MPEDA Newsletter

VOL. X NO. 6 SEPTEMBER 2022

MPEDA concludes Golden Jubilee celebrations

Mr. D. V. Swamy IAS Takes Charge as Chairman, MPEDA

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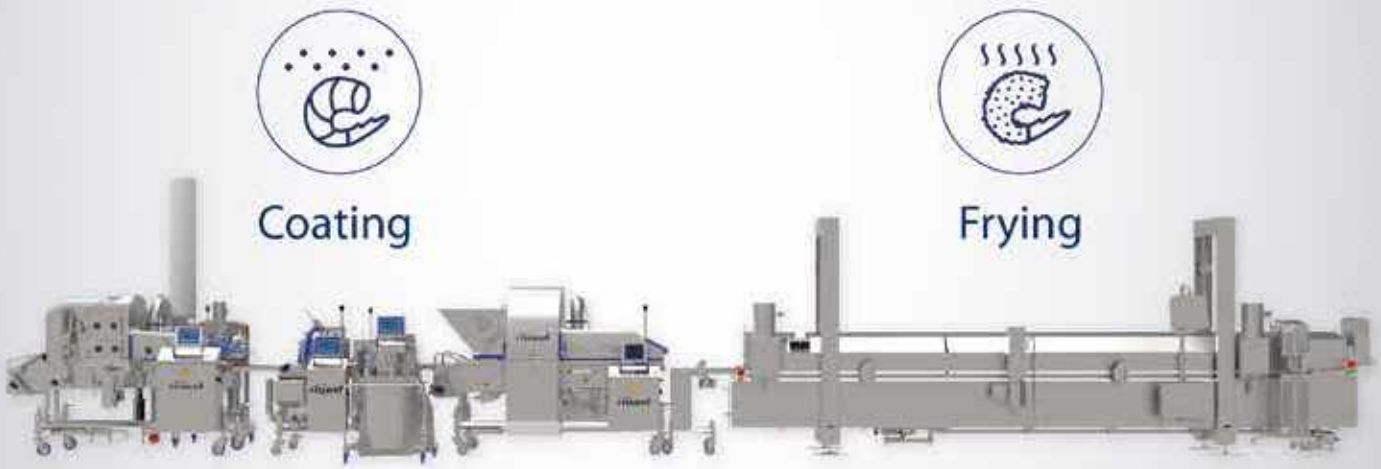

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On the Platter

Mr. Dodda Venkata Swamy
Chairman

Friends,

As you may be aware, I have taken over as the Chairman, MPEDA on 17th August 2022. Soon after, we had the visit of Commerce Secretary to Cochin to review the MPEDA activities on 19th August 2022. Commerce Secretary has chalked out certain action points for MPEDA pertaining to production sector, value addition and market promotion to boost exports to US$ 20 Billion in another 5 years. I am glad to note that Commerce Secretary was very much impressed with the functioning of MPEDA, especially its laboratory.

On 24th August 2022, MPEDA concluded its Golden Jubilee Year celebrations in all its grandeur at a function held in Cochin, wherein Hon'ble Union Minister of Commerce & Industry has given away a video message to the organization and the trade. The function was formally inaugurated online by Hon'ble Union Minister of State for Commerce & Industry Mrs. Anupriya Patel ji. Hon'ble Minister has also released a "Coffee Table book" of inspiring stories from the seafood exports sector.

The MPEDA Awards for Export Excellence for the years 2019-20 & 2020-21 were given away during the occasion by the invited guests, which included Hon'ble Member of Parliament of Ernakulam constituency Mr. Hibi Eden, former Chairmen of MPEDA and former Chief Secretary of the State of Kerala. The Champion's Trophy of MPEDA Golden Jubilee Marine Quest 2022 was also handed over to the winning team during the event by Hon'ble MP.

Though the marine product export sector has achieved record figures in 2021-22, we have to resolve quite a number of trade issues to boost up the trade and to reach the envisaged target figures in the coming years, which include compliance to regulations as per Sec 609 of US Public Law and Marine Mammal Protection Act, regulations related to biosecurity in various markets, antibiotic residue etc.

A mission from European Union will be visiting India in September 2022 to inspect our quality assurance and traceability mechanisms as far as antibiotic residues are concerned. The team will visit hatcheries, farms, processing units and labs in the states of Kerala and Odisha. We are hopeful that the EU team will recommend certain leverages to Indian exporters of aquaculture material to Europe after the visit.

It is pertinent to note that recently at the World Trade Organisation (WTO), Hon'ble Union Minister for Commerce and Industry Shri. Piyush Goyal ji has aggressively supported Indian fishers while negotiating the fisheries subsidies agreement. India has succeeded in bringing a regulation on those countries that are finishing the fish resources across the world, with deep-sea fishing. India has succeeded in bringing in a regulation for those developed countries that indulge in illegal fishing or catch fish but don't report it. This regulation also covered those who worked outside regulation and indulged in illegal, unregulated and unreported fishing.

This is a major victory for India, and has completely protected the interests of farmers and fishermen and the decisions taken in the conference will further strengthen the role of the multi-lateral body in promoting global fish trade.

I wish you all a Happy Onam and festival season!

Thank you.

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Mr. Dodda Venkata Swamy IAS joins as Chairman, MPEDA

Mr. Dodda Venkata Swamy has joined as new Chairman of MPEDA on 17th August 2022. He replaces Dr K. N. Rahgavan IRS, Executive Director, Rubber Board, who was holding additional charge of MPEDA. Mr. Swamy was serving as Development Commissioner, Cochin Special Economic Zone. A graduate in Economics and a Post Graduate in Political Science, Mr. Swamy has also done his Masters in Public Administration from John F Kennedy School of Government, Harvard University, Cambridge, Massachusetts.

A 2001 batch officer from Odisha cadre, Mr. Swamy has served as District Collector in Gajapati, Angul and Keonjhar districts of Odisha. He was State Mission Director for National Rural Livelihood Missions in Karnataka and Odisha.

He has also served as Revenue Divisional Commissioner in Sambalpur district of Odisha, and held additional charge of Vice Chancellor, Education department, Higher and Technical Education, Rourkela.

Webinar on 'Seafood market update and participation in International fairs'

South Korea

A webinar was organised in association with EOI, Seoul on 'Seafood market update and participation in BISFE 2022' on 14th July, 2022. Dr. T. R. Gibinkumar , Deputy Director (Market Promotion & Statistics), MPEDA welcomed the participants to the webinar. Mr. Swapnil Devidas Thorat, Second Secretary (Commerce & Investment), EOI-Seoul addressed the webinar and pointed that BISFE 2022 will lead to more B2B interactions and thus positively contribute towards trade.

Dr. M. Karthikeyan, Director, MPEDA briefed the seafood export of India to S. Korea and bio-security issues faced by shrimp imports to the country. The support of EOI- Seoul by providing market research and analysis of the study was acknowledged by the Director. Ms. Suh Minsung, representative of BEXCO gave a presentation on guidelines to Korean market and BISFE 2022. The S. Korean market guidelines covered the trend of consumption of marine products in the country, capture fishery, changes in product preference by consumers, strength of online food market etc. Salient features of BISFE 2022 were also covered in the presentation.

Mr. Bhushan Patil, Assistant Director (Statistics), MPEDA gave presentation on the 'Analysis of seafood market to South Korea, the presentation gave a brief of the export trend , item-wise exports, shrimp imports to South Korea, trade barriers and suggestions. It was followed by a question- answer session moderated by Dr. Gibinkumar. The webinar was attended by 44 exporters.

Singapore

MPEDA in association with High Commission of India in Singapore and Diversified Communications has organized a webinar on 22nd July 2022 to understand the benefits of participation in Seafood Expo Asia 2022. Dr. T. R. Gibinkumar, Deputy Director (Market Promotion & Statistics), MPEDA welcomed the participants and gave a brief on the objectives of the webinar. Mr. K. V. Swaminathan S. S. (PPS to High Commissioner's Office) addressed the webinar and spoke on the benefits of participating in SEA 2022. He highlighted the potential technical and commercial collaborations in the field of fisheries and aquaculture expected in SEA 2022 which would benefit the participants.

Mr. Anil Kumar P., Joint Director (Marketing), MPEDA spoke on the importance of Singapore market for

Indian marine exports. South East Asia being the 4th largest destination of Indian seafood, he urged the exporters to take the opportunity to participate in SEA 2022. A presentation on 'Analysis of seafood market to Singapore' was taken by Mr. Bhushan Patil, Assistant Director (Statistics), MPEDA. Ms. Pauline Chee from Diversified Communications gave a presentation on SEA 2022, which covered the outlook on South East market, key buyers of the fair, Business Matchmaking, event highlights etc. Question – answer session followed the presentations and Mr. Anil Kumar gave the concluding remarks.

Russia

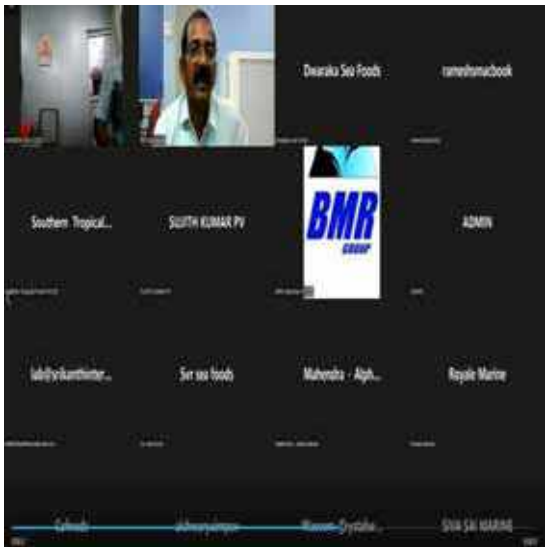
World Food Moscow is Russia's largest autumn food exhibition serving the global food and drink industry. This year World Food Moscow is scheduled to be conducted from 20 – 23 September. MPEDA in association with the coordinators of the fair has arranged a webinar for the exporters on 'Market updates of Seafood in Russia & Benefits of participation in the World Food Moscow – 2022' on 26th July, 2022. Welcome address was given by Dr. T. R. Gibinkumar, Deputy Director (Market Promotion &Statistics), MPEDA and Mr. Anil Kumar P., Joint Director (Marketing), MPEDA gave the introductory remarks. He briefed on the seafood export of India to CIS countries and to Russia in particular. During 2021-22 the target fixed for Russia is USD 162 million and only 10 percent of the target is achieved so far due to the current political situation. Participation in the fair is expected to bring about more business with Russia. A presentation on 'Market updates of Seafood in Russia & Benefits of participation in the World Food Moscow – 2022' was given by Mr. Thigginson, coordinator of the fair. Fish market updates of Russia, consumer trends, export and import, opportunities for fish producers in the fair, statistics on participation in previous fairs etc were covered in the presentation. Question- answer session was arranged for the exporters to clarify their doubts on the Russia seafood market and fair. Dr. Gibinkumar proposed the vote of thanks.

Germany

MPEDA in association with EoI, Berlin and coordinators of Fish International Bremen organized a webinar for exporters on 'Sea food market update of Germany and Benefits of participation in Fish International Bremen 2022' on 27th July, 2022. Mr. Gaurav Sharma, First Secretary (ITOU, Economics & Commerce), EOI Berlin, offered felicitations for the webinar. Mr. Anil Kumar P., Joint Director (Marketing), MPEDA gave the introductory remarks. He shared that Indian marine products exports has shown upsurge in EU market and almost 99 percent of the target fixed in 2020-21 was achieved.

A presentation detailing the Indian marine products exports to German market was given by Mr. Bhushan Patil, Assistant Director (Statistics), MPEDA. Ms. Sabine Wedell, coordinator of Fish International Bremen, presented the 'Sea food market update of Germany and Benefits of participation in Fish International Bremen 2022'. Basic consumption of seafood in Germany, Retail figures, Major preferred items and the General outline of the fair were detailed in the presentation. Participants shared their queries on Visa and Covid related travel restrictions which were cleared by EOI officials. Dr. T. R. Gibinkumar, Deputy Director (Market Promotion & Statistics), MPEDA moderated the webinar.

MPEDA-RD Vijayawada organized virtual meet with seafood exporters



A virtual meeting with exporters under the jurisdiction of MPEDA RD, Vijayawada was conducted on 2nd August 2022 on export market promotion through participation in fairs. The meeting started with welcome address by Mr. A . Jeyabal, Joint Director, who explained the participants about the purpose of the meeting, and briefed about the status of Indian seafood export during 2021-2022. While narrating the contribution of Andhra Pradesh to the export basket, he stressed the need to diversify markets through active participation in international fairs. He has also informed the exporters about the forthcoming 23rd India International Seafood Show to be organized next February in Kolkatta. Mr. Arivukkarasu, Assistant Director gave a presentation on exports and future needs.

In the group discussion ensued, major issues in the trade with different markets were discussed. The meeting ended with vote of thanks by the Joint Director, MPEDA- RD, Vijayawada.

Chairman, MPEDA meets exporters in Vizag

Dr. K. N. Raghavan IRS, Chairman MPEDA had an interactive meeting with the Seafood Exporters of Visakhapatnam on 28th July 2022. 19 seafood exporters participated in the meeting. After the meeting, Chairman visited M/s. Sprint Exports Pvt Ltd. and MPEDA Sub Regional Division at Visakhapatnam.

Chairman also made a visit to the Pilot Scale BMC facility for *Penaeus monodon* by MPEDA - RGCA at Bheemilipatnam .

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Grand ceremony conclude Golden Jubilee celebrations of MPEDA

The Golden Jubilee of MPEDA was concluded with a grand ceremony organized at Grand Hyatt, Kochi on 24th August 2022. The programme was formally inaugurated online by Mrs. Anupriya Patel, Hon'ble Minister of State for Commerce and Industry, Govt. of India. Hon'ble Minister also released a 'Coffee Table book' containing inspiring stories of seafood exporters during the function. Mr. Piyush Goyal, Hon'ble Union Minister of Commerce & Industry, Consumer Affairs & Food & Public Distribution and Textiles, GoI, gave an online message on the Golden Jubilee celebration of MPEDA.

Mr. Hibi Eden, Hon'ble Member of Parliament, Ernakulam, Mr. T. K. A. Nair IAS (Retd), former Principal Secretary & Advisor to Prime Minister of India and former Chairman, MPEDA, Mr. Paul Antony IAS (Retd), Chairman, KSIDC & former Chief Secretary of Kerala, and Former Chairmen of MPEDA, Mr. K. B. Pillai IAS (Retd), Ms. Leena Nair IAS (Retd), Dr. A. Jayathilak IAS, and the National President of Seafood Exporters Association of India Mr. Jagadish Fofandi were also present to grace the occasion. Mr. D. V. Swamy IAS, Chairman MPEDA welcomed the guest gathering. He recalled our Hon'ble Prime Minister's urge to the countrymen to start the 'Amrit Kaal' by nurturing new possibilities, realizing new resolutions and moving ahead with confidence. He also stated that the authority has been assisting stakeholders in primary production, processing, quality control, and marketing of the produces. The efforts have made India the 4th largest exporter of marine products to the global consumers and the second largest aquaculture producer. Mr. K. S. Pradeep IFS, Secretary, MPEDA proposed the Vote of Thanks.

The event also had the presence of dignitaries, senior officials in and around the Kochi city, MPEDA officials, retired officials of MPEDA, exporters etc. The Golden Jubilee year MPEDA has commenced with the formal inauguration by Mr. Mohd. Yousaf IRS, Commissioner of Customs, Ernakulam in a hybrid function arranged at MPEDA headquarters on 24th August 2021. MPEDA has organized a myriad of programmes since then conducted in various locations of the country to mark its Golden Jubilee, which included opening of Golden Jubilee Hall at its Head office building, organizing regional exporters meet, webinars, seminars, national

level Quiz programme etc. MPEDA Export Awards for Outstanding Performance in the export of marine products for the years 2019-20 and 2020-21 were distributed during the Golden Jubilee celebrations of MPEDA. Dr. M. Karthikeyan, Director, MPEDA gave a brief introduction on the export awards. 22 exporters won the awards for 2019-20 and 24 exporters won the awards for 2020-21.

In connection with MPEDA Golden Jubilee celebrations, a national level quiz programme, "MPEDA GOLDEN JUBILEE MARINE QUEST 2022" was conducted. The winners were presented cash prizes, trophies, medals and certificates. Rajeswari Memorial Endowment awards to the children of MPEDA employees for their academic excellence were distributed to the toppers in 10th and 12th standards. Golden Jubilee souvenirs were also distributed to all officials/pensioners of MPEDA and dignitaries invited for the function. The ceremony was followed by variety entertainment programmes and dinner.

Mr. D.V. Swamy IAS, Chairman MPEDA, welcomes the guests

Mr. Piyush Goyal, Hon'ble Minister of Commerce & Industry delivers online message

Mrs. Anupriya Patel, Hon'ble Minister of State for Commerce and Industry, GoI inaugurates the ceremony

Mr. Hibi Eden, Member of Parliament, Ernakulam offers felicitation

Mr. T. K. A. Nair IAS (Retd.) offers felicitation

Felicitation by Mr. K. B. Pillai IAS (Retd.)

