurs.

The Institute has pioneered the concept of open sea farming through cage culture technology. Finfish cages have been successfully launched along the east coast, ushering a new milestone in mariculture technology. Three more are being installed in Ratnagiri, Diu and Mandapam.

The Institute's dissemination of research knowledge during the last six decades has been impressive, with more than 5 000 research papers in international and national journals, 100 special publications, many information bulletins, brochures and newsletters, 53 volumes of the flagship *Indian Journal of Fisheries*, and 193 issues of the *Marine Fisheries Information Service* bulletin. The CMFRI website is regularly updated.

The Institute's HRD and outreach extension programmes have an enduring brand identity. The Agriculture Technology Information Centre helps fisherfolk with services and technologies. CMFRI training programmes in hatchery technologies and scuba diving (conducted on demand by regional research stations of the institute) are popular with fisherfolk. CMFRI assists HRD in fisheries through the post-graduate programme of the Central Institute of Fisheries Education.

#### (iii) Policies related to marine fisheries and mariculture

CMFRI assists the Government of India in formulating its marine fishing policy. The Institute recently examined the impact of the monsoon-fishing ban on behalf of

the Ministry of Agriculture. Multi-disciplinary researches in marine capture and culture fisheries have won it recognition as a premier institute.

#### *Major thrust areas of CMFRI in recent years*

**Marine Capture Fisheries:** Policy advisories for fisheries management; Short-term and long-term forecasts of fishery yields; Impact of gear on fished stocks; Trophic modelling of major marine ecosystems; Simulation of fishery yields and biomass under various scenarios; Application of remote sensing for fisheries forecasts on a GIS platform; Tag-recovery studies on straddling and migratory stocks; Impact adaptation and vulnerability of Indian marine fisheries to climate change; Impact of fisheries on biodiversity and quantification of biodiversity loss; Estimation of biomass of DSL and mesopelagics of the Indian seas; Creation of a marine biodiversity registry of the country; Rebuilding of vulnerable and overexploited stocks to the 1985 level by 2015.

**Mariculture:** Development/standardization of hatchery and farming technologies for potential marine shrimp species, lobsters, brachyuran crabs, king crabs and molluscs leading to commercialization; Development of technologies for seed production and farming of high-value species such as grouper, snapper, bream, and tunas; Open-sea cage farming of carnivorous marine fishes; Development of appropriate technologies for at least a dozen species of marine ornamental fishes of international commercial value and demand; Development/standardization of technologies for sea ranching of commercially important crustaceans, molluscs and sea cucumbers to augment natural stocks; Development of farming technologies for marine organisms of pharmaceutical importance; Consolidation and transfer of mariculture technologies of pearl oyster, edible oyster, clam, mussel,



Facilities at the CMFRI headquarters - electron microscope (left) and marine aquarium (right).

chank, sea cucumber, seaweed, shrimp and finfishes and their integration with artisanal capture fisheries; Development of blacklip pearl oyster farming technology and production of black pearls; Organic farming protocols for marine organisms.

**Marine Biotechnology:** Genetic improvement of marine cultivated species through selective breeding and hybridization; Endocrinology and reproductive physiology of cultivable marine organisms; Bioinformatics and gene library of existing and emerging marine pathogens; Bioconversion of raw material to enrich feed ingredients and reduce anti-nutrients; Bioprospecting for secondary metabolites from marine invertebrates, algae and microbes for use in disease management; Molecular taxonomy of marine organisms to develop PCR based identification tools

**Major strengths of the CMFRI**

- **Human resources – core competency:** 111 scientists qualified in various disciplines relating to marine fisheries and mariculture.
- **Research network:** Three regional, seven research and 15 field centres enable the Institute to address location-specific problems in marine fisheries and mariculture. Links with reputed R&D organizations

within and outside the country strengthen the network.

- **Infrastructure:** State-of-the-art laboratories and hatcheries carry out research in fishery biology, marine ecology, hydrography, biodiversity, statistics, marine biotechnology, economics, extension, and mariculture.
- **Resource monitoring and technology transfer:** The Institute’s network of research/ regional and field centres constitutes a strong resource monitoring system. The Institute’s economic analysis of marine fisheries — including evaluation of marine fish landings, economics of craft-gear combinations, price spread and market dynamics – has been valuable. Information is taken to the field through industry-farmer meets, village level meetings, training programmes, symposia and exhibitions. The Institute’s Agricultural Technology Information Centre serves as a single window delivery system for end-users.

**Cooperation with other fisheries institutions in India and abroad**

CMFRI has been collaborating with various national and international research and developmental institutes. These include the FAO, World Fish Center, IFS, SEAFDEC, Wageningen International, BOBP-IGO and the Marine Stewardship

Council The Institute has provided technical advice to countries like Iran, Mauritius and Bangladesh.

**Vision of CMFRI**

The Institute hopes to develop an information-based management system for changing over from open access to a regulated regime in marine fisheries, for augmenting coastal fish production through mariculture and sea ranching and for restoring critical marine habitats. In this context, CMFRI has identified the following thrust areas:

Fishery yield forecasting through modeling; Trophic modeling of marine ecosystems; Straddling and migratory fish stocks; GIS-based fishing and mariculture sites; Impact of climate change on marine fisheries; Hatchery technology for marine food fishes and their farming; Genetic improvement of farmed fishes; Bioinformatics and gene library of marine pathogens; Molecular taxonomy; Black lip pearl oyster farming and tissue culture technology; Open sea cage farming; Demand-supply, cost-benefit analysis; Policy research, WTO, CBD, IPR, TRIPS Impact; Conservation research; Impact analysis.

The CMFRI has a great future as a centre of excellence in mariculture and marine biotechnology and as a nodal organization for fisheries sustainability and management in the Indian Ocean.