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FISHING CHIMES

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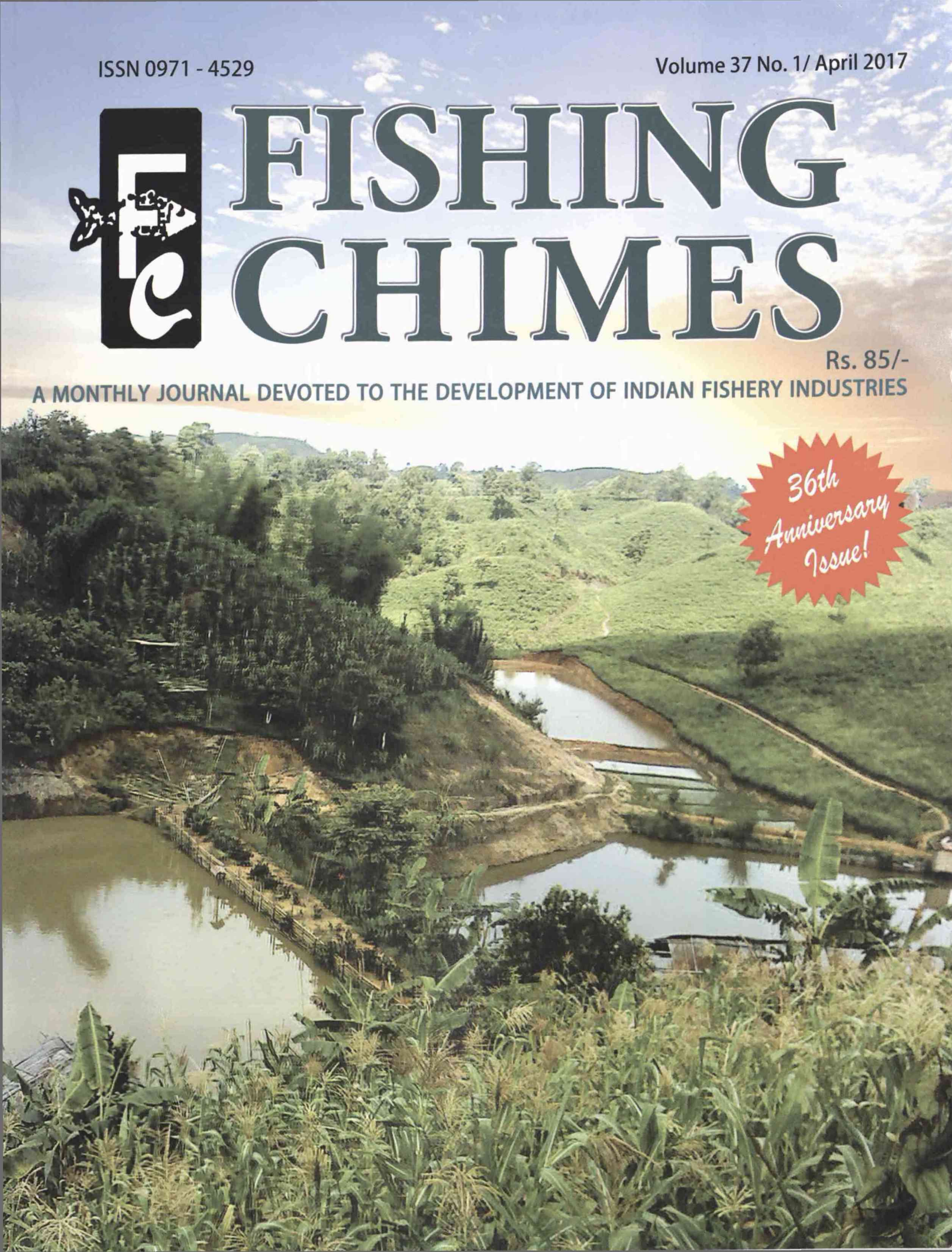