Ms. Leena Nair IAS (Retd.) offers felicitation

Mr. Paul Antony IAS (Retd.) offers felicitation

Dr. A. Jayathilak IAS offers felicitation

Mr. Jagadish Fofandi, National President, Seafood Exporters Association of India offers felicitation

Dr. M. Karthikeyan, Director, MPEDA introduces MPEDA Awards for Export Excellence

Mr. K. S. Pradeep IFS, Secretary, MPEDA proposes the vote of thanks

Mrs. Anupriya Patel, Hon'ble Ministerof State for Commerce and Industry, Govt. of India releases ' Coffee Table Book' during the Golden Jubilee celebrations

Release of ' Coffee Table Book' during the Golden Jubilee celebrations

Glimpses of cultural programmes

Status, potentials and challenges in expanding inland open-water fisheries of India: 75 thyear of service of ICAR-CIFRI to the nation

B. K. Das and U. K. Sarkar
ICAR-Central Institute of Fisheries Research Institute
Barrackpore-700120, West Bengal

Introduction

The fish production in India has reached an all-time high of 14.2 million metric tons during 2019-20 and two-third of it is contributed by inland fisheries. The average annual growth rate of 10.88% in the fisheries sector during the year from 2014-15 to 2018-19 further shows the potential of the sector to harness.

The ambitious scheme of the Government of India, i.e. Pradhan Mantri Matsya Sampada Yojana (PMMSY) aimed to address the critical gaps in fish production & productivity, quality, post-harvest infrastructure, modernization & strengthening of the value chain, and establish robust fisheries management in accelerating the growth pace of the sector through increased production and productivity, income, employment, and export.

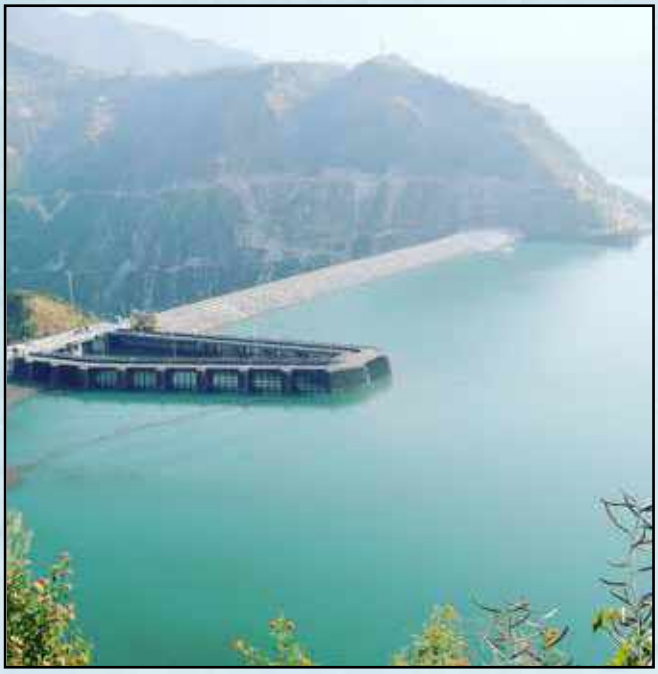
The country possesses diverse resources in the form of 45,000 km rivers, 3.51 million ha of reservoirs, 0.72 million ha of upland lakes, 0.5 million ha of floodplain wetlands, 0.3 million ha estuaries, 0.19 million ha of backwaters and lagoons. In the context of increasing demand, fish production from these inland open-water bodies need greater thrust not only for providing quality fish but also to ensure livelihood to the fishers and rural underprivileged ones.

ICAR-Central Inland Fisheries Research Institute, Barrackpore, one of the premier research institutions of the country in inland fisheries sector under the administrative control of Indian Council of Agricultural Research, was established on 17th March 1947. In 75th years of its glorious existence, the institute has played a pioneering role in ushering fisheries and aquaculture Revolution in India. The Institute has generated very useful inland fishery technologies on induced breeding and fish seed production; Composite fish culture; Fish seed prospecting and spawn collection in rivers; Reservoir and floodplain wetland fisheries management and In-situ fish seed production in cage and pen. The institute has also developed relevant guidelines for sustainable management of inland fisheries management. Through its research and technology development, the Institute has enabled the country to increase the production of fish by 11 times, since 1950-51.

With a vision of sustainable fisheries from inland open waters for environmental integrity, livelihood and nutritional security and a mission of knowledge-based management for enhanced fishery, conservation of biodiversity, integrity of ecological services and to derive social benefits from inland open waters, ICAR-CIFRI is making a visible impact on the national food and nutritional security. The present communication discusses recent developments in inland open-water fisheries in India including status, potentials, issues and way forward for sustainable utilization of the aquatic resources.

Fisheries resources and potentials

The fish production systems in the open-water resources can be classified into capture fisheries of the rivers, estuaries and backwaters, and culture-based



Kol dam, Himachal Pradesh

fisheries in reservoirs, lakes and floodplain wetlands. The network of Indian rivers with a combined length of 29,000 kms comprising 14 major rivers, 44 medium rivers and innumerable minor rivers and rivulets support one of the richest biodiversity resources in the world. The fish diversity and catch in many river systems over the years, however, have gone down, largely due to increased fishing pressure and several anthropogenic activities viz., erection of dams, sedimentation, pollution and many others.

The major rivers are estimated to yield 0.64 to 1.64 tons fish per km with an average of 1 ton/km, however, production is gradually declining due to various factors and issues. The present average yield from reservoirs is around 120kg/ha/yr, which is only about one third of its potential while in case of floodplain wetlands, the average yield is around 400kg/ha/yr against a potential of 2000 kg/ha/yr, leaving huge scope for fisheries enhancement.

Indian reservoirs are the largest and most potential inland fisheries resource, classified as small (<1000 ha), medium (1000-5000 ha) and large (>5000 ha) for management purposes. The area under reservoir fisheries has been estimated at 3.42 million ha (19,386 numbers).The area of small, medium and large reservoirs in the country are estimated to be 16,77,683 ha, 5,27,815 and 13,11,703 ha respectively. Addition of nine proposed reservoirs (99,917 ha) in seven states will further raise the total area to 3.51 million ha. The wetlands perform many important ecological functions and are considered to be the most productive ecosystem.

The wetlands are diverse in size and shape, geographical location, physical structure and chemical composition. The floodplain wetlands are also characterized by high organic productivity and accumulation of energy reserves at the detritus phase, enabling high carrying capacity, and thereby the potential for higher fish production.

Sustainable fisheries management

Inland open-water sector provides considerable scope for enhancement of fish production without deteriorating the ecological and biological integrity of the aquatic ecosystem. Stock enhancement/culture-based fishery is the most important eco-friendly options for sustainable fish production from inland water bodies. Enclosure culture in the form of cage and pen is an effective technology for seed raising and table fish production.

Wetlands and reservoirs fisheries management

The basic management for the sustainable enhancement of the reservoir and wetlands include stock enhancement, culture-based fisheries and enclosure culture.

Stock enhancement

Stock enhancement augments the stock of desired fish species through stocking or encouraging natural recruitment. Stocking of commercially important, fast growing species like the Indian major carps to utilize all the available food niches has been proved to be an effective management tool to increase fish yield.

In open water bodies, which have lost riverine connection due to construction of embankments and siltation, natural fish stocks of commercially important fish species have been depleted due to disruption of the auto-stocking process from the main rivers. In such cases, stocking with fingerlings of required fish species is found to be effective for increasing their fish yield.

Culture-based fisheries

In culture-based fisheries, fish growth is dependent on stocking density and survival is dependent on size of stocked fish. Over the years the Institute has provided technological backstopping for reservoir fisheries management in 21 States which resulted in substantial increase in average reservoir fish production in the country.

As a result of stocking, the average fish production of 2300 reservoirs enhanced from 20 kg/ha/year to 110 kg/ha/year. Production levels of 1000-1500 kg/ha/year has been demonstrated in beels in many part of West Bengal. Anicuts, barrages etc. are also suitable for culture-based fisheries and ease of recapture of the stocked fishes. The technology is environment friendly and less capital intensive and amenable to community-based activity involving local people.

Enclosure culture

In enclosure culture fishes are reared in confinement to raise fish seed and grow fish to marketable size through maintenance of free water exchange. Cage and pen have good scope for the production of table size fish thereby increasing the water productivity of reservoirs and wetlands.

In situ seed raising in enclosure is a viable and cost effective option to aid fisheries enhancement in wetlands and reservoirs. For ushering second blue revolution the culture-based fisheries is recognized as potential area in inland waters of India. Technologies developed on cage culture have been applied successfully in many reservoirs in different parts of the country.With cage technology the states like Jharkhand, Chhattisgarh and Telangana could able to produce 40-70 kg/m^3 *P. hypopthalmus* in different reservoirs.

Ecosystem-based modelling

Assessment of food web dynamics give important information on the ecosystem status and are widely used in ecological studies. Food webs are highly dynamic and vulnerable to change.

Mass balance models (Ecopath with Ecosim) have been developed and validated in peninsular reservoirs. Recently a three-dimensional model has also been developed for recommending the optimum stocking density and size at stocking in a reservoir of Kerala.

Pangas grown in cages, Telangana

Assessing ecosystem and species vulnerability

Climatic and environmental parameters are important in regulating reproduction cycles in fishes. Climate change may affect breeding phenology and plasticity thus success of reproduction in fishes. Rivers and wetlands in particular are more sensitive owing to their shallow nature. Protection and conservation of species is principally dependent on identifying breeding thresholds and underlying ecosystem processes that are vulnerable to change and their impact on reproductive success of a species.

Way forward for wetland and reservoir fisheries

The effective fisheries management in wetlands and reservoirs needs several technological interventions viz., priority on seed production and seed raising infrastructure in reservoirs and wetlands; refinement of the technology in different agro-climatic condition; appropriate governance for avoiding conflicts among the fishers and other stakeholders; diversification of species in enclosure culture; development of private public partnership; provision for post-harvest processing and value addition and their linkage to markets; ecological modeling for ecosystem-based management interventions and capacity building of stakeholders.

Riverine fisheries management

The riverine resources spreading throughout the country has been the principal source of fish of diversified species since ages. Some of the recommended programme for the restoration of riverine fisheries and ecology include river ranching, habitat restoration, pollution abatement, creation of fish passes for migratory fishes, proper monitoring of the fishing regulations including mesh size, closed season, protected waters, maintenance of maximum allowable catch and regulation of fishing gears, dissemination of responsible fisheries awareness to the fishermen, introducing of new concept like environmental flow, application of biotechnological tools like bioremediation for the control of pollutions, etc.

River Ranching

The main purpose of the river ranching programmes is to revive the threatened and depleting indigenous fishes by introducing fish seed to the natural environment. The fish seed may be procured through artificial breeding or wild seed collection from the same rivers system. During ranching programme, utmost care must be taken to avoid genetic pollution. The ranching sites on a stretch should be designated and fishing in the immediate vicinity shall be regulated after the release of individuals in to the river so as to ensure better survival of ranched fishes.

Habitat protection and ban season

Habitat protection in a river system is an effective management practice to conserve the fish diversity and to develop the overall fisheries of the river. Deep pools in rivers can be declared as sanctuaries which are found to harbour variety of species which can act as a seed multi-store for a river stretch. Such habitat protection in a river system is an effective management practice to conserve fish diversity. Ban season is another type of management measure for conservation of fish diversity and for the development of fisheries by prohibiting fishing activity especially during the breeding period so that recruitment activity of fish may not be hampered.

Pollution abatement and e-flow assessment

Industrial and domestic wastes are the main sources of pollution in rivers. Effluent treatment plant (ETP) and sewage treatment plant (STP) installation in major cities and towns along the rivers is essential for pollution control. Alteration of the natural flow regime of a river can disturb the entire river ecosystem resulting in the breakdown of the riverine fisheries and fish diversity. Thus, proper assessment of e-flow requirement of major rivers are essential for fisheries management.

Way forward for riverine fisheries management

The effective management of riverine fisheries resources requires focused programmes through identification and protection of breeding ground in river of threatened species for conservation; protection and conservation of breeding ground of commercially important species for stock enhancement; proper governance for effective management of riverine fisheries; application of GIS and remote sensing technology for resource mapping for sustainable utilisation and benchmarking of pollution and proper monitoring.

Seed stocking in Chamordaha, West Bengal

Major issues and threats

Inland open waters in India although possess a huge potential, but are also subjected to several prevailing issues requiring focused attention for sustainable development of fisheries and conservation of the fish diversity. Similarly, reservoir also faces certain challenges like scattered distribution, diverse management regime, lack of application of scientific knowledge, weak governance and policy support for fisheries, creating hindrances in realizing their fish production potential.

Floodplains are also ecologically sensitive resource showing enhanced size shrinkage in the last decade marked by declined capture fisheries and fish diversity owing to encroachment, sedimentation, eutrophication, macrophyte infestation, loss of connectivity to the main rivers, etc. Global climate change is recognized as a threat to inland open waters, especially shallow water bodies, and future efforts to restore and manage these resources will definitely be more complex. Some freshwater species have exhibited range shifts in response to increase in temperature.

Recent achievements in inland fisheries

ICAR-CIFRI ,a premier institute working for the development of inland open water fisheries development, and several other government and non-governmental organizations have associated in development and refinement of technologies and management strategies for inland open water fisheries over the years, important ones of them are as follows:

• **Strategic plan and Policy:** Strategic plan for the development of inland open water fisheries under PMMSY was prepared and communicated to the concerned department of Govt. of India. In addition, wetland fisheries development module has been published for sustainable floodplain wetland fisheries.

• **Cage culture:** Technology developed for raising table fish for exotic pangas catfish (*Pangasianodan hypophthalmus*) in reservoirs in cages with production of 40 kg/m^3/8 months. Experimental trials were successful for several other species in cages in wetlands viz., *Ompok biamculatus, Labeo bata, L.rohita, L. gonius, Systomus sarana, Barbonymus gonionotus* and *Heteropneustes fossilis.*

• **River ranching:** A total of 56 lakhs fingerlings of Indian major carps (IMC) and Mahseer were ranched in five Ganga basin states viz. Uttarakhand, Uttar Pradesh, Bihar, Jharkhand & West Bengal through 75 ranching programme to sustain and conserve the indigenous fish stock, enhance fish production and productivity, improve of economic status of locals and sustain use of fishery resources along the Ganga River under NMCG mission mode programme.

• **Electronic data acquisition system (eMATSYA):** Electronic Data Acquisition System using to capture real time fish catch data through mobile phones was developed and demonstrated.

• **Drone based application:** ICAR-CIFRI successfully designed and developed Drone based water sampling tools for inland water ecosystem for the first time.

• **Biocontrol of biofouling in cages:** Feasibility of polyculture of these species in cages has also been explored. Inclusion of 20% herbivore fish *Barbonymus gonionotus* with Pangasius has also been found not only to increase overall production but also effective as biocontrol against algal biofouling.

• **Low-cost floating fish feed for cage culture:** Using agro-industry co-products, a low cost feed with highly stable floating feed with FCR (1.3) has been developed for *P.hypophthalmus*. It saves feed cost by Rs.10-12/ kg compared to commercial feed with similar protein content. Similarly, sinking feed with high water stability has also been developed.

• **Application of acoustics for reservoir fisheries management:** Acoustic technology was utilized for identification of Potential Fishery Zones (PFZs) in reservoirs. This technology is expected to increase the fishing efficiency and reduce the fishing cost.

• **e-flow estimation:** e-flow requirement were assessed for river Dri, river Tangon, river Teesta, river Mahanadi and river Cauvery. e-flow requirements for breeding of some of the species like Rita rita and Tor putitora in river Mahanadi have been estimated.

• **Climate change mitigation:** Developed climate smart adaptation tools and identified climate resilient inland fish species. The carbon sequestration potential of diverse inland waters have been assessed.Thermal tolerance of the fish species of Ganga River basin has been documented. The climate preferendum have been estimated using innovative tools for several freshwater species which could be useful for mitigating the risk.

• **Hilsa fishery management guidelines:** Study in river Hooghly showed 20% over-exploitation of the hilsa stock. At least 20% reduction in fishing effort, along with restriction of < 90 mm mesh gill nets and banning fishing of brood fish during breeding season (June to August) are suggested for conservation of the stock.

• State Roadmap for blue revolution: Road maps for enhancing fish production from reservoirs through technological interventions including cage and pen culture for Bihar, Jharkhand, Odisha, West Bengal, five NEH states, and Andaman and Nicobar Islands have been developed by the Institute.

Conclusion

Inland open waters can play vital role in doubling fish production and achieving second blue revolution in the country. The rivers are the repository of fish germplasm and must be scientifically managed for the conservation of biodiversity.

