



**Indian Fisheries and
AquaCulture Forum**

11TH INDIAN FISHERIES AND AQUACULTURE FORUM
**Fostering Innovations
in Fisheries and Aquaculture**
Focus on Sustainability and Safety

Souvenir

 **KOCHI**
KERALA, INDIA

 **21 to 24**
NOVEMBER 2017

Organised by



Asian Fisheries Society Indian Branch (AFSIB)
Mangalore, India

Hosted by



ICAR- Central Institute of Fisheries Technology
Kochi, India





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CIFT Junction, Willingdon Island

Matsyapuri P.O, Kochi - 682 029, Kerala

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Supporting the livelihood of four million fisher folk in Indian marine fisheries – ICAR-CMFRI's recent initiatives

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Introduction

Indian marine fisheries sector is still generating the bulk of its production from the wild capture fisheries leading to employment for nearly four million people, comprising of 8.64 lakh fishermen families dwelling in 3,288 fishing villages along the east and west coasts of the peninsular India. In an earlier study by ICAR-Central Marine Fisheries Research Institute (CMFRI), we could infer that about 61.1% of coastal fisherfolk were engaged in fishing and allied activities, of which about 38% were active fishermen. This includes about 7.9 lakh full time and 1.35 lakh part-time fishermen apart from 0.64 lakh fish seed collectors (Marine Fisheries Census, 2010). Among those involved in allied activities in this sector, 36.5% were engaged in fish marketing (supply chain management) and 32.6% working on daily wages (Govt of India, 2012). Apart from this, a significant number of coastal inhabitants find their livelihood in secondary and tertiary activities related to fishing such as post-harvest handling and processing of fish, activities related to craft manufacturing and maintenance, gear preparation and mending, supply of fishing equipment, transport and logistics and others. For the entire population involved in the Indian marine fish production system, the resource comes from the natural production in the Exclusive Economic Zone (EEZ). About 58% of the resources are available in 0-50 m depth, 35% in 50-200 m depth and 7% in depths beyond 200 m. Presently, the marine fishing sector in the country is harvesting close to its estimated harvestable potential of 4.41 MMT, constituting nearly 47% demersal, 48% pelagic and 5% oceanic resource groups (Gol, 2011). However, recent assessments suggest that proper implementation of sustainable management options may enhance the production potential in EEZ to the extent of six million tonnes per annum or more (Gopalakrishnan *et al*, 2017). CMFRI is presently guiding a scientific team for revalidation of fisheries potential in Indian EEZ as per the directive of Department of Animal Husbandry, Dairying and Fisheries, Government of India.

Estimates of marine fish landings in India-2016 *vis-a-vis* issues in marine capture fisheries

India's total marine fish landings recorded a slight increase of 6.6% during 2016 compared to the previous year with a production of 3.63 million tonnes against 3.40 million tonnes in 2015. For the first time after 1998, sardine was not the top-ranked species in terms of the landings in the country. Gujarat remained at the top position for the fourth consecutive year with a production of 7.74 lakh tonnes followed by Tamil Nadu (7.07 lakh tonnes) and Karnataka (5.29 lakh tonnes). Even as Kerala, one of the major fish consuming states in the country, was slipped down to fourth spot for the first time in the history, the state registered an 8% increase in its total marine fish catch over the previous year producing 5.23 lakh tonnes in 2016. West Bengal, Karnataka, Gujarat, Kerala, Maharashtra and Daman & Diu witnessed a hike in the marine fish landings, whereas other states including Tamil Nadu registered a fall in the catch in varying degrees. Karnataka boosted its landings to reach to the third spot in the country by a production of 5.29 lakh tonnes ahead of Kerala, recording 19.6% increase over the previous year. In 2015, Karnataka was in the fourth position in the country. Mackerel, the national fish was placed in the first spot among the major resources obtained all over the country, after a long interval from 1999 with an overall production of 2.5 lakh tonnes ahead of oil sardine (2.44 lakh tonnes). However,