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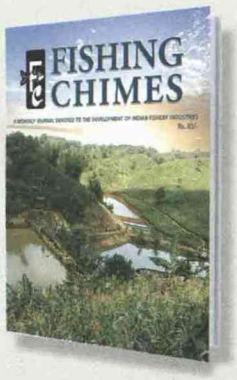
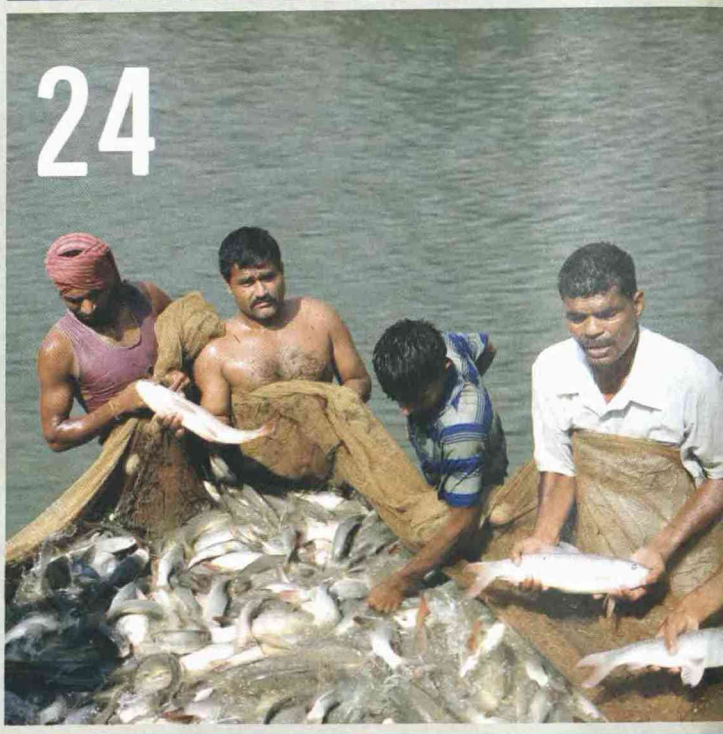
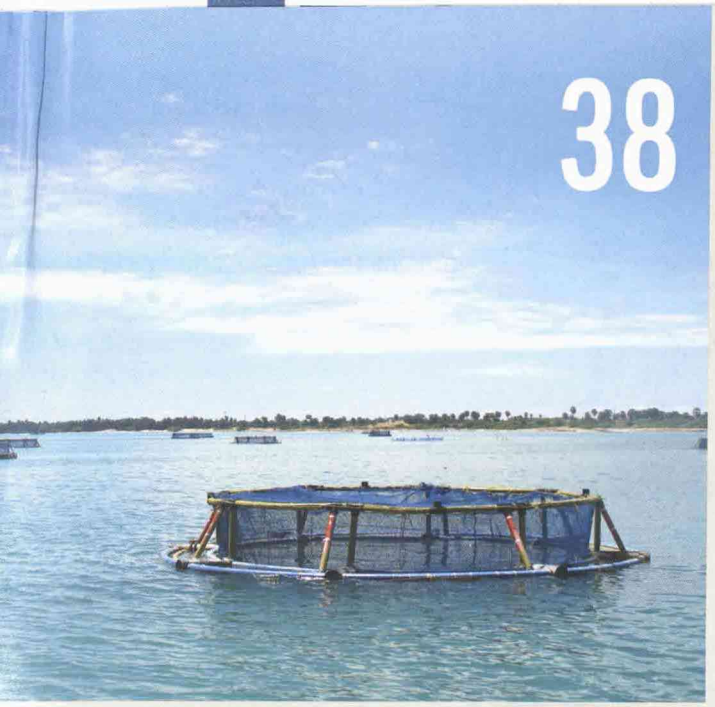


About the Front Cover

The image taken from DCFR'S article, shows carp culture in small sized ponds located in mid altitudinal Himalayan regions. In this 36th anniversary issue of Fishing Chimes, fisheries institutes in India share their research focus for the next few years. For an in depth look at DCFR's activities in the Himalayan region please turn to page 14.





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36 ANNIVERSARY

India's Largest Fisheries Research Body Turns 70 - CMFRI's Legacy and Few Recent Achievements

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The Central Marine Fisheries Research Institute (CMFRI), currently celebrating its platinum jubilee year of formation, was established as a Marine Fisheries Research Station on 3rd February 1947 in Madras. The institute later joined Indian Council of Agricultural Research, (ICAR) family in 1967 and started functioning as a premier research establishment to undertake marine fisheries research in the country. Apart from the estimation of marine fish landings, its valuation and taxonomic studies, the research activities of CMFRI are diversified to a variety of niche areas such as sea farming and coastal mariculture, development of hatchery technologies for commercially viable marine fish species, cage farming, biotechnological applications of marine resources, biodiversity studies, development of sustainable ecosystem management interventions, policy studies and so on. Apart from the Headquarters, the ICAR-CMFRI has 11 Regional Research Centres located at Mandapam Camp, Visakhapatnam, Veraval, Mumbai, Chennai, Calicut, Karwar, Tuticorin, Vizhinjam, Mangalore and Digha (newly established during the 70th year), in addition to fifteen field centres throughout the coastal belts of the country and 1 KVK at Njarakkal, Ernakulum. The CMFRI team presently comprises of 154 scientists and over 600 other staff working at the CMFRI in as many as 10 research divisions.