Conservation of the fish diversity through ranching, habitat protection, closed seasons, pollution control, e-flow assessment, public sensitization and capacity building will play an important role for sustainable fish production, conservation and ecosystem management in inland open waters.

Further, effective policy implementation, governance, value chain and increased investment towards scientific management of these inland resources need to be given adequate attention for sustenance of fisheries and biodiversity conservation.

There is a greater scope to increase fish production from inland open waters in a sustainable manner and can contribute significantly to the fish production target under the PMMSY programme.

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Treads of CMLRE in documenting the marine living resources in Indian seas

The beginning

The Centre for Marine Living Resources and Ecology (CMLRE) , was originally established as a Subordinate Office of the erstwhile Department of Ocean Development (DOD) in 1985 to operate its one of its kind Fishery Oceanographic Research Vessel "Sagar Sampada" as Sagar Sampada Cell (SSC). Subsequently, the cell was elevated and declared as an attached office of the DOD with effect from 26.12.1985. On 12.01.2001, SSC was rechristened as CMLRE and mandated to study and develop management strategies for documenting the Marine Living Resources of Indian EEZ through ecosystem monitoring and modelling studies. Besides the above, the Centre is also involved in coordinating and implementing the time targeted Research and Development programs of national and regional importance in areas related to Marine Living Resources.

Reason behind our existence – the "Sagar Sampada"

The Sagar Sampada is a world-class multipurpose Fishery Oceanographic Research vessel (FORV) with 72m long draft constructed at Dannebrog Shipyard Ltd., Denmark and commissioned on 6th November 1984. The vessel is operated and maintained by CMLRE as a shared use facility among the institutions of the Ministry of Earth Sciences (MoES) and other marine institutions of the country.

The FORV Sagar Sampada has accomplished about 400 scientific oceanic cruises since her inception, including the one to the Indian Ocean sector of the Southern Ocean and two international cruises (Mauritius and Oman waters). The vessel is ice-strengthened to support India's scientific programme in the Southern Ocean. The vessel has the provision to accommodate 59 people, which includes 34 berths for crew members and 25 berths for scientists/ supporting staff. Sagar Sampada is equipped with a satellite navigator, a helipad and a medical room to ensure safe sailing, and attains an average speed of 8 knots with an endurance of about 20 days.

Scientific capabilities of Sagar Sampada

Sagar Sampada hosts the following key facilities to accomplish its research and development mandates:

- Conductivity-Temperature-Depth Profiler (Seabird SBE 911 plus).
- Acoustic Doppler Current Profiler (ADCP) - VM Broad band- RDI OS II 75KHz for the current vertical profiler.
- CUFES – The Continuous Underwater Fish Egg Sampler - to identify the potential spawning grounds of major economically harvestable fishes.
- MPN, AKMT, Bongo &VELNet for sampling to assess the Secondary Productivity.
- Grab, Dredge and Corer for Benthic studies.
- Fishery gears – Expo Model Trawl (Fish), HSDT (CV), IKMT
- Multi-frequency Echo Sounder – EK–60 (38KHz, 120KHz, 200KHz) and
- SONAR (Side-scan)- SX 90 Split Beam.

Laboratories onboard include Hydrographic lab, Oceanographic lab, Isotope lab, Meteorology lab, Acoustic lab, Microbiology lab, Wet Fish lab, Aquarium and Tunnel Freezer & Fish Hold.

The Program

The Marine Living Resources and Ecology (MLRE) was conceived as a long-term R&D program of the Centre to understand the complex interactions between the marine ecosystem and the bio-resources therein. The

Sagar Sampada - multipurpose Fishery Oceanographic Research vessel

MLRE has produced elaborate information on various biological, physical and chemical processes and the dynamics of the marine ecosystem and its biodiversity by undertaking several systematic studies onboard Sagar Sampada. The basic information about the living resources and the processes regulating the diversity and ecology is being acquired under this program. The unique R&D activities taken up under the MLRE addressed crucial issues of national and regional importance.

The Centre is attempting to correlate Marine Living Resources to the physical and biogeochemical environment to develop an "ecosystem approach" to manage the living resources. It is a proven fact that ecosystems are responding to long-term environmental changes, and species-level responses to such changes are key in estimating the adaptability of the biota to the changing environment. Understanding the basin-scale seasonal processes was another approach by the Centre in understanding the ecosystem changes, and under this program, vast data was collected/ gathered through several expeditions in the Indian Ocean viz; IIOE, JGOFS, GLOBEC and MLRP (1998 onwards). These programmes had built a solid knowledge base concerning the overall ecosystem processes and the associated biogeochemistry of the Indian Seas.

The six significant ecosystems within the Indian EEZ viz., the North East Arabian Sea (NEASE), South-East Arabian Sea (SEASE), Lakshadweep Island (LIE), North West Bay of Bengal (NWBoBE), South West Bay of Bengal (SWBoBE) and Andaman Island (AIE) are bestowed with different forcing mechanisms and distinct biological attributes.

The food webs and energy transfer in these ecosystems are unique and distinctive. Time-series observations and monitoring programs with an emphasis on the planktonic components of different size classes, including various functional groups (multi-trophic levels) are needed to understand short/ long-term

changes, which would be helpful to assess future changes in the marine ecosystems.

South-Eastern Arabian Sea (SEAS) has been widely covered during the 12th plan period (2017—20) which resulted in the identification of many trawlable grounds and fishery resources. Though exploratory surveys were conducted in many deeper regions of the Indian EEZ, the understanding and information in the SEAS was much advanced compared to the rest of the Indian EEZ, and focus is being paid now to address these regions also.

Resource mapping

Mapping the distribution and abundance of marine living resources and studying the underlying causes of their changes due to environmental perturbation is the primary intention of the Marine Living Resources Program. During the last two decades, CMLRE has been monitoring and surveying the occurrence of Harmful algal blooms, understanding of the standing stock of marine benthos, the potential presence of non-conventional deep-sea fishery resources, etc. These survey results are the first, and perhaps, the only available information on the deep-sea fishery resources of the Indian EEZ.

Offshore grounds suitable for bottom trawling operations were delineated based on bottom topographic surveys undertaken using deep-sea echo sounders. Exploratory fishery surveys conducted in deeper waters of the Indian EEZ indicated the presence of unexploited oceanic fishery resources outside the shelf area/continental slope region, which have immense scope for harvesting as an alternate resource to the coastal fishery, which are insufficient to meet the ever-growing human needs. The extensive studies on the frequency and extent of harmful Algal Blooms that adversely affect marine biogeochemistry, resulted in the observation of 448 species of microalgae, of which 86 were bloom-forming and 45, toxic species. Major hotspot regions for HABs of green Noctiluca have been investigated.

A species-specific satellite algorithm for Noctiluca, diatom and mixed bloom occurrence has also been developed. Marine benthos, the organisms living at the bottom of the sea, and involved in the process of mineralisation through nutrient recycling besides forming food for many demersal fishes, were also studied extensively. At the national level, decadal-scale changes in benthic diversity have been monitored based on the studies conducted so far. Numerous new species of marine benthos have been discovered and documented from the Indian EEZ.

Fourteenth financial commission (2017–21)

During this period, CMLRE has reoriented its efforts to concentrate on two aspects viz., 1) Marine Ecosystem Dynamics of the Eastern Arabian Sea (MEDAS) and 2) Resource Exploration and Inventorying System (REIS) to intensify its R&D activities through in-house programs. MEDAS activities were primarily aimed at assessing the health of the eastern Arabian Sea ecosystem for biological resources which are influenced either by natural processes or anthropogenic effects.

The upwelling dynamics and associated biogeochemistry and its inter-relationship between winter convective mixing (oxygen minimum zone) and factors behind the formation/intensification of seasonal hypoxia/anoxia along the eastern Arabian Sea shelf were studied extensively. Biogeochemical and biological responses to varying degrees of upwelling intensity and associated deoxygenation were documented with precision.

REIS activities focussed on the continuous long-term documentation and inventorization of marine biodiversity. The surveys unravelled the rich diversity of marine biota, including new discoveries and geographical records, built in-house expertise in handling, preservation, storage, maintenance and cataloguing of voucher specimens. Significant importance was given to documenting marine species diversity considering the worldwide initiatives taken to investigate and protect the global biodiversity. The Ocean Biogeographic Information System (OBIS), conceived to address these issues, recognized CMLRE as its regional node to develop the Indian Ocean Biogeographic Information System (IndOBIS).

Furthermore, India being a signatory of the Convention on Biological Diversity (CBD), needs to document all the biodiversity, including marine organisms in a time-bound manner and CMLRE entrusted with the responsibility of documenting the marine fauna. A comprehensive database has been generated

New faunal discoveries

on marine species occurrence, voucher specimens (primarily collected through FORV Sagar Sampada) and from published checklists and observational peer-reviewed papers (secondary data collected from literature). The Centre leads in the area of deep-sea taxonomy, describing more than 20 new species and documented many species as endemic to the Indian Ocean region. This has helped significantly in understanding the actual species diversity and its distribution in the deeper seas of the Indian Ocean.

Major accomplishments

• Indian EEZ has been delineated to six major ecosystems viz. Northeast Arabian Sea (NEAS), Southeast Arabian Sea (SEAS), Lakshadweep Sea, Northwest Bay of Bengal, Southwest Bay of Bengal and the Andaman Sea based on their different physical processes and varying chemical and biological responses.

• Significant gradients of deoxygenation, associated with upwelling, influence the fish aggregation and catch per unit effort (CPUE) along the coastal states of western India during the peak monsoon/upwelling periods.

• Biological production is highly affected during the strong El-Nino years, like in 2009 and 2015, which has adversely affected the fishery resources and catch efforts. The microzooplankton has been found to alter the food-web of the ecosystem from the algal bloom to non-bloom regions; thereby the changes in trophic implications define the tertiary community. Increase in active predators in the secondary production when compared to a decade ago shows a shift in the food-chain.

• Catalogued the larval forms of small coastal pelagics (*Sardinella longiceps, Rastrelliger kanagurta,*

Optimizer facility

Stolephorus commersonnii) along the South Eastern Arabian Sea to identify the spawning grounds. Spawning grounds of sardines were observed at Kochi, Valappad, Kozhikode and Kannur.

• Detailed study on the bio-composition and abundance of benthos of the continental margin up to 1000 meters showed a community shift in macrobenthos in response to impact of Oxygen Minimum Zone.

• CMLRE has joined as an International Oceanographic Data and Information Exchange (IODE) Associate Data Unit (ADU) within the IODE network of data centres as part of the regional OBIS node.

• Taxonomic catalogues on various deep-sea organisms such as lobsters, mantis shrimp, angler fish, armoured sea robins, brittle stars, bristle worms, were published for scientific outreach activities.

• Digital map of the trawlable grounds in the Indian EEZ was prepared based on the data compiled from the 9th plan.

• Regions such as the Terrace of Trivandrum, Terrace and canyons off Mangalore, Visakhapatnam, and island ecosystems such as off Diglipur, Andamans etc., is found to be highly diverse and endemic in terms of deep-sea biological fauna with many new geographical records.

• Documentation of more than 600 species of polychaetes, highest number of a single group ever recorded in the northern Indian ocean makes Andamans island ecosystem as one of the 'biological hotspots'. The area off Diglipur, at a depth of 670 m, was found to be

a heavy sponge bed with rich and highly diverse deep-sea fauna including many unique and rare organism such as chimeras, sea pens etc. Sediment nature and seasonal dissolved oxygen fluctuations determines the distributional patterns of many benthic fauna.

• The survey onboard FORVSS to assess the cetacean species off Kochi waters sighted a total of 12 cetaceans which includes marine mammals such as *Stenella longirostris* (spinner dolphin), *Stenella attenuata* (pantropical spotted dolphin), *Grampus griseus* (Risso's dolphin), *Globi cephala sp*. (pilot whale), *Balaenoptera edeni* (Omura whale) and *Tursiops sp*. (bottlenose dolphin).

• Morphological identification of deep-sea organism is complemented by molecular systematics. Thus, DNA barcodes for identification in the gene level have been generated for deep-sea fishes, shrimps, crabs, echinoderms, flatworms and has been submitted to NCBI.

The centre is recognised as a designated national-level repository for marine fauna, and the Referral Centre aptly named as "Bhavasagara" being developed at its new campus maintains large collections of voucher specimens (including type specimens), primarily collected onboard the FORV Sagar Sampada. The database contains 12,889 species of marine fauna archived from the Indian Ocean as checklist v1.0.

Fifteenth financial commission (2021–26)

During the current plan, it was decided to continue with the activities such as inventorization and mapping of marine biodiversity hotspots and species assemblage patterns of Andaman & Nicobar and Lakshadweep Islands. The activities of the Centre have been reformulated under four thematic areas viz. Biodiversity and Ecology, Ecosystem processes and Ocean Acidification effects, Fishery Resources and Habitat Assessment, and Societal activities to enhance its reachability. Societal Services entail technology development for selected marine ornamental fishes and imparting training of the same to the beneficiaries to support their livelihood.

Scientific infrastructure

With the recent installation of Scanning Electron Microscope (SEM) and Micro-Computed Tomography Scanner (Micro-CT), besides the existing flowCAM, RTPCR, and other advanced laboratory equipment, CMLRE is now fully equipped to taking the lead in deep-sea biodiversity studies. This will be complemented by state-of-the-art strategies for quantifying marine biodiversity based on genomic approaches.

Deep Ocean Mission

The Ministry of Earth Sciences is the nodal ministry for the implementation of the recently launched flagship program 'Deep Ocean Mission' with six verticals aiming to develop technologies to harness the living and non-living resources from the deep-ocean environments:

i) Development of Technologies for Deep Sea Mining, Manned Submersible, and Underwater Robotics, ii) Development of Ocean Climate Change Advisory Services, iii) Technological innovations for exploration and conservation of deep-sea biodiversity, iv) Deep Ocean Survey and Exploration, v) Energy and freshwater from the Ocean and vi) Advanced Marine Station for Ocean Biology.

Among the six themes, the theme "Technological Innovations for Exploration and Conservation of Deep-sea Biodiversity" is being implemented by CMLRE as a lead agency in association with the National Institute of Ocean Technology (NIOT) and Bhabha Atomic Research Centre (BARC). Under this initiative, the inventorization of deep-sea fauna and flora from hotspots like sea-mounts, capacity building on deep-sea taxonomy and genomic studies, development of biodiversity grid, implementation of National Biodiversity Targets, Bio-prospecting of deep-sea based bio-resources will be focused. The program would involve the inventorization of deep-sea fauna and flora through systematic sampling using a remotely operated vehicle (ROV) from the selected seamounts from the Indian Ocean.

Implementing this programme would bring out socially useful and commercially relevant knowledge, processes, and technologies developed from the sea. Further, this would enable the country to become a trans-national and regional hub for Marine Biology and Biotechnology research.

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Fishery Survey of India - 'Striving towards Sustainable Fisheries'

History

The Fishery Survey of India (FSI) was established in October 1946 as a pilot project known as Deep Sea Fishing Station (DSFS) by the Government of India with the objective of augmenting food supply through development of deep-sea fishing. The institute has started it's journey as DSFS and survey activities were initiated in a humble way with one vessel namely S. T. Meena, a mine sweeper converted into a trawler. The main objectives of the DSFS were charting of fishing grounds and training of deep-sea fishing personnel, realizing the gigantic task of DSFS the Government of India had established a number of such stations on both the east and west coast of India. Accordingly, the Offshore Fishing Stations (OFS) were established at Cochin in 1957 and two more stations at Tuticorin and Visakhapatnam in 1958.

The Offshore Fishing Stations operated wooden fishing vessels and few steel trawlers. The OFSs were initially under the direct administrative control of the then Ministry of Food and Agriculture, Govt. of India and they were brought under the control of DSFS in 1959. These stations operated 20 fishing vessels, of which, 15 were wooden vessels. Due to the aging of these vessels, they became obsolete for survey. Therefore, efforts were made to acquire new vessels from abroad and indigenously built.

In 1968, an ambitious programme of exploratory survey in offshore waters of the entire Indian coast was undertaken and a fleet of 20 indigenously built steel stern trawlers (Meena series) of 17.5m OAL were inducted. In 1969, Matsya Vigyani, 32m stern trawler acquired from German Democratic Republic under bilateral aid programme of international co-operation. After the induction of Meena series vessels, eight Offshore Fishing Stations were established in phase manner viz., Calcutta (1971), Port Blair (1971), Kandla (1971), Goa (1972), Mangalore (1972), Madras (1972) and Paradeep (1972). These OFSs were established in addition to the DSFS, Bombay and OFSs, Cochin, Tuticorin and Visakhapatnam.