the catch of mackerel dropped by 33% in Kerala. A significant change observed during 2016 was in the landing pattern of bull's eye (*Priacanthus* spp). From a mere 4,691 tonnes in 2015, the catch of the fish was escalated to a six-times-high of 1.3 lakh tonnes this year. The fish emerged as a major resource in the landings with high production in the West Coast where Karnataka contributed the maximum. A huge hike in the landings of Hilsa shad, the most favourite fish of people of West Bengal, helped the state to increase its marine fish production to 2.72 lakh tonnes. The fish recovered from its previous trends of dwindling catch to reach 94,000 tonnes, a four-fold increase compared to 2015. The revival of Hilsa helped West Bengal to increase its marine fish production to 2.72 lakh tonnes in 2016 from a 1.18 lakh tonnes of 2015, a huge upsurge in the catch. At the same time, fish catch dropped significantly in Andhra Pradesh and Odisha mainly due to the cyclone which reduced fishing days in these states. Andhra Pradesh recorded a decrease of 35% during 2016 over the previous year, while 17% of catch declined in Odisha. The marine fish landing estimates of the ICAR-CMFRI also showed that chub mackerel (*Scomber indicus*), the new fish described by the CMFRI last year, was limited to the Kerala coasts only. Around one thousand tonnes of this resource was landed off the Kerala coast during 2016.

The estimate of value of marine fish landings during 2016 at the landing centre level in the country was ₹ 48,381 crores, registering an increase of 20.7% compared to 2015. At the retail level, the estimated value was ₹ 73,289 crores with an increase of 12.4% over the previous year. Even as the landings increased in the state, Kerala suffered a fall of 18.1% over previous year in the value of fish catch at the retail centres.

Only limited scope prevails for increasing production from coastal waters from capture fisheries. Oceanic waters of Indian EEZ remain under-exploited and offer considerable scope for enhancing production through targeted exploitation of large pelagics such as tunas, barracudas, rainbow runners, billfishes, pelagic sharks and oceanic squid of high commercial importance. Resources offering scope for increased production are large oceanic resources, deep sea resources and non-conventional resources such as myctophids. Further, mariculture including finfish cage farming, molluscan farming, seaweed farming and open sea marine cage farming along the Indian coasts can augment marine food production. We can classify the basic issues as Declining catch rates, Reduced per capita income, Increasing conflicts, Unsustainable fishing efforts – Increasing fleet size, Excess capacity (horse power/OAL/net-size/type), Exploitation of shelf area (neritic) at potential level, Untapped oceanic and non-conventional resources, Juvenile / under-size exploitation and High by-catch. Even with the resource as a limitation, the challenges faced by fishermen and their continued value chain are many and diverse in different states. For example, in the State of Kerala, which is a marine fish sensitive state, the fish arrival from other states is dominating the fish trade. According to the study by CMFRI, the gap between demand and the supply of domestic fish in Kerala is getting wider on a daily basis, revealing that 40% of Kerala's fish demand is met through the arrivals of fish from other states viz., Karnataka, Tamil Nadu, Andhra Pradesh, Goa, Gujarat, Maharashtra and Odisha. Despite a soaring demand, the fish price in Kerala registered a fall in 2016 mainly due to fish arrivals from other states. The price recorded a fall of 15 to 20% in 2016. This assumes significance in the context that fish price rose 35% in 2015 compared to 2014. A drastic decline was recorded in the price of mackerel (30.6%).