Prime focus of research

In order to accomplish its mandate, the CMFRI presently conducts research on characteristics of exploited marine fish stocks, carries out exploratory surveys, assesses the under and unexploited resources, undertakes research in fishery environmental characteristics and ocean dynamics besides hosting several human resource development programmes. Realising the limited potential of the oceanic resources to meet the growing demand from a fish-eating population of the country, CMFRI has allocated a significant part of its research resources to develop mariculture technologies.

A network project on mariculture led by the institute presently carries out comprehensive research programmes for developing alternative production strategies for the future. Accordingly, considerable research thrust is given to develop hatchery technologies, seed production protocols, and develop mass rearing techniques of promising species of marine fish.

The institute collects marine fisheries statistics and makes an estimation of species-wise landings and monitors them regularly from all along the country's coast. Spatial mapping of fishing grounds is carried out on a continuous basis, which helps in identifying the seasons of high abundance of spawners/juveniles and in the identification of critical fishing grounds where seasonal and spatial closure of trawl fishery can be implemented.

Based on the findings of a recent study of climate change on marine fisheries ecosystem, several solutions for climate change adaptation and mitigation have been mooted for proactive action against climate change and to equip the fisherfolk to adapt to evolving climate scenarios. Studies are also being conducted on the economics of fishery enterprises and socio-economic conditions of fisherfolk. The institute undertakes spatial mapping of fishing grounds based on satellite assisted technology. Bioprospecting of marine and oceanic resources is one of the thrust areas of CMFRI's research agenda, through which the institute has produced several nutraceuticals useful for treating lifestyle diseases. The research team at CMFRI undertakes genetic and biotechnological studies to understand the population genetic structure of fishery resources in Indian waters. Climate change studies carried out at CMFRI has been instrumental in developing national strategies for climate resilient fishing and fish culture.

CMFRI's major contributions to the nation

CMFRI undertakes an annual estimation of the marine fishery resources for more than 1200 species covering 1511 fish landing centres on a GIS platform for marine fish stock assessment. The institute maintains a National Marine Fishery Resources Database which is generated based on continuous field data collection on marine fishery resources over decades. The Fishery Resources Assessment Division of CMFRI undertakes the Marine Fisheries Census across the maritime states of the country every five years to assess the human, capital and infrastructural resources associated with marine fisheries in the country.

Cage culture technology, a promising avenue for large scale commercial production of marine food fishes to meet the future demand of fish in the country has been developed and popularised by CMFRI during the past decade. Studies on climate change impacts on marine fisheries carried out at the institute have been helpful in identifying the vulnerabilities associated with marine fisheries ecosystem and for coming up with resilient strategies. The institute has developed and popularised hatchery production technology for mussel, edible oyster and marine ornamental fishes for commercial exploitation of these resources. CMFRI has succeeded in captive breeding and successful round the year seed production of three species of finfishes viz., Cobia, Silver pompano and Orange-spotted grouper for the first time in the country.

CMFRI scientists have so far described 255 marine species new to science from various groups of fishes. The researchers at CMFRI have coordinated India's first Marine Stewardship Council (MSC) certification for the short-neck clam fishery in the Ashtamudi Lake, Kerala. 'Choose Wisely' – a sustainability labeling code developed by CMFRI was adopted by the ITC chain of restaurants all over India serving seafood. Research conducted at CMFRI has helped in delineating the scientific reasons behind the recent decline in oil sardine fishery along the south-west coast of India, to support the formulation of management guidelines to improve the status of the fishery.

The biotechnological research programmes of CMFRI has yielded rich dividends in the form of commercialised nutraceuticals, namely 'Green Mussel extract' (GMe), 'Green Algal extract' (GAe), 'Anti-Diabetic extract' (ADe) and 'Anti Hypercholesterolomic extract' that are effective for treating lifestyle diseases. The nutrition research team of CMFRI has developed commercialised fish feeds, 'Varna' and 'Varsha'.

CMFRI had launched 'Fish Watch', a web portal for real-time landing and market information from the eastern and western Indian coastal belts. Two new fishing vessels FV Silver Pompano and FV Cadalmin have been commissioned for offshore research. m@krishi service for fishermen in the State of Maharashtra provides information on potential fishing zones (PFZ) through mobile phones in the local language to fishermen which potentially reduces the scouting time for fishing by around 50%, bringing down fuel consumption and increasing profits to the tune of 25-35%.