In 1973, DSFS at Bombay was made an independent Offshore Fishing Stations (OFS). In 1974, re-orientation of the activities of OFSs took place and the institute was renamed as Exploratory Fisheries Project (EFP) and the OFS were named as the Bases of EFP. In 1976-77, Veraval Base was established and thus, the institute had 12 operational Bases with a fleet of 23 survey vessels. In 1976, Exclusive Economic Zone (EEZ) was declared and India has got an area of 2.02 million square kilometer of sea as it's sovereign right for exploitation of marine fisheries resources. Realizing this massive need of the nation towards food security, Govt. of India had started to acquire large survey vessels for the survey of demersal, pelagic and oceanic resources of the EEZ. In 1977, as a first leap to achieve this goal, Govt. of India had chartered a 69m OAL survey vessel M. T. Murena from Poland for a period of one year to carry out the exploratory survey of demersal and pelagic resources of North-West coast of India.

This was followed by acquisition of 9 vessels constructed abroad and in India under various bilateral aid programmes. This fleet included two combination trawlers (Matsya Nireekshani and Matsya Shikari) from Netherlands in 1979, two combination trawlers-cum-purse seiners (Matsya Varshini and Matsya Darshini) from Denmark in 1980, a tuna long-liner-cum-squid jigger (Matsya Sugundhi) from Japan in 1980 and four indigenously built vessels under Norwegian aid at Goa Shipyard Limited which included a purse-seiner-cum-tuna long liner (Matsya Harini) in 1980, a combination trawler-cum-tuna-long liner (Matsya Jeevan) in 1982 and two combination trawler-cum-tuna-long liners (Matsya Shakti and Matsya Vishwa) in 1983. In 1982, a confiscated Taiwanese vessel (Matsya Mohini) was added to the fleet by converting it to Stern trawler.

FSI Headquarters and Mumbai Base

FSI Chennai Base

FSI Mormugao Base

FSI Visakhapatanam Base

FSI Kochi Base

FSI Portblair Base

In 1983, with the acquisition of the larger survey fleet, the Govt. of India had decided to reorganize and upgrade the organization by adding more survey vessels, strengthening infrastructure facilities and scientific manpower.

As a result the Exploratory Fisheries Project (EFP) was renamed as the Fishery Survey of India (FSI) under the aegis of the then Ministry of Agriculture (Department of Animal Husbandry and Dairying). In 1988, the Institute was declared as a Science and Technology Institute. Consequent to the reorganization, the institute has amplified, enlarged and upgraded. With passing time, the FSI had passed through the administrative control of multiple ministries of Govt. of India viz., Ministry of Food and Agriculture, Ministry of Agriculture (Department of Agriculture and Cooperation), Ministry of Food Processing Industries, Ministry of Agriculture (Department of Animal Husbandry and Dairying), Ministry of Agriculture and Farmers' Welfare (Department

of Animal Husbandry, Dairying and Fisheries). In 2019, Govt. of India has embarked upon the ambitious programme of "Neel Kranti" "Blue Revolution" with the objective of doubling the income of the fisher folks. To achieve this goal Govt. of India has created the new ministry, the Ministry of Fisheries, Animal Husbandry and Dairying (Department of Fisheries).

Presently, the Institute has a fleet of 11 deep sea survey vessels (multifilament Tuna longliners - 2, monofilament Tuna longliners - 2 and Stern Trawlers - 7) equipped with the state of the art technology equipments. These vessels are deployed from seven operational Bases viz., Mumbai, Mormugao, Cochin, Porbandar on the west coast and Chennai, Visakhapatnam and Port Blair on the east coast in order to accomplish the mandate of the Institute.

The Institute has thus, emerged as the nodal Fishery Institute in India with the primary responsibility of marine fisheries resources survey, assessment and monitoring in the Indian Exclusive Economic Zone (EEZ) for promoting sustainable exploitation and management of the fish stocks.

The Institute has been generating real time geo-tagged data of marine fishery resources from shallow to deep and oceanic waters for more than 7 decades. In addition to the regular survey projects, research is also carried out to find out the diversified passive fishing methods and gear development for sustainable fishing by reducing by-catch & discard.

Government of India has assigned the responsibility as focal points for the matters related to the Indian Ocean Tuna Commission (IOTC). The Institute imparts training to the students sponsored by the CIFNET, Kochi on-board survey vessels on tenure basis as part of Human Resource Development programme of the Institute.

The FSI has a wide collaboration with several premier national institutes of the country for multiple research & development programmes. The Institute also been recognized by the University of Mumbai, Andhra University, Goa University, Kochi University of Science & Technology, University of Madras for research leading to Ph.D., and Master's Degree in Science. Scientists of FSI were also recognized by these universities as the research guides for Ph.D., and M.Sc., degree courses.

Marine Engineering Division (FSI-MED) is the latest addition to the Fishery Survey of India which was transferred from erstwhile Integrated Fisheries Project (IFP) currently NIFPHATT in the year 2005. The MED has a prime land of 3.8 acres and a jetty. The MED can undertake maintenance works including dry-docking / underwater repairs of the deep-sea fishing vessels at an affordable cost. The FSI-MED has ILR Servicing Centre Certified with ISO 9001:2000 and approved by the DG Shipping. It has a grab dredger with a capacity of 40 cubic meter per hour, and also Cutter Suction Dredger. The Marine Electronic Section of FSI-MED undertakes the repair and maintenance of electronic equipments like Echo-sounders, Auto Pilot, RADAR, GPS, VHF & AIS etc.

Marine Engineering Division (slipway drydock yard)

Marine Engineering Division (liferaft service station)

Mandate

The mandate of FSI is tuned from time to time to match the developmental activities of the fisheries sector as well as to meet the national and global requirements.

• Exploratory surveys, charting of fishing grounds, assessment of fish stocks in the Indian EEZ and adjoining high seas and research thereof, besides the specific surveys on request from the States and the Union Territories.

• Data collection and periodic re-validation of potential of fishery resources to provide advice on fishery management issues enshrined in the national, regional and global conventions and agreements and other associated activities.

• Monitoring survey of fishery resources in the exploited areas including coral reefs, application of Monitoring, Control and Surveillance (MCS) for regulating fishing activities and promoting Code of Conduct for Responsible Fisheries (CCRF) in the Indian EEZ.

• Maintain Data Bank and disseminate information on fishery resources to the end - users and act as an interface between the State/UTs and the Ministry of Fisheries, Animal Husbandry and Dairying, Government of India for Marine and Inland fish production and related aspects.

• Assessment of suitability of fishing gear, accessories and equipment with special reference to the preservation of environment and ecology of marine habitat.

• Fish stock identification and biodiversity studies including application of genetic tools and techniques.

• Marine fisheries forecasting including application of Remote Sensing for the benefit of Artisanal, Mechanized and Industrial sectors.

• Human Resources Development through the practical training of fishing operatives, fishermen, fisheries officials and students.

Major Functions of the Institute

The major functions of the Institute are conducting exploratory surveys, charting of fishing grounds, assessment of fish stocks in the Indian EEZ and adjoining high seas and research thereof besides the specific surveys on request from the States and the Union Territories, collection of time series geo-referred data through the exploratory surveys by the survey fleet and dissemination of survey findings/ data to the end users.

In order to disseminate the information on the survey findings, various extension activities are being carried out by the FSI in the form of Regional Workshops, Open houses, Marine Fisheries Exhibitions, awareness Rallies and direct interaction with the fishing industry, fishermen and other end users.

Besides these, the information is also being disseminated through various publications such as Resources Information Series, Meena News, Charts, Atlas, Special publications, Occasional papers and Bulletins. Other mode of dissemination is through Akashwani (AIR), Doordarshan, and various social media platforms.

Human resources development through the practical training to the fishing operatives, fishermen, fisheries officials and students are regularly being conducted. Under the capacity building programmes, the Institute organizes skill development programmes on-board to impart training on latest fishing methods, especially tuna long lining technology, squid jigging etc., to the fishermen of different maritime states and Union Territories.

Major achievements & contributions

• The FSI popularized demersal trawling technique in Indian waters and introduced several resource-specific fishing techniques including purse seining, trap fishing, squid jigging, pot fishing etc.

• Identified potential fishing grounds for various finfish, crustacean, cephalopod and other marine fishery resources in different regions of both the coasts and island groups of Indian EEZ.

• Introduced and established feasibility of multifilament and monofilament tuna longline fishing for oceanic tuna, billfish, sharks and other large pelagics and Bottom set vertical longline gear for perch resources.

• FSI has prepared species inventory of demersal, pelagic, meso-pelagic and oceanic fishery resources in the Indian EEZ and estimated the abundance index of these resources in the Indian EEZ and resource potential of individual species/resources for sustainable management.

• Biological studies conducted by the FSI scientists,resulted in, collection of important information on diet, maturity, growth etc., of different species, which are essential for management and conservation of these resources in the Indian EEZ.

• Survey and monitoring of marine fishery resources of Indian EEZ and adjoining seas are being continued to understand the status of stocks, fluctuation in the fishery, abundance and availability.

Vision, Mission and Focus

To augment the fish production and fishermen income through exploration of new or untapped fishery resources and fishing grounds, while ensuring the sustainability of the resources and ecosystem.

Mission of FSI is to develop as a "Centre of excellence" for fishery exploration and assessment to ensure new and sustained fishery resources availability to the fishermen, thereby providing cheap protein rich food for the citizens and raw materials for the industry; mapping of resources distribution over space and time; location of new fishery resources and charting of new fishing grounds; meeting the geo-referred data requirements of the fisheries management authorities of the nation and international organisations. To achieve the Vision and Mission envisaged, FSI will function with the following in focus:

1). Continuation of existing programmes to monitor the stocks of demersals and pelagics by trawling and oceanic resources by longlining for sustainable fishery and enhanced food security.

2). Future programmes:

• Focused studies on the submerged banks and sea mounts of the Indian EEZ and adjoining high seas for prospecting new fishery resources

• Survey of tunas, billfishes and pelagic sharks resources using drift gillnetting, pole and line fishing and purse seining in the Indian EEZ and high seas

• Survey of coastal pelagic resources by midwater trawling and purse seining

• Exploration of new resources of mesopaligics by midwater trawling in the Indian EEZ and high seas

• Focused survey of oceanic squids using squid jigging in the Indian EEZ and high seas

• Exploratory surveys for southern bluefin tuna, Antarctic toothfish, krill etc. using longlining and trawling in the Southern Ocean and Antarctic waters

• Assessment of marine fishery resources in co-relation with environmental and oceanographic parameters including temperature, salinity, oxygen, nutrients, rainfall, currents and wind.

• Studying the impact of climatic variability on marine fish diversity and abundance in the Arabian Sea and Bay of Bengal.

• Studies on marine pollution due to marine litter, marine debris, micro plastics, oil spill and ghost fishing (abandoned and lost fishing gear) and their impact on marine fishery resources

• Survey and assessment of marine mega fauna including marine mammals, sea birds, snakes and sea turtles of the Indian EEZ

• Adoption of latest methodologies for fish stock assessment and development of new models for tropical fish stock assessment

• Strengthening of the marine engineering division of the Institute for construction and repairs of deep sea and high seas fishing boats, making and repairs to the marine fishing equipment and allied facilities.

• Application of remote sensing in forecasting of all types of fishery resources

• Studies on the aquatic food web and trophic interactions

• Application of GIS as a tool for fisheries management

• Capacity building of the scientific manpower as well as the stakeholders; Establishment of national fisheries training centre for imparting training to fishermen on boat construction, fishing gear fabrication, boat/vessel navigation, boat/vessel engineering, lifesaving equipments, fishing and onboard post-harvest technologies

• Commercialization of technological innovations through consultancies, training, demonstration and extension education, through public-private partnership, in the fields of marine engineering and fishing technologies.

CIFNET leads training manpower for marine fisheries

1. Introduction

Govt. of India, in 1959 constituted a committee on "Fisheries Education", for assessing the manpower requirement and to suggest measures for providing trained manpower for boosting the fishery developmental activities. CIFNET, the erstwhile Central Institute of Fisheries Operatives (CIFO), was thus established in 1963 at Kochi on the recommendation of above committee to meet the trained manpower needs of ocean going fishing vessels and that of fishing industry.

Subsequently, a unit of CIFNET was established in Chennai in 1968 and another unit at Visakhapatnam in 1981 to cope up with the additional requirements due to expansion of fishing fleet/industry of the country. Since then, CIFNET is serving the nation by creating trained manpower needed for manning the ocean going/deep sea fishing vessels.

CIFNET plays a pivotal role in shaping the blue revolution of the country by creating technical manpower for marine fishing operation. This is the only national institute of its kind in the country to meet the training requirements of technical and certified Personnel to man the ocean going fishing vessels such as Skippers, Mates, Engineers and Engine drivers of the power fishing vessels as stipulated in the Merchant Shipping (Amendment) Act 1987. The Institute is also responsible for developing the required technical manpower for the supporting shore establishments and for the effective operation of fishing vessels.

2. Mandate

• To create technical manpower for the operation of Ocean going /Deep sea fishing vessels.

• To create trained manpower to manage fishery establishments.

• The Institute has also expanded its mandate for training the fishermen of the coastal states and Union Territories through capacity building training programme under Blue Revolution/Pradhan Mantri Matsya Sampada Yojana(PMMSY).

• To provide training for technical teachers for manning the fishermen training centres attached to Maritime States and Union Territories.

• To conduct studies on fishing craft, fishing gears and equipments and provide extensive training to accelerate advancement in fishing technology for enhancing productivity of fishermen and increasing marine fish production.

• To help developing nations in the South-east Asian, Middle east and African regions to create technical manpower for development of Marine Fisheries

3. Contributions made to fisheries sector since inception of CIFNET

• Development of Skilled Manpower for Deep sea fishing vessels

• Construction and Introduction of Ferro cement boats

• Energy conservation in fishing vessel by introducing Kort nozzle

• Location of Tuna grounds and training personnel on Tuna Long line Technique

• Demonstration of Shrimp trawling using resource specific fishing gear

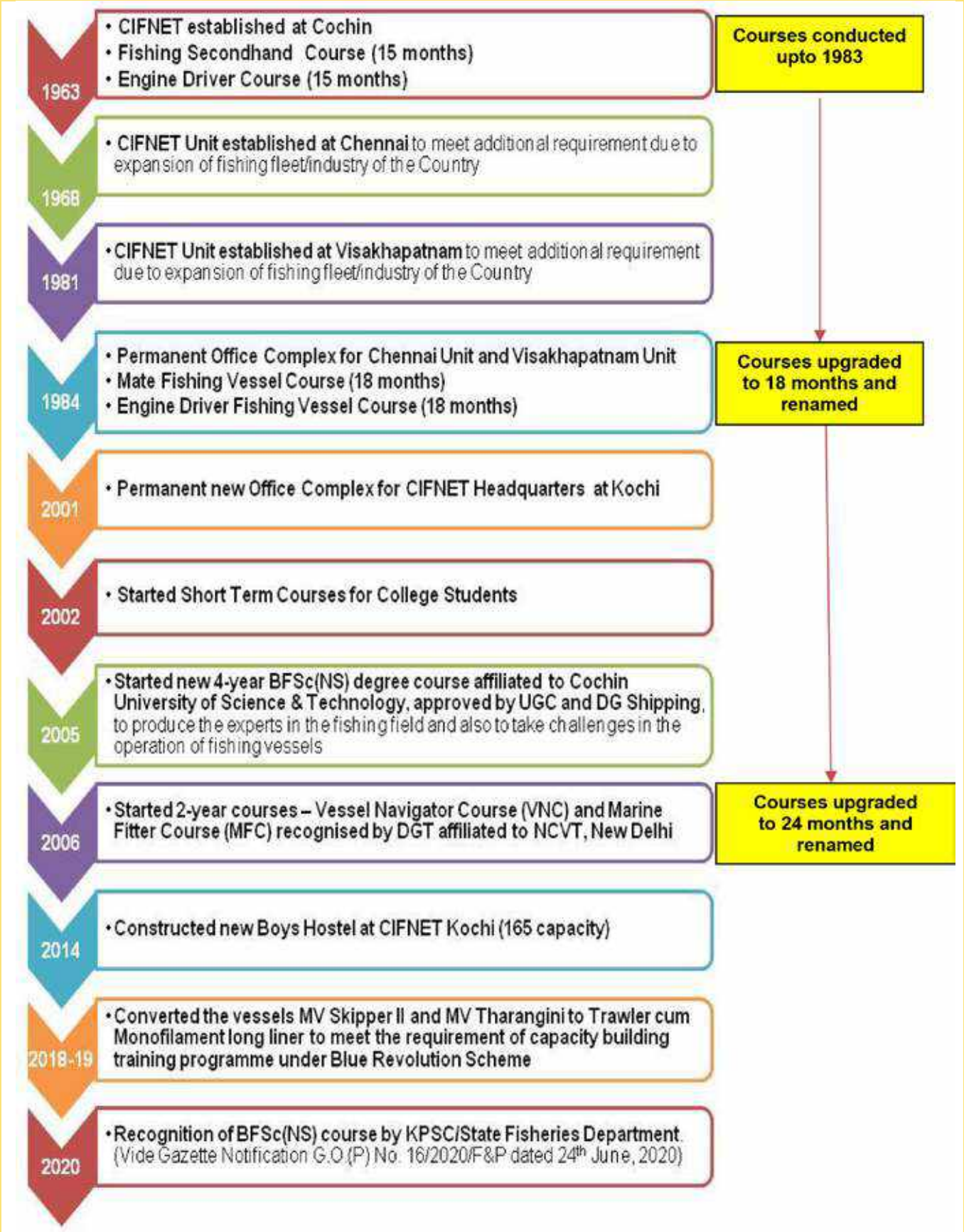
• Conducted experiments with Turtle Excluding Device (TED) on Trawl nets operated off Orissa (Puri) coast

• Study on the usage of LPG as fuel on Outboard Motor operated in traditional fishing sector

• Capacity building in Deep sea fishing on Mono filament long lining and onboard handling of tuna for Fishermen

• Training of Fishermen through outreach programme

4. Major developments of CIFNET since inception



5. Training courses offered at CIFNET

• Organized training in the field of Fishing gear technology & fishing Technique, Seamanship & Navigation, Marine Engineering, Refrigeration, Electrical engineering & Electronics are being conducted at all the three centres of CIFNET. The training with the emphasis on practical learning is imparted through various regular and short-term courses as follows.

