



Agrisearch with a human touch



PROFILE Central Marine Fisheries Research Institute

All set for a blue revolution



The Central Marine Fisheries Research Institute was established by Government of India on February 3, 1947 under the Ministry of Agriculture and Farmers Welfare and later, in 1967, it joined the ICAR family and emerged as a leading tropical marine fisheries research institute in the world. Initially the institute's focus was on creating a strong database on marine fisheries sector by developing scientific methodologies for estimating the marine fish landings and effort inputs, taxonomy of marine organisms and the biological aspects of the exploited stocks of finfish and shellfish on which fisheries management were to be based. This focus contributed significantly to development of marine fisheries sector from a predominantly artisanal, sustenance fishery till the early sixties to that of a complex, multi-gear, multispecies fisheries.

One of the major achievements of CMFRI is development and refinement of "Stratified Multistage Random Sampling Method for estimation of marine fish landings in the country with a coast line of over 8000 km coastline and landing centres. Currently, the institute is



maintaining the National Marine Fisheries Data Centre (NMFDC) with over 9 million catch and effort data records of more than 1000 fished species, from all maritime states of India.

The Institute's multi-disciplinary approach to research in marine capture and culture fisheries has won it recognition as a premier institute comparable to any well-established marine laboratory in the world. Presently the institute has 3

Regional Centres located at Mandapam, Visakhapatnam and Veraval and 8 Research Centres at Mumbai, Chennai, Calicut, Karwar, Tuticorin, Vizhinjam, Mangalore and Digha. Besides, there are also fifteen field centre and 2 KVKs (Ernakulam and Kavratti, Lakshadweep) under the control of the institute. The nearly five fold increase in marine fish production and the increasing contribution of marine fisheries to the GDP growth are supported by the robust research efforts and its impact on fisher folk, fish farmers, fisheries policy planners and managers.

VISION

Sustainable marine fisheries through management



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intervention and enhanced coastal fish production through mariculture for improved coastal livelihoods.

MISSION

To develop an information based management system for changing over from open access to regulated regime in marine fisheries, augment coastal fish production through mariculture and sea ranching and restore critical marine habitats.

MANDATE

- Monitor and assess marine fisheries resources of the Exclusive Economic Zone (EEZ) including impact of climate and anthropogenic activity and develop sustainable fishery management plans.
- Basic and strategic research in mariculture to enhance production.
- Act as repository of geo-spatial information on marine fishery resources and habitats.
- Consultancy services and human resource development through training, education and extension.

OBJECTIVES

- Marine fishery resource assessment.
- Productivity and production enhancement through mariculture.
- Conservation of marine biodiversity.
- Transfer of technology, training and consultancy.

Major research focus and its impact on marine fisheries sector in India

Support to strengthen marine fishery management regime in India

From beginning, CMFRI has focussed on gathering information of the marine fishery resources of India. Through its sustained efforts a database on fisheries landings and effort statistics has aided the developing



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effective fisheries management plans with stakeholders participation; proactive measures to ensure regulated and sustainable fisheries and aiding efforts in marine fisheries management realm by preparing policy guideline documents based on the research programmes of the Institute. The National policy on Marine Fisheries (NPMF) 2017 notified by the Ministry of Agriculture and Farmers' Welfare was developed with wide stakeholders' consultations by the institute and is a major step towards a framework for a sustainable marine fisheries development model in the country. Marine fisheries policies for the state of Kerala and Lakshadweep Islands, Karnataka, Goa and Andhra Pradesh are formulated with the reassert and policy inputs from CMFRI scientific expert teams. CMFRI has prepared a document entitled Indian Marine Fisheries Code which guides the establishment of a sustainable marine fisheries resources management model for India in accordance with Food and Agriculture Organization's (FAO) Code of Conduct for Responsible Fisheries (CCRF). Other contributions of CMFRI recognized as major inputs for the national level policy making are policy guidance on Fish Aggregating Device (FAD); based on which Government of Karnataka banned an FAD assisted cuttlefish fishery that was contributing to growth and recruitment overfishing of cuttlefishes and leading to loss of livelihoods and income to local fishers, guidance on National Plan of Action (NPOA) for sharks in India for increasing awareness of the need to ensure their sustainable exploitation and conservation, guideline on temporal and spatial measures of effective Trawl Ban for Government of Kerala, recommendation on Minimum legal size (MLS) of commercially important marine fishes aimed at restricting juvenile fishing for various coastal States (Based on which Government of Kerala notified MLS for 58 commercially important species in the Gazette), recommendations on use of technology in agricultural insurance' to NITI Aayog, guidelines for Mariculture Policy in India etc. CMFRI also coordinated and provided scientific inputs for India's first Marine Stewardship