Seed production technology of high value marine species and national marine brood bank

The opportunities thrown open by mariculture is even more promising which include open sea cage farming, sea weed farming, integrated multi-tropic aquaculture (IMTA), mussel and oyster culture, ornamental fish production, pearl culture etc. The mariculture and export industry in the country will get a major boost, with the ICAR-CMFRI, Kochi successfully developing the seed production technology of two new food fishes, a marine ornamental fish and a marine ornamental shrimp which are commercially important and are high value marine species in the export market. While the Vizhinjam Research Centre of ICAR-CMFRI developed the breeding technology of the food fish named 'pink ear emperor', ornamental fish 'Marcia's anthias' and ornamental shrimp 'camel shrimp', the Visakhapatnam Regional Centre recently developed the seed production technology of Indian Pompano '*Trachinotus mookalee*'. The successful development of captive brood stock and breeding of all these species is the first of its kind in the world. ICAR-CMFRI took two years to develop the technology by using the Recirculating Aquaculture System (RAS) set up at the Institute.

The pink ear emperor (*Lethrinus lentjan*) is a high value food fish with superior flesh qualities and hardy nature. It is popular in the domestic market and has a potential demand in global seafood markets too. This is a sought-after food fish which attains a growth up to 2 kg and fetches ₹400 to 600 per kg in the domestic market. Indian pompano belongs to the Carangidae family, which is distributed in the Indo West Pacific region and is reported to be present in 15 different

countries of the Asian continent. In India, the fish is reported from both the west and the east coasts. It is a marine fish with sporadic occurrences in bays and lagoons and the adult fishes prefer shallow coastal waters with rocky areas.

In the wake of dwindling catch of the species, the breeding technology of these species will help the country boost the production of the species through mariculture activities such as cage fish farming. Presently the open sea cage farming in the country is restricted to four species of marine fishes. According to ICAR-CMFRI's technology, cages made of GI pipes with a dimension of 4 m X 4 m X 3 m (length, breadth and depth and a volume of 48 cubic metre) is suitable for farming in Kerala waters. The depth of the cage may vary depending on the depth of the water body. Seabass and pearl spot could be cultured in same cage simultaneously. Around rupees one lakh is adequate for installing the cage and stocking seeds of seabass and pearl spot in a cage, in addition to the fresh feed cost which requires another ₹ 60,000 for a cage. About 1000 numbers each of seabass and pearl spot seeds could be stocked in a cage of this size. After six months, seabass is expected to attain a weight of 700 g to 1.2 kg and pearl spot 250 g depending on the stocking size of the seeds (about 50 g). An average 700 kg of seabass and 250 kg of pearl spot could be harvested from one cage itself within six to seven months of culture with a survival rate of 90%. The farmer will get around ₹ 650 /kg of seabass and ₹ 550 for pearl spot in market.

The seed production of Marcia's anthias (*Pseudanthias marcia*), which is a high value marine ornamental fish, is a great achievement as it exhibits a complicated breeding habit. The species is one of the most expensive reef fishes traded in the marine aquarium export market and fetches around \$ 30 per fish in international market. The standardisation of larval rearing protocol of this species was also developed at the Centre successfully. Anthias, which is present near coral and patchy reef areas in the sea, is facing immense challenge with respect to its breeding habitats at a time when large-scale degradation of coral reefs is happening. The present technology developed by ICAR-CMFRI will also help the scientists to produce the fish seeds artificially without disrupting its ecosystem. The hatchery production and larval rearing technology of the camel shrimp (*Rhynchocinetes durbanensis*) will bolster the export industry of marine ornamental varieties. The shrimp grows up to 4-5 cm in length and fetches \$ 10-12 in the international market and in the local market it is sold at ₹ 500-700 per piece.

Further, the CMFRI has got an amount of ₹ 9 crore from the Centre to establish national brood banks of two marine fishes namely cobia and pompano. The Department of Animal Husbandry, Dairying and Fisheries (DADF) under the Ministry of Agriculture and Farmers Welfare approved CMFRI's proposal to enhance production of farmed cobia (*Rachycentron canadum*) and pompano (*Trachinotus blochii*) through the establishment of their brood banks and supply of larvae to all coastal states for seed production. The broodbank will be set up at Mandapam and Vizhinjam Regional Centres of the CMFRI and the regional hatcheries will be established in all maritime states. The broodbank will have quarantine facility, broodstock holding tanks, recirculation aquaculture systems and photo thermal control systems. The proposed facility will sustainably produce fertilized eggs and newly hatched larvae from bio-secure brood stocks of cobia and pompano fed with suitable diets under controlled water quality parameters and photoperiod.