Sl.No.	Course	Duration
1	BFSc (Nautical Science)(Affiliated to CUSAT recognized by UGC	4 years
2	Vessel Navigator Course (NCVT) recognised by DGT, MSDE, New Delhi with NSQF Level 5	2 years
3	Marine Fitter Course (NCVT) recognised by DGT, MSDE, New Delhi with NSQF Level 5	2 years
4	Shore Mechanic Course	1 year
5	Elementary Fishing Technology Course(Statutory course)	2 months
6	Advanced Fishing technology Course (Statutory course)	2 weeks
7	Fishing technology for Coast guard officers	1 week
8	Shortterm courses for fishermen under PMMSY scheme(In-house and outreach)	1-6 days
9	Short term courses on Fishery Technology, Marine Engineering, Refrigeration & Electronics, Nautical Science for fishery officials ,professional & VHSS students.	Tailor made
10	Special training course for National & Overseas candidates	Tailor made

Post institutional training

CIFNET Trainees on completion of their institutional training acquire their sea service and working experience onboard fishing vessels by joining as Junior Deckhands and Engine room assistants. Based on their rank in the examination and seniority, the trainees are provided training opportunities onboard the Government of India fishing vessels available at CIFNET, FSI, CIFT and other organizations. Trainees are also acquiring sea service by working on board fishing vessels of private fishing industry. After acquiring required sea service, the trainees qualify the competency as Mate /Engine Driver fishing vessel by passing the competency certificate exam conducted by Mercantile Marine Department. After passing the basic competency examination, they acquire further sea service, to qualify for Skipper and Engineer of fishing vessel.

For post institutional training to acquire required sea service, besides CIFNET vessels, the trainees are provided opportunities on board the fishing vessels of Fishery Survey of India, Central Institute of Fishery Technology, Department of Ocean Development etc. On board, the students are familiarised with the ways of seafaring as well as fishing using gears like bottom trawling and tuna long lining. They are provided hands

CIFNET Headquarters at Cochin

on experience on managing a ship at high seas. For this, the vessel is fitting with the advanced navigation and communication systems like Automatic Radar Plotting Aid, Automatic Identification System for automatic tracking of vessels and Digital Selective Calling system that allows sailors to communicate using medium frequency and high frequency maritime radio systems. These will train the students in collision avoidance procedures.

6. Overall achievement of CIFNET

CIFNET has been conducting various regular and short term courses since inception. A total of 23,438 candidates have been trained as on March 2022 and 398 students are currently undergoing the regular training.

(a) Capacity building training programme for fishermen on tuna longline and onboard handling

CIFNET is conducting Capacity Development Training Programme under NFDB assistance on Long Line Fishing and Tuna Handling Onboard the Vessel for the fishermen since 2017. A total of 490 fishermen have been trained under this programme till March 2022.

(b) Training programmes of CIFNET for fishermen under PMMSY through short term courses

Towards achieving the objectives of Pradhan Mantri Matsya Sampada Yojana (PMMSY) the Institute has formulated various training programmes, newly designed for skilling/training of the fishermen by reaching to the fishing villages/fishing harbours. The training aids and accessories are taken to the respective places of outreach training programme which are conducted in coordination with fishery associations/ officials, local bodies of the fishing villages/ gramma panchayat.

(c) MoU between CIFNET and MPEDA-NETFISH for fishermen training

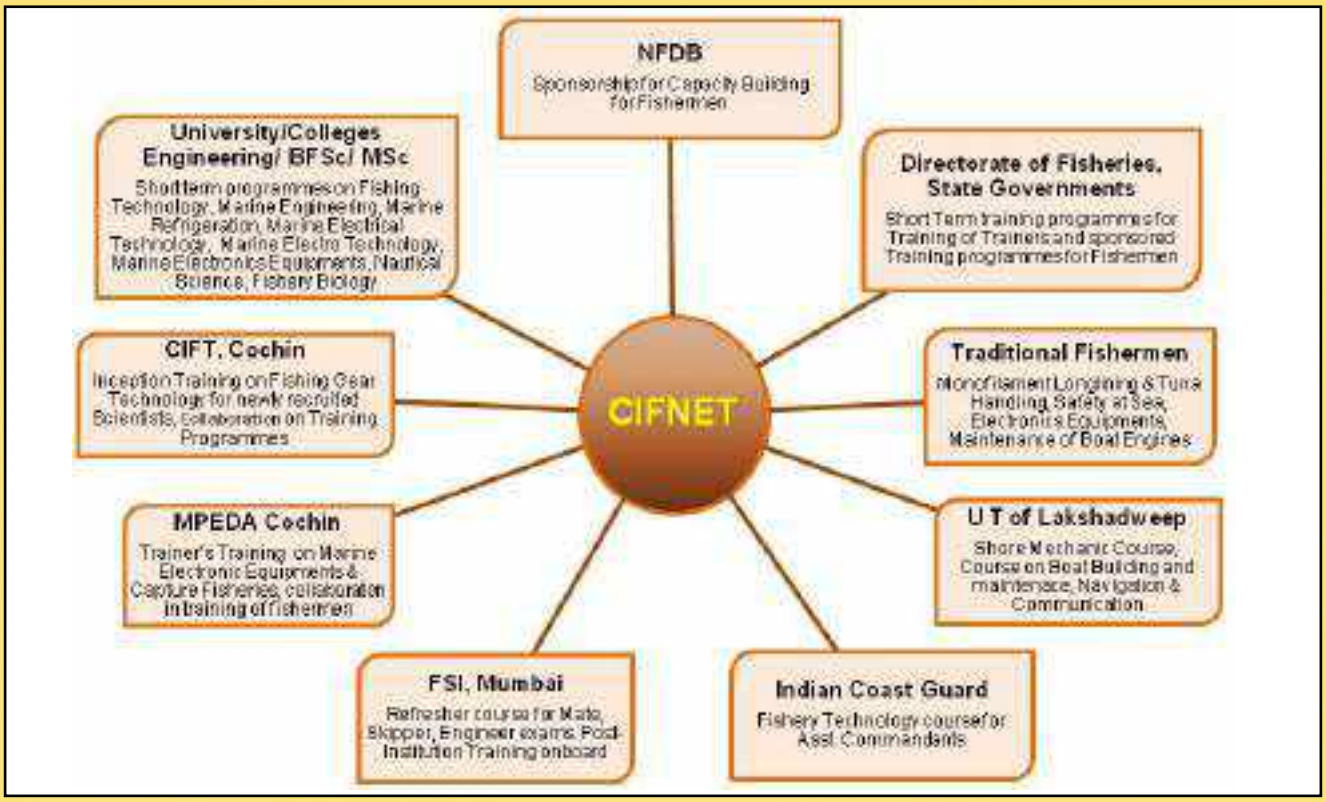
CIFNET and MPEDA-NETFISH signed a Memorandum of Understanding (MOU) on 13th April 2022 to conduct training programmes jointly for fisher community in all coastal states and Union territories in India. This initiative has been taken in the best interest of fisher community and aims at welfare and socio-economic upliftment of the fisher community, as well as resource conservation and post-harvest quality management by imparting adequate skill development training programmes under Pradhan Mantri Matsya Sampada Yojana (PMMSY) scheme.

(d) Skill Training for fishermen of Andaman and Nicobar islands under PMMSY

A special training programme under PMMSY scheme was conducted for fishermen of Andaman& Nicobar Islands during the period from 15.3.22 to 13.4.22 in 10 batches for a total of 385 fishermen.

7. Infra structure facilities of the institute

CIFNET has excellent facilities to train students and professionals in almost every aspect of deep sea fishing. It can cover subjects in three key areas



involved, namely seamanship navigation, fisheries technology aboard the vessel and marine engineering. The institute is well equipped with Fishing gear Technology hall, fish processing lab, biology, microbiology and biochemistry lab, marine engineering workshop, engine room simulator, refrigeration, pneumatics and hydraulic labs, Navigation simulator, Radio-Telephone station, Navigation Chart hall, Electronics, Electrical and Computer labs to provide the students with a comprehensive knowledge about the industry and keep them abreast with the most modern technology available anywhere in the world.

Besides the infrastructures in the institute, CIFNET boasts three big sea-faring vessels to give hands-on training for students. These vessels MV Prashikshani MV Skipper II and MV Tharangini are fitted with bottom trawling and tuna long line fishing gears.

CIFNET has excellent hostel facilities available for students registering for various courses at their centres. The new hostel building at Kochi can accommodate nearly 160 students, while the old hostel building is used to accommodate fishermen joining for on the job training. The hostels at Vishakhapatnam and Chennai can accommodate 120 and 90 students respectively.

8. Inter-institutional activities in the development of marine sector

CIFNET is associated with various Central and State government organizations, Indian coast guard, Universities, Colleges and private fishing industry by way of imparting the technical knowledge available in the development of marine fisheries sector. The inter-institutional activities of CIFNET are depicted below.

9. Future vision of CIFNET

1. Continuing with the Regular Training Programmes of VNC/MFC/BFSc (NS) complying with DGT, New Delhi/CUSAT, Kochi regulations issued time to time. The syllabus has been revised recently for the above courses in order to meet the present challenges/ development.

2. Giving maximum importance for the fishermen training through in-house/outreach programmes under PMMSY Scheme.

3. Strengthening of the courses by providing established lab for microbiology and fish processing as per the national standards.

4. Replacing of the existing old vessels with the indigenized new vessels to meet the future training requirements onboard.

Diversification of livelihoods among coastal Families through brackish water aquaculture technologies integrated with agro- based technologies and societal developments

[Livelihood programme in Pulicat lake]

Dr. B. Shanthi, Dr. T. Senthil Murugan, Mr. I. F. Biju and Dr. C. V. Sairam
ICAR- Central Institute of Brackish water Aquaculture, Chennai 600 028

Brackish water aquaculture is a prospective sector for realizing higher returns in short time span through scale neutral technologies. In addition, the fishers can spend their lean period and non-working hours for income generation activities based on brackish water aquaculture.

The economic conditions and social status of the women, tribal and their family justify that they need profitable technologies for increasing their livelihood source. The coastal tribal and coastal women are primitively hunters, fishers, crab collectors, fish and crab farming farmers, live feed collectors, fish processors and fish marketers. Owing to their meagre life skills, they have remained as a marginalized community and suffer from social and economic discrimination. They often lose their traditional livelihood due to urbanization and associated habitat modification. During lean fishing season, their major income from fishing is affected and they are compelled to look for alternative avocation during off-season. The available common brackish water resources in these villages can be effectively utilized for brackish water aquaculture.

Brackish water aquaculture technologies like milkfish nursery rearing and grow-out culture in brackish water pond and pen, Asian seabass nursery rearing in brackish water pond and low volume cage culture in open water, crab farming in brackish water pen and boxes, fish food product development integrated with agro-based farming interventions like poultry and duck farming and community/societal development programmes like, Children and Youth Study Center were demonstrated and established for the tribal and coastal SC beneficiaries of Lakshimipuram tribal Nagar, Kattur village and Thonirevu village, Kottaikuppam Panchayat, Pulicat, Tiruvallur district, Tamil Nadu. Before the implementation of the project, required capacity building programmes and exposure visits to Muttukadu Experimental Station of ICAR CIBA were undertaken to the project team of farmers and farmwomen.

A. Community fish farming integrated with agro-based farming among tribal families of Kattur village, Tiruvallur district, Tamil Nadu (under STC)

Brackish water canals and creeks leading from Pulicat Lake seem to be a rich source of brackish water for coastal aquaculture interventions. Aquaculture technologies viz., two tier milkfish farming in pond and pens, seabass nursery rearing in hapas, crab farming in pen and boxes were demonstrated by integrating with agro-based farming like duck and poultry farming, vegetable gardening, etc.12 Scheduled Tribal families of Lakshimipuram tribal nagar, Kattur village were adopted under the CIBA – ST component. Crab and fish pens were installed, fish, feeds and assets were distributed to the beneficiaries. Nutritional status, skill development, decision-making roles and dignity was improved among the tribal beneficiaries. Taboos and beliefs were overcome.

Bank accounts were opened for the beneficiaries and the realized profit of ₹ 70,000 mainly from crab farming was deposited in their bank accounts and re-invested in farming. Due to unexpected floods during the North East Monsoon, rest of the interventions were severely damaged, which indicates that coastal communities, which are prone for natural calamities like cyclones, floods etc., need suitable insurance mechanisms/ development schemes for their livelihood income.

Crab farming in pens and boxes, seabass nursery rearing (in hapas) and milkfish farming in community pond and open pen by Scheduled Tribal families of Lakshimipuram tribal Nagar, Kattur village

Dr. K. P. Jithendran, Director-CIBA interacting with the beneficiaries

B. Alternative livelihood opportunity development integrated with agro-based farming among coastal Scheduled Caste community of Tiruvallur district Tamil Nadu (under SCSP)

Alternative livelihood opportunity development through crab farming was undertaken among the 35 coastal Scheduled Caste families under the CIBA - SCSP schemes at Thonirevu village, Kottaikuppam panchayat, Pulicat, Tiruvallur district.

Crab farming in pens and boxes, seabass nursery rearing (in hapas) and milkfish farming in community pond and open pen by SC beneficiaries under the SCSP initiatives

Profit earned from crab harvest and Fish food product

At Thonirevu village in Kottaikuppam panchayat, Pulicat and Kattur village, Minjur taluk, Tiruvallur district, 2 pens of 20 x 30 feet in size were stocked with water crabs in the size range of 640-660 g. The crabs were stocked into the pens as well as the boxes. The pens were stocked at a density of 1/m^2. They were fed with trash fish at the rate of 10% of the body weight daily in two rations. The boxes were monitored daily and left over feed and waste were removed daily. After 30 days of stocking, a total of 73.3 Kg of hardened crabs were partially harvested from the pen and boxes. An average amount of ₹ 50,000/-was the income generated from the sales of the mud crabs which was harvested from the pens. This profit amount was deposited in the beneficiary's bank account and reinvested in crab farming intervention.

Crab farming and fish food processing by SC & ST beneficiaries at Kattur village and Thonirevu village

Visit of Hon'ble Union Minister of State for Fisheries, Animal Husbandry and Dairying

Hon'ble Union Minister of State for Fisheries, Animal Husbandry and Dairying and Information and Broadcasting, Dr. L. Murugan, visited the crab harvest mela conducted at demonstration site, Pulicat Lake in Tiruvallur district Tamil Nadu on 18th September 2021. The Minister interacted with the beneficiary families about the livelihood activities taken up by CIBA and appreciated the work done by the scientists of CIBA for enhancing the livelihood status of coastal poor families.

Dr. L. Murugan, Hon'ble Union Minister of State for Fisheries, Animal Husbandry and Dairying and Information and Broadcasting, interacting with the beneficiaries

Other livelihood activities

1. Fish Food Processing and Sales Unit

At Thoniveru village, a fish food unit was installed by CIBA as an alternative income generating activity for the 18 coastal SC women beneficiaries. The necessary amnesties for the fish food unit like, kitchen utensils, chair, tables and cooking facilities were provided by ICAR-CIBA through the SCSP scheme. The beneficiaries were also trained in the preparation of fish food items as well as in restaurant hygiene.

The beneficiaries prepare fish food products like fish pickles, papads, etc. for sale to tourists and local people. Apart from this the fish food unit have dine in as well as food packaging facility for serving the visiting tourists and public. Apart from this, the unit also under takes bulk catering on order basis. Breakfast and lunch with fish curry, fish fry, crab soup, fish cutlet etc. are the common menu served in the fish food unit. The fish, shrimps and crabs harvested from the culture activity was used for preparing fish food dishes for sales.