Mobile app for online fish sale

As an adaptation strategy to improve income of fishermen and to help them cope up with adverse climatic events, the ICAR-CMFRI has developed a multivendor E-commerce website (www.marinefishsales.com) and associated android app (*marinefishsales*) through the National Innovations on Climate Resilient Agriculture (NICRA) project. The website and mobile app is aimed at helping fish farmers and fishermen to sell their farmed fish and marine catch directly to customers online and to fetch better income without depending middlemen.



fact that the country needs to shift from traditional single species management approach to a more advanced one addressing ecological and human well-being with good governance. An Ecosystem Based Fisheries Management (EBFM) model has been successfully developed for the

Council (MSC) certified fishery, for the short-neck clam in the Ashtamudi Lake, Kerala.

Integration of Satellite Technologies into Fisheries Management

To effectively utilize satellite technology for managing marine fisheries sector the Institute has joined hands with the Indian Space Research Organization (ISRO) with the aim to identify and forecast Potential Fishing Zones (PFZ). GIS based resource mapping of distribution and abundance of fin fishes and shellfishes off the Indian coast and using the GIS technology for mapping of marine fish landing centres. The CMFRI special publication on 'Handbook on Application of GIS as a Decision Support Tool in Marine Fisheries' and the GIS based inventory of 1278 marine fish landing centres of Indian coast prepared by CMFRI, was even sought by Indian Navy.

Ecosystem Approach to Fisheries Management (EAFM)

CMFRI's initiative in promoting EAFM is based on the

South-west, North-west, Gulf of Mannar coasts and can be used to facilitate well managed fisheries.

Addressing climate change concerns in marine fisheries sector

Climate change is now recognized as one of the greatest long-term challenges to marine ecosystems and fisheries. Under the National Innovations on Climate Resilient Agriculture (NICRA), a network project of Indian Council of Agricultural Research (ICAR), to deal with climate change in marine ecosystem CMFRI has focussed on preparing the marine fisheries sector to minimize the impact of climate change. It is also aimed at addressing critical knowledge gaps about climate change impacts, improve monitoring and translating the knowledge into active management responses. Relationship between temperature and abundance of resources such as threadfin breams and the effect of projected rise in sea surface temperature due to climate change by modeling the biomass dynamics using a variant of SEAMICE models for the south Kerala region has been done. The carbon foot print, blue carbon potential of mangroves and sea grass and life cycle assessment of fishing operations indicated that fishing operations for Kerala coast had