This new project will resolve the issue of scarcity of quality seeds of cobia and pompano which are among the most suitable species for sea cage farming in Indian waters. Since the present marine capture fisheries is unable to meet growing seafood demand, we have to focus on increasing the marine fish production through mariculture activities. However, scarcity of quality seeds is a major impediment to the mariculture industry in the country. The proposed brood banks and regional hatchery facilities will cater to the requirements of quality seeds of cobia and pompano in all the maritime states. With the establishment of the brood banks, production of 48 million newly hatched larvae of pompano and 30.72 million newly hatched larvae of cobia could be achieved per year. The Mandapam Centre of CMFRI would act as the national nodal centre coordinating the seed production programme facilitating the supply of the seeds to various regional hatcheries set up across the maritime states in the country. CMFRI has already developed the technology for mass production of fish seeds of cobia, silver pompano, Indian pompano, orange spotted grouper and pink ear emperor. There is a network of over 1300 cages spread across the country under the technical guidance of the CMFRI. Lack of adequate seed supply often hamper the mariculture industry and so brood banks of marine finfish as a national facility is the need of the hour.

National Mariculture Policy

Unfortunately, the lack of a proper mariculture policy is a major lacuna to enhance mariculture ventures such as sea cage farming in the country. It is anticipated that with the availability of favourable policy guidelines for utilization of

coastal waters and increased private investments, the enterprise would expand further in coming days. The areas of focus include development of a leasing policy, demarcation of potential mariculture sites along Indian coasts on a GIS platform, measures to strengthen feed supply for mariculture ventures, guidelines for development of infrastructure and value chains for brood stock management, and large scale seed production of prospective fish and shellfish species and so on (George *et al.*, 2017). The CMFRI would continue its efforts in drafting the National Mariculture Policy in collaboration with the fisheries departments of maritime states and Union Territories to develop the existing mariculture practices into a massive scale and to avoid conflicts of interest between other sectors. CMFRI has conducted several sittings of scientific experts to come up with draft terms of reference with respect to the National Mariculture Policy. The same will be finalised soon and circulated to all the maritime States for obtaining feedbacks from the states and stakeholders.

More nutraceuticals from the sea

CMFRI recently developed the anti-obesity nutraceutical product using natural marine bioactive ingredients from selected seaweeds after years of intensive research and the product was found to be effective in combating dyslipidemia and obesity. (*Dyslipidemia* has an abnormal amount of lipids (e.g., triglycerides, cholesterol and/or fat phospholipids) in the blood). The bioactive principles contained in Cadalmin™ ACE inhibit various enzymes such as hydroxymethylglutaryl coenzyme A reductase and various target receptors, which are responsible for causing obesity and dyslipidemia. Cadalmin™ ACE provides a unique blend of 100 per cent natural marine bioactive ingredients from selected seaweeds with an eco-friendly 'green technology', which is currently under patent. The product has been proved to be devoid of any side effects following long-term oral administration of the tablets as established by detailed pre-clinical trials. The nutraceutical product is prepared from seaweeds, which are known for their extraordinary medicinal properties and are commonly available in the Indian coastal waters. Cadalmin™ ACE is the fourth in the series of the nutraceutical products developed from seaweeds by CMFRI. CMFRI had already developed nutraceuticals for diabetes and arthritis. The CMFRI is in the process of developing more health products and nutraceuticals from seaweeds that are bounty in Indian coastal waters.