The GPS location of this fish unit is also available in the maps platform so that the visiting tourists can

Fish Food Unit Thonirevu village, Kottaikuppam panchayat, Pulicat, Tiruvallur district

locate the fish food unit with ease. Two coastal groups *"Enjiamman"* and *"Vardhammal"* coastal SC families participate in fish food preparation in roaster duty every alternate week. A profit of ₹ 15,000 to ₹ 20,000 is being realized monthly from the fish food sales.

This profit amount was divided among the beneficiaries group and deposited in their bank accounts. The income generated was reinvested into this activity for purchase of materials required for running the fish food unit. The highlight of this intervention is each beneficiary family has invested ₹ 1000/- per family as their share for this avocation and with the inputs and support of ICAR-CIBA they are operating this fish food unit with team responsibility and self- realization.

This fish food unit operation seems to be a boom to these beneficiaries during the lean season for aquaculture activities. The fish food unit also helps in the better utilization of harvested fishes from farming activity done by the community. This intervention gives them a supplementary income to the beneficiaries in addition to aquaculture activities.

2. Children and Youth Library

Youth and children study centre was established at Thonirevu village, Pulicat, Tiruvallur district of Tamil Nadu by CIBA during 2021, for the SC school children's and youth students. There was no proper tuition centre or place of study in this village for SC youth and children in this village.

During the "COVID-19" epidemic lock down, children were seated under the tree and found roaming with mobile phones and wasting their study time. An unused community hall was renovated and converted into youth and children study center. After school time they visit this centre to attend tuition and read books kept in the library. Educated unemployed woman in the village was appointed as tuition teacher in this centre to take classes for students studying LKG to 10th Standard. Students and youth actively make use of this centre and get benefited. A trust by name "Sevabharathi" of Ramakrishna Math has come forward to support this Youth and children study center established by CIBA. They are supporting this centre by paying tuition fees for the tuition teacher, donating books, stationary, mosquito nets, charts and provisions for the students and youth attending this centre. School children's and youth in the village got benefited in their curricular activities.

Youth and children library cum study centre at Thonirevu village, Pulicat, Tiruvallur district

Conclusion

Brackish water aquaculture technologies integrated with agro-based farming systems and societal development has been tested. The technologies are technically feasible, economically viable for coastal SC and tribal families and have also created awareness among fisher folk about the value of brackish water resources and the need for conservation and sustainable utilization. If these interventions are adopted by the coastal and tribal families it can effectively become a viable enterprise, for their livelihood improvement.

Active participation, infrastructure, support from STC and SCSP Scheme community and technical back up from CIBA have made this initiative a success. Today, Kattur and Thonirevu of Tiruvallur district in Tamil Nadu has become a model village under the STC and SCSP Scheme initiatives for the establishment of similar projects in the other fishing villages. These interventions have given them an opportunity to learn a new alternative livelihood. The interventions have helped them to earn an additional income and also improved their standard of living. Apart from this literacy development and socio-economic improvement of coastal SC and tribal community are the long term achievements of these interventions under the STC and SCSP Scheme initiatives.

Sustaining growth in the fisheries sector through appropriate and effective technologies

Dr. Leela Edwin, Director (Acting) & Dr. Nikita Gopal, Principal Scientist, ICAR-Central Institute of Fisheries Technology, Cochin -68202

Introduction

Fisheries is one of the sunrise sectors of the economy and has seen the fastest growth rates in the primary sector. The growth has been also fuelled by the rapid expansion of aquaculture. Together capture and culture fisheries provides affordable nutrition to a large section of our population, is an employment and income generator being the direct and indirect occupation of millions of people in fisheries and ancillary industries. Vital contributions in three areas, viz., nutritional security, employment generation and foreign exchange earnings have made fisheries a vibrant food sector of the Indian economy

Though the ingenuity and agency of our fishers has been a major factor in the growth that has been witnessed, this has been ably supported and guided by several institutional mechanisms and frameworks like suitable enabling state policies and technologies that institutions working in specialised areas developed and transferred. The ICAR-Central Institute of Fisheries Technology (ICAR-CIFT) has also been in the forefront of these efforts being the only Institution in the country working in areas of harvest and post-harvest fisheries technologies, covering the entire spectrum of activities in fish value chains.

The ICAR-CIFT was established as the Central Fisheries Technological Research Station on the recommendations of a high power committee constituted by the Ministry of Food and Agriculture, Government of India. It started functioning at Cochin on 29th April 1957, under the Department of Agriculture of the then Ministry of Food and Agriculture. The Institute was given its present name in 1962. The administrative control of the Institute was brought under the Indian Council of Agricultural Research in 1967. The ICAR-CIFT has been focusing on basic, strategic and applied research aimed at minimizing biodiversity loss and environmental impacts, maximizing utilization of resources with stress on value addition of existing fishery products and effective waste management. In addition, the institute has also been playing a vital role in developing, recommending and implementing standards for fishing gears, fish products and waste management systems in fish processing industries. The Institute is also at the service of the nation as one of the NABL accredited laboratory recognized as a Referral Laboratory and Reference Laboratory for fish and fishery products that are exported or imported. The Institute has a well-established Agri-Business Incubation Centre which has been catering to the enterprise development in fisheries targeting youth, women, and other vulnerable groups and encouraging establishment of start-ups to become employment generators.

Interventions in harvest and post-harvest fisheries

Some of the technologies developed by the Institute for fishing include design and development of appropriate, environment friendly, responsible fishing systems (craft and gear) for various types of fishing. This has covered both marine and inland water bodies and resources. The basic design of the trawler that is a precursor to all the trawlers operating off the Indian coast was developed by ICAR-CIFT. Energy requirements are high in capture fisheries and aquaculture. Green technologies, particularly depending on renewable sources viz., solar, wind, current, tidal etc. will go a long way in reducing the energy use and efficiency of the sector. The FV SagarHarita, a 19.75m long fuel efficient multipurpose fishing vessel was designed by

ICAR- CIFT and built by Goa Shipyard Limited (GSL) and is now operational and the design provided by the Institute has been accepted by the Government of India under the PMMSY programme and several states are constructing fishing vessels based on this design. The Institute has also introduced a solar powered boat and is experimenting with LPG for propulsion purposes. Detailed assessment will have to be made on the ecological footprint, in terms of natural resources consumption and GHG release in fishing [and fish processing] and the Institute has already pioneered work in this area.

The Institute has always focused on development of gear that propagates sustainable and responsible fishing, like the semi-pelagic trawl that does not damage the sea bottom. Its work in by-catch reduction is globally recognized and devices that exclude juveniles and by-catch [like the Square-mesh cod end and the TED - Turtle Excluder Device] have been major contributions from the Institute.

Recent research on development of nano materials that can be used for improving durability of craft and gear is going to make the sector more economically viable. The Institute has also worked extensively on documenting the fishing craft and gear in the country, including in inland areas and the north eastern states. With the demand for food continuing to grow in terms of both quantity and quality with growing population, fish production also needs to keep pace for which technologies of exploitation need to be constantly evolving. Work on, fish behaviour that will help in designing more efficient gear, use of AI based technologies for fishing, acoustic pingers to control attack of fishing nets by marine mammals, control and reduction of micro-plastics and other marine debris etc. are areas that are being actively pursued.

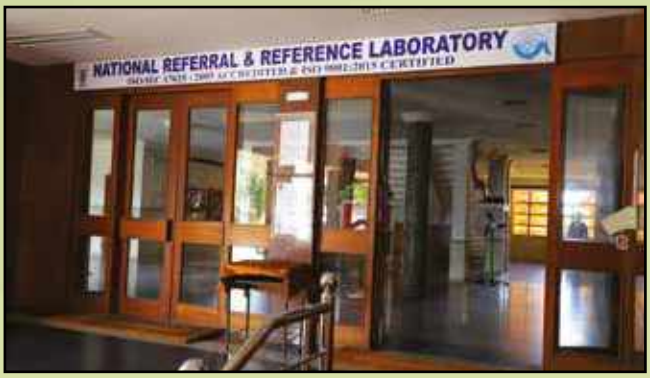
To make the capture fisheries sector economically viable and sustainable development of better fishing systems with stress on cost effectiveness with improved efficiency and durability of materials, recommendation for regulation of fishing units, reduction in fuel usage, and better and efficient craft and gear combinations will be required. The fishing fleet has to be state-of-the-art, modern and efficient ensuring decent work spaces and livelihoods for people engaged in fishing activity. Also we need to develop Climate Change Responsive and Resilient Fishing Systems Capture and Culture Fisheries that are high precision eco-system oriented, with standardized craft-gear combinations for emerging species compositions. Integration of satellite technology, AI, sensors, cameras and other IT enabled tools to

monitor the craft and gear as well catches underwater, with automated logging mechanisms are required and the technologies must be conservation oriented by exclusion of non-targeted species and sizes. The ICAR-CIFT takes this into consideration while developing its research and dissemination programmes.

To ensure responsible utilization of harvested fish, adopting suitable post-harvest technologies is equally important to prevent spoilage and food loss and the Institute has pioneered fish and fishery product development, packaging technologies and by-product development. Technologies and protocols right from handling of fish catch on-board along the entire post-harvest chain have been developed and regular capacity building is undertaken. Fish is highly nutritious but it is also highly perishable and it undergoes spoilage faster than other muscle foods.

Research in both conventional and advanced post-harvest technologies by the Institute aim to preserve the quality of fish so that it can be transported to distant locations under controlled storage conditions to offer quality products to the consumers. Conventional post-harvest interventions include technologies for chilling and freezing, curing and drying, thermal processing, smoking, extrusion, value added products have been developed by the Institute. Good handling practices coupled with proper storage, preservation and packaging will result in responsible management of this nutrient dense food commodity. A wide range of fish and shellfish products varying from whole, headless, peeled gutted, headless gutted fish, fillets, steaks, loins, cubes can be preserved by chilling. As consumers prefer fresh fish products without chemical preservatives, use of alternative natural preservatives that enhances the quality of fish have also been experimented and standardized.

Value added fishery products like Ready to eat products, breaded and battered products etc. offer better option for product diversification, fortification and market penetration with improved revenue for seafood industry through product diversification and increased availability of convenient and snack products in the domestic markets. This also brings in higher margin realization from available seafood resources within the domestic market for seafood processors. The Institute has actively engaged in research in developing value added products from conventional and un-conventional fish resources.



National Referral & Reference Laboratory

Testing Lab

To overcome the issue of limited shelf life for stored fish, various packaging materials including laminated packaging materials have been tried and tested, including packaging materials by laminating two or three packaging materials, like polyester laminated with low density polyethylene for chilled fishes. Apart from interventions in packaging material, advanced technologies like vacuum packaging, modified atmosphere and active packaging technologies have been developed by the Institute, for a number of fishes. Apart from this advanced packaging methods. Advanced technologies like High Pressure Processing, Irradiation, Pulsed light technology, Pulsed Electric Field, Microwave Processing, Radio frequency and Ultrasound have application in fish processing and preservation to offer quality products to consumers which have been major research areas of the Institute. Driers developed by the Institute has been fostering hygienic drying if fish and fishery products and is actively disseminated through the ABI.

A recently developed Refrigeration enabled mobile fish vending kiosk for hygienic selling of fish is being distributed to beneficiaries by SAF, Government of Kerala and is a model that can improve fish vending done by women.

The direct contribution to the seafood industry both domestic and export, is through the interventions the Institute makes in assuring quality of fish and fishery products. The nascent seafood export industry was supported by the Institute in the early 1950s by developing quality standards and protocols and ensuring their implementation so that seafood exports form the country could happen. The Institute continues to support this activity and now the country has a well-established, world class seafood industry. As a Referral and Reference lab the Institute continues to aid in developing standards with FSSAI and Codex.

The Institute is part of the Assessment Panel of Exports constituted by the Export Inspection Council, Government of India to do assess the export worthiness of all the seafood export units in India. They form part of the 3 member of team which assesses the seafood factories all over the country and certifies the export worthiness. Analytical services are provided to the Indian seafood sector on. 266 parameters that are covered under the NABL accreditation scope and 140 parameters under non-NABL scope. The ICAR-CIFT rapid detection kits – 'CIFTest' – for checking adulteration of fresh fish with formaldehyde and ammonia was a timely intervention that was simple and effective for controlling adulteration that had become fairly wide-spread.

For mitigating lifestyle diseases, fish can pay an important part and the Institute has been in the forefront in establishing the nutritive value of different species of fish as well as working on solutions for malnutrition among children, women and other vulnerable sections of the population. Fortified fish powders have been developed and have been found to be effective in combating several conditions. Work on other functional and disease combating properties of fish are also underway.

The road ahead

The sector faces challenges like climate change requiring responsive strategies to adapt to the changes in natural exploitable resource base. Livelihoods of the small-scale fishers are more vulnerable to shifts and changes, whether climatic or socio-economic-political and they will need back-stopping. The focus on total utilization of harvested fishery resources, including unconventional resources will continue, concentrating on zero loss,

Pre Processing Facility

consumer driven processing. Development of quality systems for safe fish from production to consumption including standards, processes and protocols for ensuring and monitoring product quality and safety will be continued including rapid detection methods for chemical and microbiological hazards for improved food safety, risk assessments of emerging chemicals and pathogens for safeguarding consumer health and addressing food safety issues and development of standards for GM fish.

The Institute is the only Reference Laboratory in the country for fish and fishery products mandated to development of official methods, validation of test protocols, generation of proficiency test materials and capacity building on food testing at National level.

This Lab will collaborate with International Reference and Referral Labs for non-targeted screening and confirmation of emerging contaminants. It is also the only Referral Laboratory in the country for fish and fishery products which is mandated for testing legal samples and for dispute settlement.It is also responsible for implementation of official test methods across notified labs. ICAR-CIFT will facilitate introduction of green, renewable and recyclable energy and technologies in the fishing and fish processing sectors, along with enhancing efforts in appropriate capacity building at all levels in the system. The Institute is equipped with state-of-the-art facilities and is open to collaboration with other institutions and organizations for working towards a sustainable and economically viable fisheries sector in the country.

Fish genetic resources for conservation and utilization

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Introduction

India possesses rich aquatic biodiversity across different ecosystems. Out of 34,300 fish species reported globally, India contributes to about 7.7% of global fish diversity (Froese & Pauly, 2020). Natural aquatic resources are important as majority of the resources for food still come from wild, due to low domestication levels in the fisheries sector. Management of the fisheries resources draws parallel to that followed in wildlife and forestry besides agriculture. Being a source of food, aquatic germplasm resources are also playing an important role in various products of commercial value and sustain other related trades such as ornamentals, sport fishes and few value-added products. The challenge is to secure the IPRs related to aquatic germplasm, so that the country can maintain its stake in its natural wealth and its potential benefits. (ICAR-NBFGR, 2016). Cataloguing and devising conservation measures of the fish genetic resources of the nation is essential for sustainable utilization of these resources for prosperity.

Genesis and prioritized research areas

The ICAR-National Bureau of Fish Genetic Resources (ICAR-NBFGR) was established in 1983 under the aegis of Indian Council of Agricultural Research to undertake research related to conservation of fish germplasm resources of the country. The Institute's vision is, assessment and conservation of fish genetic resources for intellectual property protection, sustainable utilization and posterity.

The mandate of the Institute includes collection, classification and cataloguing of fish genetic resources of the country, maintenance and preservation of fish genetic material for conservation of endangered fish species, and evaluation & valuation of indigenous and exotic fish species. The Bureau possess excellent infrastructure and expertise in several research areas including the development of fish databases, genetic characterization, gene banks, fish germplasm, habitat inventory, risks analysis of exotic species, diagnostics for OIE notified pathogens, aquatic microbes and germplasm conservation with special focus on threatened, prioritized and exotic fish species. The institute also undertakes capacity-building programs for various stakeholders.

Carps raised in captivity and developing as brooders in Germplasm resource centre at NBFGR, Lucknow

Initiatives in conserving fish genetic resources

Database development

The Institute has developed databases on diverse ecosystems and a few online databases on genomic resources of the fish species in India. The database was developed on freshwater fishes of the northeast and

western Ghats, fish diversity checklists for eight states and three different systems (Western Ghats, Gulf of Mannar and Vembanad Lake). In addition, four online databases–namely Genome, fishOmics, AqGRISI, and NRFC for the fish germplasm resources of the country. The database, AqGRISI contains information about 3278 fish species of the country.

Documentation and cataloguing

Exploration of various river basins viz., Indus, Ganga, Ghagghar, Brahmaputra, Mahanadi, Krishna, Godavari, Cauvery and their tributaries, particularly in the peninsular region was carried out and fish accessions were collected for taxonomic validation, stock identification, and repository. Tissue bank has been established with over 13,000 accessions. Discovered 57 species during explorations of ecologically diverse habitats in India during the last 10 years.

Generation of genomic resources

Species-specific molecular signatures of over 600 Indian marine and freshwater finfish and shellfish species were generated to resolve taxonomic ambiguity and for accurate documentation of species diversity.

Population genetic structure of 26 fin and shellfish species were studied across the native distribution range in Indian waters, which would help in management strategies, stock-specific conservation and river ranching programs.