Under the Human Resource Development initiatives, CMFRI conducts regular training programmes in fisheries and marine biology. So far, the institute has produced over 300 Masters and 160 PhD degree holders.

CMFRI offers Consultancy Services in specialised areas to over 100 clients.

CMFRI's role in Marine Fisheries Policy Making

Right from its formative years, CMFRI has contributed significantly towards policy discourses related to marine fisheries sector in India. Some of the recent policy initiatives in which CMFRI has taken active participation include:

- Formulation of National Marine Fisheries Policy, 2016-draft
- Report of the technical committee to review the duration of the ban period and to suggest further measures to strengthen the Conservation and Management Aspects, 2014.
- Preparation of the Marine Fisheries Policy documents for ensuring the sustainable management of marine fisheries of Kerala & Lakshadweep Islands, Karnataka & Goa and Andhra Pradesh.
- Development of Marine fisheries management code
- Policy guidance on Fish Aggregating Device (FAD), based on which Government of Karnataka banned FAD assisted cuttlefish fishery.
- Guidance on National Plan of Action (NPoA) for sharks in India for increasing awareness of the need to ensure their sustainable exploitation and conservation.
- Policy guidance on Light fishing, submitted to Government of Karnataka & Goa.
- Trawl Ban Committee report submitted to Government of Kerala.
- Taskforce Report on 'Use of technology in agricultural insurance' submitted to NITI Aayog.
- Developed Minimum Legal Size (MLS) estimates for 58 species of commercially important marine fishes aimed at restricting juvenile fishing. Based on this, Government of Kerala notified MLS for 14 commercially important species in the Gazette.

Outreach activities

The Agricultural Technology Information Centre (ATIC) of CMFRI serves as a 'single window delivery system' for the technologies and services as an interface between fisher folk, entrepreneurs and scientists. ATIC regularly takes part in exhibitions and other extension platforms to showcase the research outputs and achievements of CMFRI. Similarly, KVK-Ernakulum of CMFRI develops and disseminates location specific technological modules and acts as Knowledge and Resource Centre for agriculture, fisheries and allied activities. Besides, scientists at various research centres and divisions of the institute regularly take part in various extension and outreach activities for the benefit of the fisher folk at large.

Academic collaborations

CMFRI collaborates with a number of research and academic organisations in and outside the country for strengthening its research programs and for complementing its academic and human resource development activities. Some of the prominent research/academic collaborations include:

- Faculty exchange programme with Plymouth Research Laboratory, United Kingdom.
- International research collaboration with Michigan State University, United States, Rhodes University, South Africa and Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia as part of the GULLS project.
- Technical collaboration on Bay of Bengal Project (BOBP) and Bay of Bengal Large Marine Ecosystem Project (BOBLME).
- Research project linkages with Indian National Centre for Ocean Information System (INCOIS), National Institute of Oceanography (NIO) and several other fisheries research institutes and government departments.
- Academic partnerships with universities such as Cochin University of Science and Technology (CUSAT), Kerala University of Fisheries and Oceanic Sciences (KUFOS), Mangalore University and Manonmaniam Sundaranar University, Tamil Nadu.

Over the past seven decades, the institute has grown significantly in size and stature emerging as a leading tropical marine fisheries research institute in the world displaying an unparalleled research acumen and unbridled commitment which helped in boosting the marine fish production and management of the fisheries sector and the livelihood of 40 lakh fisherfolk of the country.

Cage fish farming becoming popular in Kerala and other maritime states under CMFRI guidance

The coastal aquaculture in Kerala will get a major boost, with the cage fish farming model being widely popularised in different parts of the State under the technical guidance of the Central Marine Fisheries Research Institute (CMFRI). Even the non-farming community has turned into the less expensive fish farming model after they received technical support and capacity enhancement training extended by the Mariculture Division of CMFRI, in areas such as cage fabrication and installation, site identification, seed selection, feed management and trading.

Soon after the training, the participants from different parts of the State began farming commercially important fish varieties such as pearl spot, sea bass, red snapper, tilapia and giant trevally in the brackish and freshwater bodies of their respective regions. Besides Ernakulam where the maximum number of cage farming enterprises is in operation, the initiative has also been taken in six districts namely Kannur, Malappuram, Thrissur, Alappuzha, Kottayam and Kollam. It is the success story of cage fish farming venture in Pizhala in Ernakulam which has attracted more people including non-farmers into this practice. There are around 100 farming units in place in Pizhala Island under the guidance of CMFRI where most of the farmers are women.