NITI Aayog, ICAR-CMFRI join hands for sustainable development of marine fisheries

Aimed at implementing the Sustainable Development Goal-14 (SDG) of the United Nations in India, ICAR-CMFRI developed an implementable plan in collaboration with NITI Aayog and WWF-India. Representatives of all the coastal states and UTs along with stakeholders including the concerned officials from the central government ministries, academia and scientists from research institutes, UN bodies and NGOs participated in the brainstorming for this. A set of recommendations was finalised by the experts for achieving the stipulated targets included in the Sustainable Development Goal-14 of the United Nations.

The major recommendations include proposals for stopping registration of new fishing vessels in Indian waters to solve over-capacity in the sector; implementing licencing scheme to fishing gear and boat building yards; setting up marine parks, community reserves and no-take zones; uniform Minimum Legal Size (MLS) restrictions on all coastal States and UTs to prevent juvenile fishing and Ocean Regulation Management Act to bring uniformity in fishing in Exclusive Economic Zone (EEZ). Besides, the recommendations include calls for all coastal states to put in place a Vessel Monitoring and Surveillance (VMS) system; classifying ecologically sensitive marine hotspots as Biodiversity Heritage Sites and include marine literacy in school curriculum to create awareness on the importance of coastal and marine conservation. Proposals for restricting fishing rights exclusively to the fishers living in coastal villages, formation of District Level Committees (DLS) for monitoring CRZ violations, recognising importance of women groups and women organisations in coastal developments and formulation of National Mariculture Policy to boost mariculture as an alternate livelihood have also been included in the recommendations.

CMFRI to develop fishery management plan for the Islands

CMFRI has launched a new research project to improve the fishery of Lakshadweep. As part of the project, the scientific team will develop fishery management plan for the Islands. The main objectives of the project are to assess the stock of exploited marine fishery resources of Lakshadweep; to analyse the economic performance of fishing methods and market dynamics and assess the socio-economic status of fishers in the region; to relate fish stock dynamics with environmental variables; and to develop a fishery management plan for sustainable harvest and to transfer the plan to stakeholders. The Institute always wanted to develop the fishery management plan for the Islands in particular.

Lakshadweep because the region was in urgent need of the same for developing a well-accepted global market network for its fishery. Monitoring and assessment of exploited marine fishery resources of every territory along the coast is essential for sustained fish production. Further, the Institute is collaborating with the Andaman and Nicobar administration in implementing mariculture programmes such as sea cage farming, black lip pearl mariculture, seaweed farming and for streamlining the existing fish data collection procedure in the Andaman Islands.

Recent Societal Initiatives

Theeranaipunya - helps transform lives of young fisherwomen

The *Theeranaipunya* project, imparting training for skill enhancement and capacity building implemented by the Central Marine Fisheries Research Institute (CMFRI) with the support of the Society for Assistance to the Fisherwomen (SAF), is helping transform the lives of fisherwomen youth into a better level. A model initiative for women empowerment, the CMFRI's *Theeranaipunya* project focuses on the cognitive development of young fisherwomen in Ernakulam district helping them achieve better living standard. Under the project, a two-month training programme is offered to the educated unemployed young fisherwomen, along with stipend. It aims to enhance their employability skills and to help them secure suitable jobs. Under the programme, the participants are given guidance in pursuing higher education by helping them select appropriate programmes of study. In addition, extensive training on profiling, understanding and improving self, aptitude, motivation, personality, interpersonal skills, management strategies and communication is provided to the participants in the programme. *Theeranaipunya* also focuses on developing entrepreneurial skills among the fisherwomen youth and encouraging them to become entrepreneurs. The unemployed fisherwomen youth who have an educational qualification of plus-two or above are being selected by the CMFRI along with the SAF to the training programme. Three batches have successfully completed the training under the programme so far. The third batch of *Theeranaipunya*, which concluded recently, had 35 participants. After the class room training in the first month, the participants were offered experiential training in different governmental and non-governmental organisations, hospitals, business enterprises, research institutions and so on based on their need assessment and career planning. This capacity building training project is a means of CMFRI's social commitment towards the fisher community. The coastal belt of Kerala is having highly dense population and most of them are below poverty line. Presently the income earned by the fishermen is insufficient to improve their living condition. There is an urgent need of uplifting their socio-economic conditions by empowering the fisherwomenfolk. *Theeranaipunya* programme is meant for ensuring better employability to the fisherwomen youth and for making them financially self-reliant. CMFRI is extending further support to the participants to help them placed in better positions even after them completing the two-month training programme.