Under the CRP Genomics, in which the institute is a lead centre, a high-quality draft genome assembly of *Tenualosa ilisha* has been generated and seven novel gene variants are identified. Differential expressing genes in various salinity levels were studied and identified with hub genes, which are highly associated with salinity tolerance with osmoregulatory function in the high-value fish species.

Draft whole-genome sequencing of two commercially important fish species, *Labeo*

Advanced fingerlings of Labeo dussumeri produced in ICAR - NBFGR hatchery, Kochi

rohita, and Clarias *magur* was completed in collaborative mode. Complete mitochondrial DNA has been sequenced in eight fish species for ascertaining the evolutionary significance of the species.

Germplasm resource centres

The institute has established a germplasm resource Centre in Guwahati, Assam in collaboration with Guwahati University for northeastern fish resources. Further, *Labeo rohita, L. dero, L. bata, L. rajasthanicus, Catla catla, Mystus cavasius, Garra gotyla, Sperata seenghala, Mastacembalus armatus* and *Rita* rita are being maintained in the germplasm resource centre in the Institute's campus at Lucknow. A newly discovered fish species from river Krishna, Pangasius silasi, is being

New species and new distributional records of marine ornamantal shrimps described by the ICAR-NBFGR at Lakshadweep

maintained in open water cages at Nagarjuna Sagar dam, Telangana. Other fishes such as *Ompok bimaculatus, Labeo calbasu* and *Notopterus notopterus* are also being maintained to monitor individual growth and for broodstock development (NBFGR, 2019).

In Lakshadweep, ornamental shrimp/fish breeding and rearing through community aquaculture centres for improving the income of native inhabitants is going on. A facility has been established for marine ornamentals at Agatti island, Lakshadweep, which are hand-holding community aquaculture units, maintained by the women of Agatti Island to raise marine ornamental organisms to marketable size for the generation of alternate income sources.

This is a unique venture, where science and societal development is taken up as hand in hand through the use of indigenous organisms. The program was initiated in 2018 as a DBT-funded research project and the scope of the project was expanded under the institute's Tribal Sub Plan programme and local islanders are undergoing training to develop their capacity in growing the ornamental organisms in community aquaculture units.

Advanced fingerlings of Horabagrus brachysoma produced in ICAR - NBFGR hatchery, Kochi

In a similar line, another initiative of a live germplasm resource centre for clownfish was established at Airoli, Mumbai, Maharashtra in collaboration with the Mangrove Foundation, Government of Maharashtra, where 10 clownfish species are being maintained.

A master hatchery facility is established for producing the seeds, which could be given to the trained beneficiaries to rear them to marketable size as a measure of livelihood development. Three clown fishes, *Amphiprion ocellaris, A. percula* and *A. frenatus* are currently being produced in large quantities and supplied to the cluster mode rearing units at three coastal districts of Maharashtra.

Presently, 13 such rearing units are under operation. A similar initiative has been started recently for the beneficiaries belonging Pitchavaram mangrove region, Tamil Nadu in collaboration with the Faculty of Marine Sciences, Annamalai University, Parangipettai and Fish for All centre, M. S. Swaminathan Research Foundation, Poompukar, Tamil Nadu. Besides, in collaboration with the NBFGR, the Fish for All centre is also supporting to the livelihood of local people at Poompuhar and Pitchavaram, Tamil Nadu on carp culture and crab fattening, respectively.

Another germplasm resource centre was established on the premises of Kerala University of Fisheries and Ocean Studies, Kochi for indigenous freshwater fishes of the Peninsular India with special focus to Western Ghats. Three locally important indigenous fishes of Kerala, Malabar labeo (*Labeo dussumieri*), Yellow catfish (*Horabagrus brachysoma*) and Naadan mushi (*Clarias dussumieri*) are being mainly targeted.

The fishes were bred in hatchery conditions and after nursery rearing, the seeds were distributed to the Department of Fisheries, Government of Kerala and interested fish farmers for further rearing. Indigenous ornamental varieties, which are having trade value, such as Three spot barb (*Dawkinsia rubrotinctus*), Narayan barb (*Pethia setnai*) and (*P. nigripinnis*) are also bred in captivity and being promoted for Ornamental Aquaculture (NBFGR, 2020).

In addition to the germ plasm resource centre established in various parts of the country, ICAR-NBFGR is undertaking large-scale propagation assisted stocking of carps in river Ganga.

Adhering to the objective of conservation of aquatic genetic diversity, fish fingerlings are produced from the broodstock, which was raised and maintained in the ICAR-NBFGR farm with collection of wild types from the river Ganga and stocking them in protected areas, gives the opportunity to grow to adults and thereby, support future generations of fish population. The institute has ranched around 2.0 lakhs advanced fingerlings of five carp (catla, rohu, mrigal, calbasu, bata) varieties in river Ganga.Ganga Aquarium is established in the Institute's premises to create awareness and also increase the understanding of aquatic life and the environment to build widespread awareness for the conservation of aquatic genetic resources. The aquarium holds more than 100 indigenous fish varieties, including marine origin.

Cryopreservation of fish sperm and utility in conservation

Sperm cryopreservation protocols have been developed for around 30 commercially important and few endangered fish species of the country. The initiative will address the issues of insufficient milt production or variation in the maturity of two sexes for captive breeding of cultivable species (Lal and Jena, 2016).

Further, NBFGR is conducting cross-breeding experiments across the country using the cryopreserved milt of Indian Major Carps from native distribution i.e., River Ganga for enhancing the genetic diversity of the brooders and young ones, thereby improving the growth and reproductive traits.The work on this line in association with the Department of Fisheries, Govt. of Tamil Nadu has yielded a promising result.

Cell line repository

The National Repository of Fish Cell Lines (NRFC) was initiated with the funding support by the Department of Biotechnology, Government of India, which serves as a National Referral Centre of fish cell lines for facilitating fish cell lines requirement for research purposes. Currently, out of 63 cell lines belonging to 33 fish species (24 freshwater, 7 marine and 2 brackish waters) are being maintained. The facility accepts fish cell lines from various research institutions, maintains the cell lines using cryopreservation, and distributes the same on a need basis to the researchers of the country (Kumar *et al*., 2020).

Exotics and fish health management

National Surveillance Programme for Aquatic Animal Diseases (NSPAAD) was implemented with the ICAR-NBFGR, as a lead institute with the support of DAHDF and NFDB. The success has become visible within a short span of six years from the inception of the program, initiated in 14 states of India and has been expanded to cover 19 states and 2 Union Territories (UT) with 31 collaborating centers. The program has been helping in providing evidence-based inputs to DoF regarding aquatic animal health issues, introduction of exotics and science-based inputs to queries from the trading countries (Sood *et al*.,2021).

National Strategic Plan for 'Aquatic Exotics and Quarantine Guidelines' is developed to regulate the introduction of exotics in the country. Species-specific guidelines for the import of tilapia, sutchi catfish, ornamental fish and white shrimp were developed. Data on the distribution of alien fish species in various drainages were generated and the impact of 14 species was quantified using a developed risk assessment process and protocols (FIST).

Indian Network of Fisheries and Animal Antimicrobial Resistance (INFAAR) has been implemented to document AMR in different aquaculture production systems, describe the spread of resistant bacterial strains and resistance genes, identify trends in resistance and generate hypotheses about sources and reservoirs of resistant bacteria through a structured national surveillance program. The crucial data emerging at the spatial level will be input to formulate strategies and policies to prevent and reduce the spread of AMR in farmed animals, fish and subsequently to humans (Rathore *et al*., 2020).

Bibliographic databases on fish pathogens and diseases, aquatic species introduction in the country, Indian fish pathologist's directory and alien fishes and quarantine information system have been developed. Molecular techniques for detection of OIE-listed pathogens such as *Aphanomyces invadans*, Koi herpes virus, Yellow head virus and taura syndrome virus were developed. Besides, monoclonal antibodies were produced against serum immunoglobulins of *Labeo rohita* and *Channa striatus*.

Human Resource Development

The Institute organizes various capacity building programmes for National and International researchers in the area of fish genetic resources and conservation. An Aquaculture Research & Training Unit of the Institute is functioning at Chinhat, Lucknow. This unit is carrying out human resource development activities including practical training programs and fishery advisory services pertaining to fish culture, induced breeding, quality fish seed production, pond and hatchery management.

Future perspectives

India possess diverse fish germplasm and their effective management can increase fish production. The issues pertaining to biodiversity loss and depletion of fish stocks need to be addressed in a priority manner. The necessity of developing a comprehensive database on fish diversity for mainstreaming the fish germplasm. Compilation of data on a spatial scale using GIS tools would assist massive data handling and decision-making in devising conservation measures.

Management needs to be aimed at preserving existing biodiversity and also the evolutionary processes for long-term sustainability. The conservation of fish diversity in the country demands an integrative approach combining capture, culture and environmental programs using advanced technological innovations.

These wild relatives of farmed and potentially farmable aquatic species must be valued and protected in order to ensure their future availability for use in aquaculture. The expansion of activities such as development of species-specific gamete cryopreservation, establishment of germplasm resource centers for endangered organisms, and in situ conservation programs will help in the conservation of important fish species. Strengthening the activities such as captive-based culture system, cryobanking of fish gametes, DNA banking, and cell line repositories are essential for the conserving and effective utilization of fish genetic resources, in a sustainable manner.

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Role of NIFPHATT in capacity building and product development in fisheries post-harvest technology

Indo-Norwegian Project (INP), the forerunner of the Integrated Fisheries Project (IFP) was established in the year 1952 at Kollam in Kerala as the offspring of a tripartite agreement among India, Norway and UNDP. During 1963, Headquarters of the project along with the Norwegian experts was shifted to Cochin. Taking the cue from the flagship project, similar units were setup at Kannur in Kerala, Karwar in Karnataka and Mandapam in Tamil nadu. During 1972, these units were handed over to respective state governments.

According to the recommendations made by Cadre Review Committee, mandate of IFP was reoriented and redefined by the then Ministry of Agriculture. Consequently, Processing, Marketing, Training, Refrigeration and Civil Engineering Sections were retained with IFP and other divisions were transferred to Fishery Survey of India (FSI) and Central Institute of Fisheries Nautical Engineering and Training (CIFNET). As per the Gazette Notification No. S.O. 937 dated 03.05.2008, Government of India renamed IFP as National Institute of Fisheries Post Harvest Technology and Training (NIFPHATT). Headquarters of the NIFPHATT is located at Kochi, Kerala and a unit was also set up in beach road near the fishing harbor complex at Visakhapatnam, Andhra Pradesh.

Current mission of NIFPHATT is to take up the new challenges and opportunities in the fisheries sector through post-harvest technology up-gradation and dissemination, human resource development, gender development, relief and rehabilitation programmes for the fishermen communities and consultancy in establishing infrastructure related to fisheries post-harvest technology.

Present mandates of NIFPHATT are:

1. Post-harvest technology up-gradation and its transfer to beneficiaries such as rural fishermen community, small scale industries, export processing houses, and students through consultancy, job work and training.

2. Value added product development by way of process and product diversification from all varieties of fish including low value, unconventional species and seasonally abundant fishes.

3. Imparting training in the field of post-harvest technology, refrigeration technology, quality control and value added products.

4. Providing consultancy services and training for rural development programmes/ women empowerment programmes in fish processing, supporting local fish farmers, self-help groups of fisher community, fishermen's co-operative societies functioning under Panchayathi Raj Institutions.

5. Popularization and test marketing of value added products from fish varieties including low value, unconventional species and seasonally abundant fishes.

6. Extension of the activities through popularization and test marketing of value added products to new areas and develop markets in all states in a phased manner with added attention to rural areas and enthusing entrepreneurs to enter into sea food processing industry.

NIFPHATT's Activities in a nutshell

a. Capacity building programmes:

The Institute's training programmes are aimed at University students, personals employed in fish processing industry and Fishermen/fisherwomen/ SHGs. NIFPHATT's pilot scale production units on freezing, canning, drying, value addition etc; provide a very unique opportunity for them to acquire experience of real time fishery products development and thus,

equip the future generation with know-how on Good Manufacturing Practices by providing hands-on training in all aspects post-harvest technology. On-job training and In-plant training for students pursuing specialized education in the field of fish/food processing is a flagship programme of the Institute.

Processing plants and laboratory of the Institute serve as an apt venue for hands-on training in fish processing and quality assurance. Institute also offers specialized training programmes such as hygienic handling and high-end product development from seafood, on-board and on-shore handling of sashimi tuna, microbiological analysis of seafood, VHSE apprenticeship training, HACCP concepts and canning technology.

1. On-job training to university students and VHSE students from fisher community

On-job training imparted by the Institute has received wide acceptance and appreciation from various schools, colleges and universities. The training provide hands-on training in different aspects of fisheries post-harvest technology viz., hygienic handling of fish, freezing, canning, smoking, refrigeration, quality control, product development etc.

During the training, the trainees are given the opportunity to develop various value added products like dressed fish, fish fillet, fish cutlet, fish finger, fish pickle, fish ball etc. Students pursuing specialized education in Fisheries, Bio-technology, Food science, Food Engineering and professionals working in the fisheries sector across the country are beneficiaries of the programme.

2.Skill up-gradation programmes for fisherfolks

Comprehending the pivotal role played by the fishermen community in the fisheries sector, this Institute has designed various training programmes to generate awareness and boost entrepreneurial skills of the community with more focus to fisherwomen in order to make them self-sustainable. These programmes are tailor made for each region/locality to suit to the species available, geographical considerations, local diet preferences etc. Courses are conducted at the Institute and also on-site as per request.

"Training on hygienic handling and high-end product development" is one of the flagship programme of NIFPHATT. Under this, trainees are instilled with the know-how for production of various frozen, dried, pickled and ready to cook/eat fishery products. Primary thrust is given to hygienic handling of the commodity right from capture to consumption. The course is also intended at boosting entrepreneurship among the trainees to take up new ventures like seafood kitchens/catering centers etc.Training on on-board handling of tuna for sashimi production is a course designed for traditional fishers. Through this training, fishermen are enlightened on the economic advantages, on-board handling and storage practices to be followed for landing fish in sashimi grade quality.

3.Training on microbiological analysis of seafood

Fish and seafood are a main source of animal protein in the diet. However, seafood is also one of the most perishable food items. Seafood-associated infections are caused by a variety of bacteria, viruses, and parasites; this diverse group of pathogens results in a wide variety of clinical syndromes, each with its own epidemiology. To guarantee consumer safety it is imperative to limit the microbial levels in food below desirable levels. This in turn requires a basic understanding about the etiologic agent, their source and enumeration methods. The training provides insight on the essential microbiological parameters to be analysed in water, ice, fish and fishery products and methods for determining the same.

4.Training on HACCP concepts

Hazard Analysis and Critical Control Point (HACCP) is an internationally recognized system for reducing the risk of food safety hazards. Any company involved in the manufacturing, processing or handling of food products can implement HACCP to minimize or eliminate food safety hazards. Adherence to HACCP norms can guarantee the safety of fish products and help to enhance consumer confidence in such products. The programme on "HACCP concepts" aims at familiarizing the trainees with the principles and steps involved in HACCP implementation. It also provides insight into implementation and monitoring of HACCP system and finally the auditing of the system through different case studies.

5.Apprenticeship training programme

This is a one year programme exclusively designed for the passed out candidates from Vocational Higher Secondary Schools. The training is conducted in association with Regional Directorate of Skill Development & Entrepreneurship, Trivandrum, Under Ministry of Skill Development and Entrepreneurship, Government of India.

Major objective of the programme is to create a cadre of fisheries experts with sound practical and theoretical knowledge. During the programme, trainees are given hands-on experience in all the processing activities, quality assurance, microbial analysis, hygienic handling of seafood. Students are also paid monthly stipend to meet their pocket expenses.

b.Product development:

Quite a few ready to serve, ready to cook, heat and eat products have been developed and popularized by NIFPHATT including new generation products

such as canned products, frozen products, battered and breaded products, dried and smoked products, retortable pouch packed products etc.

c.Market research and sensitizing through test marketing:

Popularization and test marketing of value added products from all fish varieties including low value, unconventional species and seasonally abundant fishes is being carried out by the marketing section. The normal skeptic attitude of customers towards preserved fishery products is being overcome by the promotional marketing of such products. The message of fish as a healthy food is being continuously propagated through participation in exhibitions and trade fairs.

d.R&D efforts:

Some of the recently developed, test marketed and popularized products include canned anchovies in ginger flavour, cold smoked farmed oyster canned in oil, canned squid with ink flavour, ready to serve oyster curry in pouches etc.

Several value added like fish fillets, minced meat, coated products etc. were developed from unconventional and seasonally abundant fishes like Balistids. Flavour extract (taste maker) was developed from shell and head of fresh water prawn.

e.Popularizing and promoting fish as health food:

The importance of fish as a health food both in terms of its protein and fatty acid content is being widely popularized and promoted among the various population of India. This is achieved mainly through making and presenting fish in more convenient and value added forms.