This is a positive sign that Kerala is moving towards fish revolution utilising its highly prospective water resources. Sea cage farming has turned into a huge hit in other coastal states especially in Gujarat, Maharashtra, Goa and Karnataka under CMFRI's All India Network Project on Mariculture (AINP-M). Sea cage farming is yet to establish off the Kerala coast, however, the brackish and fresh water resource in the State has a bright prospect for the cage farming of species such as pearl spot, seabass, red snapper and tilapia.

Less expense, more profit

According to CMFRI's technology, cages of length and width of 4m each and a depth of 3m (48m³), made of galvanised iron pipes is suitable for farming in Kerala waters. The depth of the cage may vary depending on the depth of the water body. Seabass and pearlspot can be cultured in the same cage at a time. Around Rs 1 lakh is adequate for installing the cage and stocking seeds of seabass and pearl spot, in addition to the fresh feed cost which requires another Rs 60,000 per cage. Around 1000 seeds of seabass and pearlspot each can be stocked in a cage of this size. After six months, the seabass is expected to attain a growth of 700g to 1.2kg of weight and pearl spot 200 to 250g depending on the stocking size of the seeds (about 50g). A total of an average 700kg of seabass and 250kg of pearl spot can be harvested from one cage itself within a duration of 6 or 7 months with a survival rate of 90%. The farmer will get around Rs 650 for a kilo of seabass and Rs 550 for pearl spot in the market. Those who wish to start cage fish farming can approach CMFRI and register their name in the Mariculture Division for technical support.

Integrated Multi-Trophic Aquaculture, a novel method

Integrated Multi-Trophic Aquaculture (IMTA) and mariculture for biodiversity conservation are also the areas which need more focused research. IMTA 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 a fishermen group by integrating seaweed with cage farming of cobia *(Rachycentron canadum)*. A total of 16 bamboo rafts (12× 12 feet) with 75kg of seaweed per raft can be integrated with one cobia cage of 6m diameter. It has been proved that in one crop of 45 days the seaweed rafts integrated with cobia cage will give an average yield of 260kg per raft while the same was 150kg per raft for the rafts which were not integrated.

An addition of 110kg of seaweed/raft can be achieved due to the integration with cobia cage farming. There was increased number (average 90-100 nos.) of newly emerged apical portion/tips in a bunch of harvested seaweed from the rafts integrated with the cobia cages. The bunches having more numbers of newly emerged apical portion/tips when used for replanting, will be ready for harvest within 40 days, whereas the seaweed with fewer numbers of newly emerged apical portion/tips, if used as seed, will be ready for harvest only after 54 days.

The technology is being adopted by 100 farmers of Palk Bay, Ramanathapuram, Tamil Nadu. In addition to the revenue generated from cobia farming, an additional income of Rs 32 lakhs could be realised due to additional seaweed yield (11 tonnes) from IMTA. The IMTA adopted by 100 farmers would generate additional 1200 man days per crop of 45 days.

All India Network Project on Mariculture

To give a fillip to fish production in the country, Central Marine Fisheries Research Institute (CMFRI) will now focus on popularising mariculture activities in all the maritime states. All India Network Project on Mariculture (AINP-M), co-ordinated by the CMFRI, has formulated an action plan for developing and popularising marine grow-out systems, farmer-friendly hatchery technologies for commercially important fishes and establishing a centre of excellence in mariculture research in the country. AINP-M is a major research programme with a financial outlay of Rs 42 crores undertaken by CMFRI with the centres from all the maritime states to strengthen the mariculture initiatives in the country.

Apart from the three species-cobia, seabass and pompano, for which commercial level hatchery production is currently available in the country, CMFRI is in the process of developing technologies for three more marine species which will boost mariculture activities. Due importance would be given to popularise the farming technologies developed by conducting demonstrations in the farmers' fields. At a time when capture fisheries production is undergoing a stagnation period, mariculture can be considered as the only option to meet the ever increasing demand for marine food products. Open sea cage farming method developed by CMFRI is one of the best farming models which could be effectively popularised among the fishermen community in the country.

The mariculture sector will address the ever increasing demand for quality seafood for human consumption and, to some extent, bridge the gap between demand and supply in marine fish production. As the amount of wild caught fish has remained stagnant over the years, mariculture can be considered as one of the best alternative livelihood options for the coastal fishermen community.