CMFRI Research Vessel – Silver Pompano



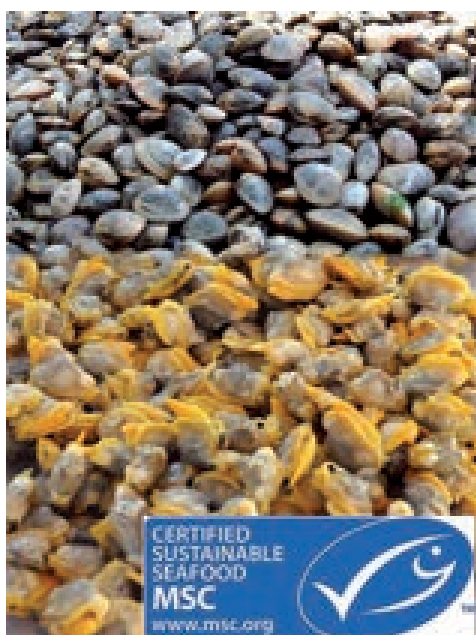
Fish Cage

Hatchery technologies

Technologies for seed production and grow-out culture of cobia (*Rachycentron canadum*), groupers (*Epinephelus coioides*) silver pompano (*Trachinotus blochii*), Indian pompano (*Trachinotus mookalee*) and pink ear emperor (*Lethrinus lentjan*) have been developed and demonstrated by CMFRI, while efforts are on to bring more promising species under farming. In addition, five species of snappers and carangids have been prioritized for developing seed production technology. Hatchery production technology for mussel, edible oyster and 14 varieties of marine ornamentals, including Marcia's anthias, clowns, damsels, hybrids, camel shrimp and cleaner shrimp has been achieved. The indigenously developed Re-Circulatory Aquaculture System (RAS) is also functioning at the Institute to boost seed production round the year.



Cobia fingerlings in cage



Yellow clam or short neck clam fishery of Ashtamudi Lake – First Marine Stewardship Council (MSC) certified fishery of India with CMFRI's support

highest emissions during harvest phase followed by post-harvest and pre-harvest phases. Multivendor e-commerce portal and Mobile App, low cost feeds for Integrated Multi-trophic Aquaculture (IMTA) and Participatory mode of coastal vulnerable resource mapping are few of our initiatives. Through adoption of a number of coastal villages and converting them as "Climate Smart Villages", organizing field demonstrations on technologies for climate change adaptation and mitigation, livelihood sustainability enhancement through provision of know-how and alternative income generating activities are some interventions carried out by CMFRI.

Fishery socio economics, marketing, trade and fisheries governance

Focussed studies on economics of fishery enterprises and socio-economic conditions of fisher folk. Valuation, estimation and analysis of marine fish landings and its economic performance, supply chain management, price behaviour of marine fish varieties, fish consumption patterns, impact of GST on fisheries sector and vulnerability of coastal villages are being estimated annually both at landing centre and retail market levels for different maritime states. An estimation of value of marine fish landings in India, during 2011-2017 indicated an increase of fish landings at landing centre level from ₹24,369 crores in 2011 to ₹52,431 crores in 2017, with an annual increase of 14.5%, while at retail centre level, increased from ₹38,147 crores to ₹78,404 crores with an annual increase of 15.08%.

Innovations in mariculture

Globally, mariculture is the fastest growing animal food producing sector and an increasing source of protein for human consumption. Envisaged to be the future of Indian marine fisheries mariculture has not yet developed into a major contributor of seafood production in India. However, ICAR - CMFRI remains on forefront to promote various mariculture activities such as cage fish farming, seaweed farming, bivalve and pearl farming, ornamental fish culture, integrated multi-trophic aquaculture, etc. The Research and Development programme on marine cage farming in India which was initiated by CMFRI with the grants received from the Ministry of Agriculture has been successfully demonstrated technically all along the Indian coast with the financial support of National Fisheries Development Board (NFDB). By year 2018, 1609

Integrated multi-trophic aquaculture, a novel method

Integrated Multi-Trophic Aquaculture (IMTA) is the practice which combines appropriate proportions of finfish/shrimp with shell/ herbivorous fish and seaweeds in farming to create balanced systems for environmental and economic stability. The CMFRI has successfully conducted the demonstration of IMTA under participatory mode with fishermen groups by integrating seaweed with cage farming of cobia. It has been proved that in one crop of 45 days the seaweed rafts integrated with cobia cage will give an average yield of 260 kg per raft against a control, which yielded 150 kg per raft.