Felicitating the sea going first fisher couple from Kerala

The first sea going 'fisher couple' Shri K.V. Karthikeyan and Smt. K.C. Rekha in the country hailing from Chettuva, Thrissur, Kerala was felicitated in CMFRI and they were equipped with sea cages and cage farming technology by the Institute for generating additional income. Tuna Pillai Fisher Folk Welfare, a trust instituted by the family in memory of late Dr. P. P. Pillai, a former scientist of CMFRI, is sponsoring the education of one girl child from the fishing community every year. Ms. Maya Karthikeyan, a plus two student and daughter of the first sea going 'fisher couple' was identified jointly by the State Fisheries Department, Government of Kerala and CMFRI and the financial assistance handed was over to her in a function held at CMFRI.

"Swachh Samundar Abhiyaan" – Clean seas for better future

The CMFRI has won National Swachh Bharat Award in recognition of CMFRI's success implementation of Swachh Bharat activities across the country by introducing innovative methods last year. The CMFRI grabbed the second prize in national level among the institutes functioning under Indian Council of Agricultural Research (ICAR). During the previous year, CMFRI had formulated a swachhata action plan in public-private partnership which included treatment of wastes, usage of eco-friendly technologies, awareness in health and yoga, ensuring public participation in cleanliness drives, campaigns against plastic usage, measures for water conservation and awareness on plastic wastes in coastal water bodies etc. Moreover, the setting up of 'Fish Cemetery', an art installation to create awareness about the danger of dumping plastic wastes into sea, helped CMFRI to win the prestigious award considering it as an innovative method.

In addition, ICAR-CMFRI had launched cleanliness drive in the premises of major fishing harbours and the beaches across the country by ensuring public participation with a view to spread the awareness to keep our seas clean for a better future. Besides the Kochi Centre, the cleanliness drive was carried out by all Regional Research Centres of the ICAR-CMFRI located in various parts of the country, viz. Veraval, Mumbai, Karwar, Visakhapatnam, Mandapam, Tuticorin, Chennai, Mangalore, Calicut and Vizhinjam.

Conclusion

The sustained marine fish production will be the lifeline of coastal inhabitants, who have limited alternative sources for their livelihood. ICAR-CMFRI is coming up with alternative strategies and options that can potentially improve the incomes of India's impoverished and vulnerable coastal fisherfolk. There is a possibility of extending the frontiers of fishing to sustainably exploit the untapped deep sea and non-conventional resources. Further, it is important to economise the fishing operations for better profitability such as improving the fishing efficiency using recent technologies in harvest related operations, scouting the resources with the aid of satellite remote sensing assisted techniques and improved information communication technology tools. Further, the options available in mariculture related technologies were popularized through a series of demonstrations and participatory farming in maritime states of India. Through successful demonstrations on cage farming of marine fin and shellfish conducted along the maritime states, fishermen groups adopted cage farming in various states of India. Several farmers groups and development agencies in the coastal regions of Tamil Nadu, Karnataka, Andhra Pradesh, Kerala, Goa, Maharashtra, Odisha and Gujarat states have made agreement for technical support with CMFRI for cage farming (more than 1000 cages). With the inputs from CMFRI, National Fisheries Development Board (NFDB) has included marine cage farming as one of its developmental schemes. Thus, the team CMFRI is constantly in its pursuit to come up with technologies befitting the coastal communities to strive with more passion relying on its legacy of seven decades of committed research on marine fisheries.