The AINP will focus on developing viable and farmer-friendly technologies for marine fish seed production and farming, especially cage farming. The indigenous cage farming method developed by the CMFRI, is well received by the farmers of various coastal districts and is economically feasible. National agencies on fisheries development are promoting this activity based on the inputs given by CMFRI through various incentives like subsidies and schemes.

New Regional Research Centre in West Bengal

The Central Marine Fisheries Research Institute (CMFRI) has opened a new regional research centre in Digha, West Bengal with an aim to fulfil the research and development needs of marine fisheries in West Bengal and Odisha. This is the 11th regional research centre of CMFRI. The centre will primarily focus on assessing the important commercial marine fish stocks of West Bengal including Hilsa, a popular variety of fish in the region. At a time when the availability of Hilsa is showing a drastic decline in recent years, the CMFRI centre will focus on research activities for the conservation and sustainable harvest of the fish species and developing effective resource management practices.

The centre will provide advisories to the Bengal and Odisha governments on the optimum number of fishing vessels and the option for management of fish stocks in the State by way of regulations. Regular monitoring of marine landings and assessment of fish stocks will be carried out at the centre to help the State in managing the marine fish resources of the region ultimately benefitting the fishermen. The mariculture technologies of commercially important fishes developed by the CMFRI will be popularised and promoted in the State in tune with environmental and geographical aspects of the region.

ICAR-CMFRI develops GIS-based database on fishing centres in India- Database handed over to Indian Navy to ensure security of fishermen at sea

In a major development, aimed at ensuring the safety and security of the fishermen at sea, the ICAR-CMFRI prepared an inventory of all the fish landing centres in the country, describing their GIS (Geographic Information System) location, types of fishing activity, seasonality of fishing and the extent of fishing operations from each of the fishing centres. The institute handed over the database to the Indian Navy in order to make coastal security measures easier, by monitoring intrusion into Indian territorial waters from neighbouring countries. Details of traditional landing centres and modern fishing harbours have been included in the database.

Dr A.P. Dineshbabu, Principal Scientist at the Mangalore Research Centre of ICAR-CMFRI coordinated a research team comprising 22 scientists and 85 other staff to prepare the inventory. The information about the landing centres and operational areas of fishing will be useful in efficient marine spatial planning of various activities in the sea by protecting the security and livelihood concerns of the fisherfolk along the Indian coast.

The team collected information on 1,278 landing centres along the Indian coast spanning all maritime states (Gujarat, 129; Maharashtra, 149; Goa, 34; Karnataka, 93; Kerala, 201; Tamil Nadu, 359; Andhra Pradesh, 204; Odisha, 54 and West Bengal, 55). The geo-tags of marine fish landing centres is also a crucial work in facilitating national security. Fishermen can be considered as soldiers in the sea because they are constantly moving in and out of the sea scouting for fish at the same time observing some unscrupulous activities if any. The document with the spatial tags of fish landing centres developed by ICAR-CMFRI will help the Navy, the Coast Guard and other security agencies in disaster management as well.

Wonder herbs from the oceans - ICAR-CMFRI develops nutraceutical products from seaweeds

The ICAR-Central Marine Fisheries Research Institute (CMFRI) has been working on the frontier areas of marine bioprospecting/bioactive molecule discovery from seaweeds and developing high-value nutraceutical products as dietary supplements and health management. The Institute has developed and commercialised the nutraceutical products Cadalmin™ Green Algal extract (Cadalmin™GAe) and Antidiabetic extract (Cadalmin™ADe) as green alternatives to synthetic drugs to combat rheumatoid arthritis pains and type-2 diabetes, respectively. Cadalmin™Anti-hypercholesterolemic extract (Cadalmin™ACe) has been developed from seaweeds to combat dyslipidemia and obesity, and the product is being out-licensed to a pharmaceutical company.

According to marine scientists, seaweeds are one of the predominant oceanic flora and these invaluable marine herbs are considered as a prolific source of bioactive compounds as they are able to produce a great variety of secondary metabolites characterised by a broad spectrum of extraordinary medicinal properties. Seaweed has long been part of the traditional diet of coastal communities. It is widely consumed in East Asia, particularly in Japan, China and Korea. Studies demonstrated that in Japan, the rate of mortality is less and hence their life expectancies are very high. It is reasonable to evaluate this result because Japanese are regular consumers of seaweeds. Seaweeds are classified as Rhodophyta (red algae), Phaeophyta (brown algae) or Chlorophyta (green algae) depending on their nutrient, pigments and chemical composition.