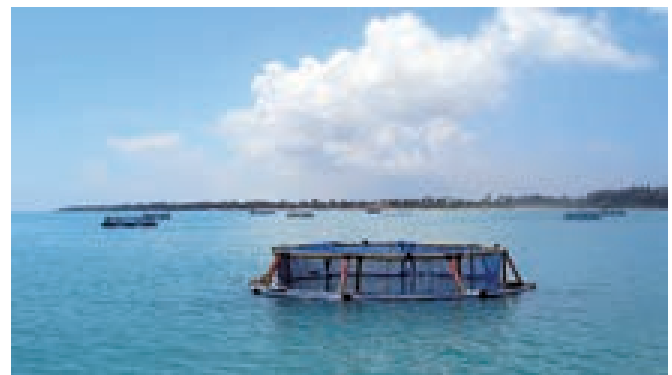


Cobia fingerling

cages were installed in different marine locations in India under the technical support and guidance of CMFRI. Continuous refinement of technology is taking place through various research projects of CMFRI and All India Network Project on Mariculture (AINP-M) funded by ICAR, Government of India. The successful seed production of a marine ornamental, camel shrimp, *Rhyncocinetes durbanensis* was achieved at Mandapam Regional Centre of CMFRI. The Tribal Sub Plan (TSP) programme of the institute has extended technical support in cage farming to several tribal groups in the states of Gujarat, Maharashtra, Karnataka and Kerala and helped them to attain better livelihood skills and income through fish farming.

Marine Biotechnology

Bioprospecting of marine and oceanic resources, through which the institute has produced several nutraceuticals useful for treating life style diseases and dietary supplements from seaweeds, has been recognised. The Institute has developed and commercialized nutraceutical products Cadalmin™ Green Algal extract (Cadalmin™GAe) and Antidiabetic extract (Cadalmin™ADe) to combat rheumatic arthritic pains and type-2 diabetes, respectively. Nutraceuticals from seaweeds to combat dyslipidemia, obesity, hypo-thyroid have also been developed and out-licensed to pharmaceutical companies. A Nodadetect a single tube RT lamp diagnostic for Noda virus detection in marine fish of mariculture interest has been developed by the institute. This highly specific, sensitive and rapid method of screening marine broodstock fish ensures certified specific pathogen free eggs and larvae. To understand the population genetic structure of fishery resources in Indian waters specific studies were carried out. The complete mitogenome characterisation of *Etroplus suratensis* from Vembanad Lake, genetic stock structure



Open Sea Cage Farms

investigations in *Lutjanus argentimaculatus* and Indian oil sardine *Sardinella longiceps* and bioprospecting for biotic and abiotic stress responsive genes from *Crassostrea madrasensis* and their characterisation have yielded valuable baseline data.

CMFRI'S MAJOR CONTRIBUTIONS : AT A GLANCE

- Estimation of multispecies multi-gear marine fish landings for more than 1200 species covering 1511 fish landing centres on a GIS platform from the EEZ of India for marine fish stock assessment following the self-developed stratified multi-stage random sampling design and maintaining a National Marine Fishery Resources Database which is generated based on continuous and perpetual field data collection on marine fishery resources over decades
- Annual estimation of marine fish landings at landing centre and retail market level carried out to work out the contribution of fisheries sector to the agricultural and National GDP.
- ICT initiatives include 'Fish Watch', a web portal for real time landing and market information from the landing centres; 'Choose Wisely' – a sustainability labeling code developed by CMFRI which was adopted



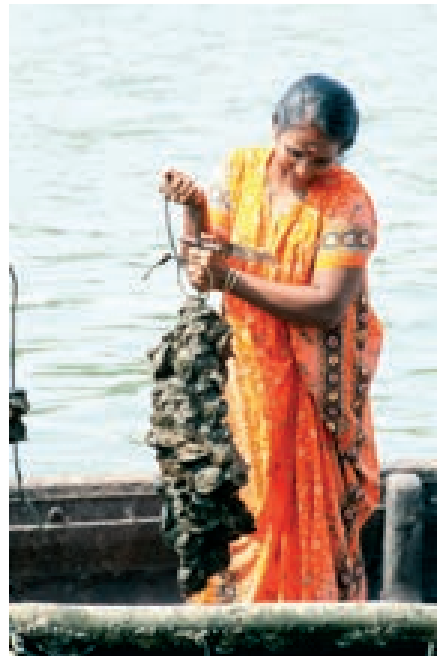
Cage Farming Harvest

by the ITC chain of restaurants all over India serving seafood; *m@krishi* service supported by TCS in collaboration with CMFRI provided and tested a platform to inform fishermen in Maharashtra on potential fishing zones (PFZ) through mobile phones in local language; *Litter atlas* an interactive map on litter status of Indian beaches