Dr Kajal Chakraborty, Senior scientist at the ICAR-CMFRI, who developed the nutraceuticals from the seaweeds, believes that the discovery of metabolites with biological activity from seaweeds increased substantially in the last three decades. These substances exhibit an appreciable number of distinct biological activities, such as anti-tumoral, anti-viral, antifungal, insecticidal, cytotoxic, phytotoxic, and anti-proliferative actions. Most of the bioactive substances isolated from seaweeds are chemically classified as brominated, aromatics, nitrogen-heterocyclic, nitrosulphuric-heterocyclic, sterols, dibutanoids, proteins, peptides, sulphated polysaccharides, terpenes, acetogenins, alkaloids and polyphenolics. Seaweeds are the only sources for industrially important phycocolloids such as agar, carrageenan and alginate. They have a lot of applications as stabiliser, viscosifier, gelling and emulsifying agents.

Why are Seaweeds prolific producers of pharmacologically active metabolites?

Seaweeds constitute a major share of marine flora, and they were reported to possess structurally diverse compounds of various bioactivities endowed with antihypertensive, anti-inflammatory, and anticarcinogenic activities. These species grow in extremely hostile saline habitats and have evolved a number of specialised biochemical mechanisms to withstand salt-triggered oxidative stress conditions, which are governed by multiple biochemical mechanisms facilitating cell homeostasis and water retention ability. However, the absence of oxidative damage in the structural components, deterrence of predation, and the ability to reproduce successfully suggest that their cells are the storehouses of bioactive metabolites with potential pharmacological properties. Therefore these marine floras are considered as valuable sources of bioactive compounds with potential pharmacological significance.

Seaweeds contain a large assemblage of species that predominate in the coastal shelf areas of the southern Indian subcontinent. Novel secondary bioactive metabolites from seaweeds are attracting attention because of concerns about the toxic effects of synthetic drugs and the growing demand for new compounds of 'marine natural' origin, having potential applications in the pharmaceutical field. Considering the importance of the group, ICAR-Central Marine Fisheries Research Institute developed a research program to systematically search these candidate seaweed species for the development of promising bioactive molecules for human health and medication.

Miracle cure of several life-threatening diseases: Nutraceuticals from seaweeds

The rich diversity of seaweeds represents an untapped reservoir of bioactive compounds with valuable pharmaceutical and biomedical use. The research work at ICAR-Central Marine Fisheries Research Institute envisages a systematic approach involving chemical profiling of major species of seaweeds for lead pharmacophores coupled with evaluation of target biological activities against different disease models, for example, 3-hydroxy-3-methylglutaryl coenzyme A reductase, type-2 diabetes modulators (dipeptidyl peptidase-4, protein tyrosine phosphatase 1B), angiotensin-I, inflammatory cyclooxygenases and lipoxygenases. Optimised physical/chromatographic procedures have been developed by this institute to isolate and purify the molecules with target bioactivities.

An emerging area of research

Seaweed-derived bioactive components with potential health benefits are an emerging area of research. Considering the underutilisation of seaweeds, exploring bioactive compounds and development of any biologically useful products has dual benefits as health products and their commercial farming in coastal habitats, resulting in C- sequestration and C-budgeting in a scenario where climate change may pose a serious threat in future. Development of value-added products from these underutilised species will also promote their farming in coastal habitats, which has not been seriously explored earlier due to the lack of knowledge about their commercial importance. Seaweeds are the natural bounty of the great oceans, and these invaluable marine herbs are gifted with extraordinary medicinal properties. ICAR-Central Marine Fisheries Research Institute has devoted a research program to develop various health products from seaweeds towards their utilisation based on the National Policy to harness the potential of this natural wealth of Indian coastal waters.

ICAR-CMFRI extends technical support

Bangladesh: ICAR-CMFRI has extended a helping hand to Bangladesh by providing technical support to improve its marine fisheries sector, in the area of marine fish stock assessment, as part of a follow-up of the recommendations of the India-Bangladesh Joint Working Group (JWG) on cooperation in the field of fisheries and aquaculture.

In association with the Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO), ICAR-CMFRI trained a total of 12 mid-level officials from the Bangladesh Fisheries Department, Bangladesh Fisheries Research Institute in Mymensingh and the Institute of Marine Science and Fisheries, University of Chittagong on methods of stock assessment of tropical fishes.

The officials were trained on using various statistical tools, software and applications for the assessment of fish stock and data collection. The concept of genetic stock characterization using molecular markers and its relevance on stock assessment was also dealt with. Practical sessions and field visits were given importance in the training programme. Apart from this, the trainees were provided with an opportunity to experience fishing, onboard CMFRI's fishing vessel F.V. Silver Pompano.

Climate Change CMFRI submits Country Status Report on Indian Fisheries to SAARC

The Central Marine Fisheries Research Institute (CMFRI), has submitted the Country Status Report (CSR) about the impact of climate change on coastal fisheries and aquaculture sector in India, at a meeting between SAARC Agriculture Centre (SAC) and representatives from SAARC nations during a video conference convened by the SAC. The video conference was part of the Dhaka headquartered SAC's initiative to assess the impact of climate change in agricultural sectors of the SAARC member countries and come with resilient strategies.

The remedial steps to be taken to mitigate the impact of climate change on fisheries and aquaculture are as follows:

- Developing collaborative and comprehensive efforts to address climate vulnerabilities and commissioning of SAARC level task force to formulate strategies to mitigate the impact of climate change.
- Conducting awareness programmes on reducing greenhouse gas emissions and expansion of open sea cage farming and pen culture in coastal water bodies.
- Introducing saline temperature tolerant and fast-growing fish species for coastal aquaculture.
- Establishing fish sanctuary for improvement of natural stocks; setting up common gene bank for vulnerable species; developing alternate energy and fuel sources for inland and marine capture fisheries.
- Utilising e-commerce ventures and information and communication technology (ICT) for social and livelihood security of fishers and fish farmers.
- Framing of wetland conservation policies to manage coastal ecosystem.
- Encouraging community-based coastal fisheries and aquaculture management.
- Upgrading and modernising fishing industry-related infrastructure and setting standards for fishing practices.
- Supporting member countries through education, training, exchange programmes, visits, project support and resource

sharing.

- Developing ecologically sensitive habitats, mangroves, corals and wetlands.

- Farming of potential carbon sequestering species such as seaweeds and integrating with multi-trophic aquaculture (IMTA) and

- Developing low-cost fish farming technologies in tune with climate variability.

CMFRI transfers technology of seaweed farming to Andaman

The emerging seaweed farming industry, generally perceived as one of the most environmentally benign types of mariculture activity, will get a major boost in the country, with the institute transferring its technology of seaweed cultivation to the Andaman administration. The CMFRI provided scientific inputs on methods of seaweed farming suitable to the Islands, as part of the institute's initiative to intensify its consultancy services.

A feasibility study conducted in the seawater inundated areas in South Andamans revealed that these regions have huge potential for seaweed farming. The coastal areas that were devoid of coral reefs were selected to avoid environmental disruptions. The officials of the Department of Fisheries in Andaman were given training on the fabrication of floating rafts with bamboo, tying of seed material (seaweed fragments) in the ropes, tying of seeded ropes in the bamboo rafts and positioning them in the sea. The officials were also provided with technical inputs like monoline culture method of the seaweed, its distribution and diversity in the Palk Bay and Gulf of Mannar regions and seaweed products, besides being educated about the wild collection of seaweed and identification of commercially important seaweed species. Field visits were arranged to the seaweed farms at Munaikadu, Thonithurai and Kottaipattinam and seaweed processing unit at Manamadurai.

The seaweed farming venture, to be launched off the Andaman coast, is expected to meet the growing demand in the industry. Seaweeds are a valuable source of raw material for industries like health, food, medicines, pharmaceuticals, textiles, fertilisers, animal feed, etc. Seaweeds are also used for the production of agar, alginates and carrageenan. Chemicals from brown seaweeds such as alginic acid, mannitol, laminarin, fucoidin and iodine have been extracted successfully on a commercial basis. The CMFRI has been providing consultancy services to the Fisheries Departments of all States, and private entrepreneurs within and outside the country.

Conclusion

Sustainable fisheries management options, if implemented properly, indicate a possible enhancement of production potential in Indian EEZ to the extent of 6 million tonnes per annum or more. Opportunities in open sea cage culture and related developments in the field of mariculture during the last 5 years show a way forward in open-sea mariculture practices and propose an yield to the tune of 4 million tonnes per annum in the coming years from mariculture sector alone. High mariculture production, in countries such as China, South East Asia and others, is due to the production of seaweeds and molluscs, but the Indian seafood market comprises mainly of fin fishes of edible standards. With development in the right direction, there are possibilities that the marine fish production may rise to 10 million tonnes per annum (6 million tonnes from capture and 4 million tonnes from mariculture) by 2050.

Seaweed being harvested

Cobia fingerlings in cage