- National quinquennial census of marine fisher population and infrastructure facilities and estimated value of marine fisheries and fishing fleet economic efficiencies
- Optimized fishing fleet size of various craft-gear combinations for rational exploitation of marine resources in all maritime states of India
- Monitored biology and health of commercial marine fish stocks (133 stocks) of India. Developed and applied several analytical models to assess the finfish and shellfish stocks in all maritime states for providing Fishery Management Plans and advisories on seasonal fishing bans and potential yields
- Developed hatchery and grow-out technologies for shrimps, pearl oysters, oysters, mussels, clams, ornamental fishes, sea bass, cobia, pompano and groupers (totaling 37 species)



Recirculation Aquaculture Facility at CMFRI Mandapam Centre



Oyster farmer with ready to harvest farmed oyster rens

- Established commercial farming of mussels and oysters in coastal areas with an annual production of over 10,000 tonnes benefiting nearly 6000 women self-help groups
- Identified and mapped new and non-conventional deep sea marine resources by vessel based surveys, including abundance maps

of oceanic squid resources. The Institute has so far described 255 marine species new to science from various groups of fishes

- Used modern biotechnological tools for development of marine nutraceuticals (GMe, GAe, Ade and Ate) for human well-being and functional feeds (Varna and Varsha) for mariculture species
- Assessed major marine and island habitats and evaluated their biodiversity; and developed restoration protocols through artificial reef deployment
- CMFRI conducts regular training programmes in fisheries and marine biology. So far, the institute has produced over 300 Masters and 160 PhD degree holders
- Provided science back-up for India's first eco-labelled (MSC certified) fisheries (short-neck clam) meeting



Nemipterus japonicus haul in Kochi, Kerala



Anti-diabetic extract



Anti-obesity extract



CMFRI pearl string

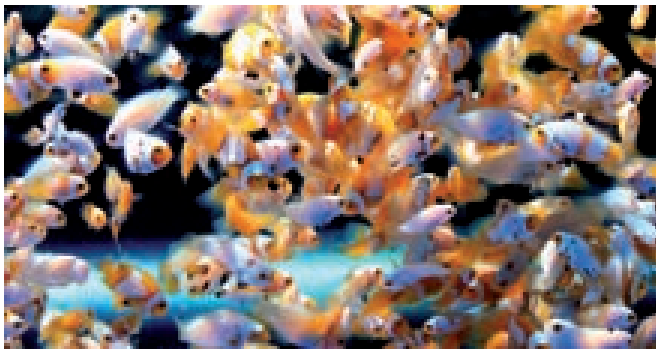
- global standards of fisheries management
- Delineated the scientific reasons behind the recent decline in oil sardine fishery along the south-west coast of India, to support formulation of management guidelines to improve the status of the fishery.

OUTREACH ACTIVITIES

Agricultural Technology Information Centre (ATIC) of CMFRI serves as a 'single window delivery system' for technologies and services developed by the institute. There are two Krishi Vigyan Kendras (KVK) functioning

under the institute presently. KVK-Ernakulam has developed and disseminates location specific technological modules and acts as Knowledge and Resource Centre for agriculture, fisheries and allied activities.

Administrative control of KVK at Kavarathi, Lakshadweep Islands has been recently taken up by the institute from CIARI, Port Blair. The main focus will now be for enhancing farmers' income and employment opportunities especially for women, through value-added products development and facilitate increased market access.



Designer crown fish – the new ornamental fish variety

Academic collaboration and training

Collaborations with a number of research and academic organizations inside and outside the country have included the Plymouth Marine Laboratory, UK; Nansen Environmental and Remote Sensing Centre (NERC), Norway; Michigan State University, USA; Rhodes University, South Africa and Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia besides fisheries related institutes and academic universities in the country.



Ornamental Fish – Anthias

Way forward

Sustainability of fishery resources is core to a healthy and vibrant marine fisheries sector in India. To grow further, the following focus areas have been identified:

- Fishery modelling and forecasting
- Green auditing – valuation of marine bio-diversity and ecosystem services
- Nanotechnological approaches in mariculture and environment management.

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