Products are developed through a non-fish eater's perspective, trying to address all his apprehensions towards fish as a food item. Brochures and publications by the institute are widely circulated among the stakeholders.

f. Promoting novel and nascent entrepreneurship in value added fish export:

The value realized from the export of fish in frozen form is almost on par with or slightly above the domestic rates. In order to shift the focus of our exporters from frozen to chilled form NIFPHATT has set up a chilled tuna processing facility (meant for other fishes also during lean seasons). This plant has a water front with landing/berthing facility facing the main channel. This plant is expected to act as groundswell for entrepreneurship by acting as incubation center.

Way forward

Spearheading along the path of skill development, the Institute also keep its other important mandates abreast. Production, Popularization and test marketing of nutritious seafood products and spreading the message of "seafood as a safe food for the future" are one of the key areas where NIFPHATT has established its reign.

The Institute also offers consultancy services on establishment of fisheries infrastructure. NIFPHATT is also actively involved in standard fixing exercises by serving as an expert member in various national and international committees. Thus the Institute has a remarkable past studded with post-harvest activities and value based training programmes in fisheries sector.

Along with the regular training programmes, The Institute is presently intensifying its focus on skill up-gradation of the fishermen/fisherwomen/fish farmers- the primary producers of the sector. As the capture fishery is nearing stagnation, efforts are also in place to analyse the issues in processing and marketing of cultured fish and recommend remedies to equip farmers and processors for domestic and international marketing of farmed fishes and products thereof.

Consistent effort to maintain pace with dynamic changes in fisheries sector has helped NIFPHATT in establishing wide inter-institutional linkages with National and State establishments. Patronage from administrative Ministry and cooperation from Central/ State Government Departments and Agencies, SHG's, NGO's University/Colleges and VHSE Schools which enabled NIFPHATT to carve out its niche in fisheries post-harvest sector of the country is gratefully acknowledged.

NATIONAL FISHERIES DEVELOPMENT BOARD
GOVERNMENT OF INDIA

REQUEST FOR PROPOSAL

O&M of Phase-1 and DBFOT of Phase-2 of the 'Coastal Aquaculture Facilities' At Mulapolam Village, Srikakulam District, Andhra Pradesh in PPP Mode

National Fisheries Development Board (NFDB), Dept. of Fisheries (DoF), Govt. of India (GoI), intends to select an experienced and capable Private Entity for the 'Operation & Management' (O&M) of 'Phase-1' and Design, Build, Finance, Operate & Transfer (DBFOT) of 'Phase-2' of the **Coastal Aquaculture Facilities** proposed in **70.00 Acres** of 'Beachfront Land Parcel' with Fresh Water, Seawater & Brackish Water Resources with an estimated 'Project Cost' of **Rs.120.00 Crores** at Mulapolam, Srikakulam Dist., Andhra Pradesh in PPP Mode.

Project Location and Details

Project Site spread in an extent of 99.185 Acres is located at Mulapolam Village, Sompeta Mandal of Srikakulam District, Andhra Pradesh. Proposed site is located at 10 Kms., from Haripuram, 110 Kms., from Srikakulam Town and 230 Kms., from Visakhapatnam City. The Site is well connected by NH-16 (Chennai-Kolkata Highway) at a distance of 18 Kms.

For further details, interested parties may contact:

The Chief Executive , National Fisheries Development Board (NFDB), Pillar No: 235, PVNR Expressway, SVPNPA Post, Hyderabad-500052, Telangana State, Phone: +91-040-24000201; 24000177; Email: info.nfdb@nic.in

Amendments/Addendum/Corrigendum to the RFP shall be posted only on NFDB Website: www.nfdb.gov.in; DoF Website: www.dof.gov.in; and GoI eProcurement Portal: https://www.eprocure.gov.in

Issue & Receipt of RFP

- RFP Document can be downloaded from www.nfdb.gov.in; www.dof.gov.in; and https://www.eprocure.gov.in from **19.08.2022** till **22.09.2022**
- **Pre-Bid Meeting**: **02.09.2022 at 11.00 Hrs. (IST) at NFDB**
- **Online submission**: Bidders shall upload their bids at 'GoI' eProcurement Portal: https://www.eprocure.gov.in on or before **23.09.2022** before **16.00 Hrs (IST)**
- 'Hard Copies of the Technical Bid' shall be submitted on or before **27.09.2022** before **16.00 Hrs (IST)** at the **O/o. The Chief Executive, NFDB, Hyderabad.**

राष्ट्रीय मात्स्यिकी विकास बोर्ड

National Fisheries Development Board

मत्स्यपालन विभाग/Department of Fisheries

मत्स्यपालन, पशुपालन और डेयरी मंत्रालय /Ministry of Fisheries, Animal Husbandry & Dairying

भारत सरकार /Government of India

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REQUEST FOR PROPOSAL (RFP)

'O&M' of Phase-1 and 'DBFOT' of Phase-2 of the 'Integrated Coastal Aquaculture Facilities' Mulapolam Village, Srikakulam District, Andhra Pradesh in PPP Mode

NFDB/Division I/Mulapolam Land Development/2020-2021 Dt. 19-08-2022

National Fisheries Development Board (NFDB); Dept. of Fisheries (DoF); Govt. of India (GoI), intends to select an experienced and capable 'Private Entity' for the 'Operation & Management' (O&M) of 'Phase-1' and Design, Build, Finance, Operate & Transfer (DBFOT) of 'Phase-2' of the **Coastal Aquaculture Facilities** proposed in **70.00 Acres** of 'Beachfront Land Parcel' with Fresh Water, Seawater & Brackish Water Resources with an estimated 'Project Cost' of **Rs.120.00 Crores** at Mulapolam, Srikakulam Dist., Andhra Pradesh in PPP Mode.

Issue of RFP Document & Pre bid Meeting:

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Amendments/Addendum/Corrigendum to the RFP, if any, shall be posted only on the NFDB Website: www.nfdb.gov.in; DoF Website: www.dof.gov.in; and GoI eProcurement Portal: https://www.eprocure.gov.in

Sd/-
Chief Executive, NFDB

Orienting research and education to newer concepts of quality certification in seafood trade

Dr. B. B. Nayak and Dr. Ravishankar C.N., ICAR-Central Institute of Fisheries Education, Mumbai

Marine export promotion has transcended from a trade promotion activity to a scientific research-backed process, that would need thorough understanding of the environment, risks, management options, and life cycle of products. The terms like green technology, carbon credit, traceability, sustainability, block chain technology and circular economy are now common qualifying descripts of industries involved in trade of exportable commodities. Consumers in developed countries have become more conscious of the parameters that are not the core requirements of quality or safety and rather are meant to safeguard overall health of the environment and climate. They exert pressure on trade units to comply with parameters, that not under the control of the processor or trader. Few of such issues are discussed here which need greater scientific support for the export promotion.

Sustainability aims at ensuring the resource availability for the subsequent generations despite current state of resource utilisation. It calls for maintaining balance among economic growth, environmental care, and social well-being. A sustainable fishery is one where fish are collected at a rate that prevents the population of fish from declining over time due to fishing methods. The sustainability standards are used to assess if a fishery is well-managed. To assess sustainability of a fisheries, one needs to consider the rate of fishing mortality, rate of recruitment and changes in the supporting environment.

The sustainability standards would need the data such as the biomass of fish stocks in ocean, level of fishing effort, environmental and ecosystem impact, etc. Fisheries research institutes contribute to country's fisheries sustainability by carrying out fisheries stock assessments, generating catch and effort data, and suggesting legislations on the minimum and legal size at capture, minimum mesh lengths, closed fishing seasons and areas, declaring size at first maturity, craft and gear related restrictions based on scientific data. To promote scientific fishery resource management, the country must develop appropriate policies and strategies by taking inputs from fisheries research institutes and from other state departments. In short, the scientific institute must come up with stock assessment data, which can be compared with capture data to ensure that no location is fished more than maximum sustainable yield (MSY) level. This would also demand a proper traceability data and that the fishing ground is not affected by the illegal, unreported unregulated fishing (IUU fishing). Marine Stewardship Council (MSC) standard for fisheries is used to assess sustainability of wild captured fishes through a credible and robust, assessment procedure mostly done by independent, third party assessment bodies.

Traceability is another area that needs serious attention. Many importing countries have started demanding traceability data. As per the EU Common Food Law (EC-178/02, 2002) The traceability is defined as the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution.

Traceability involves both tracing and tracking. While tracing is backward process where origin is identified by history or records in supply chain, the tracking is the forward process where end users and trading partners are identified by location in supply chain. Both tracing and tracking improves the visibility of the product in the supply chain. At present barcodes are developed and put along the labels of the consignments, which would instantly indicate the fish capture location, pre-

processing and processing facilities, the transporter to be able to trace the product. This has become important for the fish food commodities that are traded across the country boundaries and therefore producer is responsible for the health of the consumers. However, affectivity of the process depends on our capability to detect false declaration as well as other fraudulent practices. Since research organizations are holding data with respect to species and stock distribution along Indian coast, the use of such data in routine export operation has not become a practice. In addition the stock assessment data in combination with harvest area record may indicate if we are over harvesting any stock, thereby bring in more control on harvest leading to sustainability of stock. Such practice may become meaningful; the fishing has to be effectively regulated.

The regulation of fishing efforts, mesh size, closed season and protected areas etc. needs to be more seriously implemented. There are also DNA based scientific methods available within the country to detect the adulteration of fish or shrimp products which are adulterated with similar species. These methods become useful in the case of incorrect declaration or fish caught by IUU fishing used for shipping as a product of that locality. The standard numbers ISO 12875:2011 - Traceability of finfish products, ISO 18537:2015, Traceability of crustacean products, ISO18538 for cultured molluscan shellfish and ISO 18539 for wild caught molluscs supply chain are being widely adopted. With automation becoming more common, there needs to be massive procedural correction, to meet the need of contactless sorting as well as recording through barcodes or through RFIDs. Illegal, unreported and unregulated fishing activities have been a menace in the fishing industries. Several international meetings and discussions have been organized to implement measures to curb this menace.

An illegal fishing includes operating without valid permission or in contravention to the conservation and management guidelines enforced by a country. Unreported fishing include misreported, under reported or unreported catch for commercial benefit by evading the requirements by the law of the country. Usually vessels operating without flags and not following any conservation guidelines would be termed as unregulated. In short, the IUU fishing affects conservation efforts and long-term sustainability, thereby having a bearing on both sustainability as well as traceability.

Production of clean green fish is an important area that has come up to boost international trade. For seafood exporters catering to environment sensitive customers, it has become important to demonstrate that the fish or fish products are low in carbon footprint. As late as in 2020, the ISO 22948, Carbon footprint for seafood – Product category rules (CFP–PCR) for finfish have been published. The suppliers showing eco-sensitivity have a margin over their competitors in markets of the developed world. Carbon footprints and carbon auditing

have become means of judging whether the food has been produced by methods that uses minimum carbon in terms of energy. There are empirical calculations by which each type of energy used can be described as carbon equivalent. All inputs, whether, water, electrical energy or even wrapping paper can be given a score in terms of carbon equivalent. At present, many third party certifiers are involved in assessment, guidance as well as certification of this standard. In other words, it is always encouraged to use renewable energy, conserve water and adopt environment friendly practices.

Life cycle assessment of any product from production until consumption are also calculated and considered. Some work has been going on in few scientific institutes towards calculating the carbon footprint of each type of fisheries activities. Efforts towards achieving such standards not only make business sense, but also improve environmental sustainability. Ways and means to cut energy have become more scientific than the empirical calculations. The circular economy concept advocates use of durable and recyclable goods to reduce overall impact of the activities on the environment. It also encourages, sharing, leasing, recycling and reusing of materials to reduce the waste to minimum in contrast to use & throw concept.

Application of Block chain technology in fisheries trade will be important in near future. Block chain technology did not evolve as a requirement in fisheries but as a part of cryptocurrency data encryption technology. Considering its utility, block chain technology is now applicable in many fields including fisheries. Blockchain simply translates into a set of blocks containing digital information that is stored in a public database or chain. The food supply chain has different activity blocks like capture, processing, transport, and distribution.

The data of each block is encrypted within the block, but the information of each block are linked to another making an encrypted information chain. Such way of information encryption allows transparency within the block and when necessary, makes the data in the other blocks in the chain verifiable.

The way digitization is happening in all fields of life, the fisheries sector has to adopt the block chain technology to make safety and quality related information stored securely, and are verifiable. The encrypted data helps in tracing reasons for any product failure, reasons for rejection or even points out at the route of pathogen transmission.

Recent changes in higher education curriculum

Keeping view of the changes happening in our domestic and export market requirements, the higher education syllabi at national level and at University level have undergone changes. Trade regulation, certification and export documentation are part of the masters' syllabus and are taught in addition to quality management systems.

The sustainability studies have now been emphasised at greater details for the resource management students. The students learn the most modern methods of assessing stock and environmental health, and are adequately skilled through practicals on field level data.

The fish productivity assessment at single trophic level is no more a complete method, and has now to be supported by primary and secondary productivity data. In addition, it has become important to link validated remote sensed data while extrapolating productivity of a large area. The masters and PhD research helps the students to further hone their skills. The student research areas include assessment, characterisation and delineation of stocks.

The curricula and the students research programs go hand in hand in creating a pool of experts who can offer best fisheries management solutions. The students are also given skills in establishing minimum legal size of many varieties of commercial fish as well as generating DNA barcode data that can be used for detecting product adulteration.

Convergence of activities among developmental, research and academic organisations

Much of the developmental activities of the organisations like MPEDA, NFDB, EIA or state fisheries departments will be better served if supported by research data and are guided by new knowledge available in the field. These agencies directly work with the farmers, fishers and industries to implement their programs. They have to quickly adapt to the changes in the international and national requirements. The emergence of new pathogens, increased stringency in monitoring and the add-on quality parameters as stated in earlier in the text need thorough understanding and substantial groundwork for effective implementation on the ground.

At present, the useful data relevant to the emerging needs of developmental agencies are generated incidental to the routine activities in the research organisations, and not due to the collaborative efforts between the developmental and research organisations. Each focused area should be formulated into application-oriented projects, the results of which can be used for setting operational parameters for the harvesters, processors and exporters. The convergence will help in harnessing the potential from research capabilities available within the country for the social, environmental and economic benefit.

Ocean Information Services for the sustainable fisheries to fulfil India's Blue Economy aspirations

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As we celebrate Azadi ka Amrit Mahotsav (AKAM) in India and the UN Decade of Ocean Science for Sustainable Development (UNDOSSD 2021-30), we can fairly say that India is at the cusp of the Blue Economy revolution, aided by FIDF and PMMSY. The effective and sustainable harnessing of the marine fishery is an essential aspect of the same and cannot be imagined without seamless support of ocean observations and operational services. In this article, the INCOIS team outlines efforts to date in this field and the future roadmap to fulfil India's requirements in harmony with nature.

Indian marine capture fishery is a typical multi-species tropical fishery. The first significant rise in annual marine fish production occurred in the 1960s with the introduction of the mechanized fleet. However, fishery remained mostly an individual affair, and to date, it has not taken any significant corporate shape. This had inhibited the fleet from venturing away from the shore in many parts of the country. However, towards the end of the '90s, India launched its first satellite for studying oceans – IRS-P4, known as Oceansat-1. Oceansat-1 with sensor Ocean Colour Monitor (OCM) onboard started providing Chlorophyll data. The availability of satellite data helped in providing Potential Fishing Zone (PFZ) advisory as a free of cost service to Indian fisher community within Indian EEZ (Exclusive Economic Zone) by Indian National Centre for Ocean Information Services (INCOIS), Hyderabad. INCOIS is an autonomous body under the Ministry of Earth Sciences with a mandate akin to weather department but for services pertaining to the ocean.

Initially, this service used Sea Surface Temperature (SST) data from the NOAA series of satellites. Eventually, data from more satellites such as MODIS and MetOP were also incorporated. The service initiated as a one-day delay product made available weekly-twice, is now being provided in Near-Real Time mode on a daily basis. Today the Indian Marine Fishery Advisory Services (MFAS) is a unique program with decade-plus long experience and data-archive, reaching to estimated 700,000 fishermen on a daily basis. Validation experiments carried out in the 2000s showed mostly positive and encouraging results.

Similarly, from fishermen's feedback, PFZ advisories are found to be beneficial in obtaining more profit by the reducing search time (and fuel consumption) for shoals. This, in turn, helps to reduce India's carbon footprint by cutting carbon emissions per unit mass of fish caught. Currently, the MFAS programme provides two types of advisories: PFZ advisory for general fish aggregation areas and does not distinguish/ discriminate on species to be found in the PFZs. The tuna PFZ advisory mainly applies to the large oceanic tuna, and in the Indian context, it can be considered effectively as Yellowfin Tuna (YFT, *Thunnus albacares*) PFZ advisories.

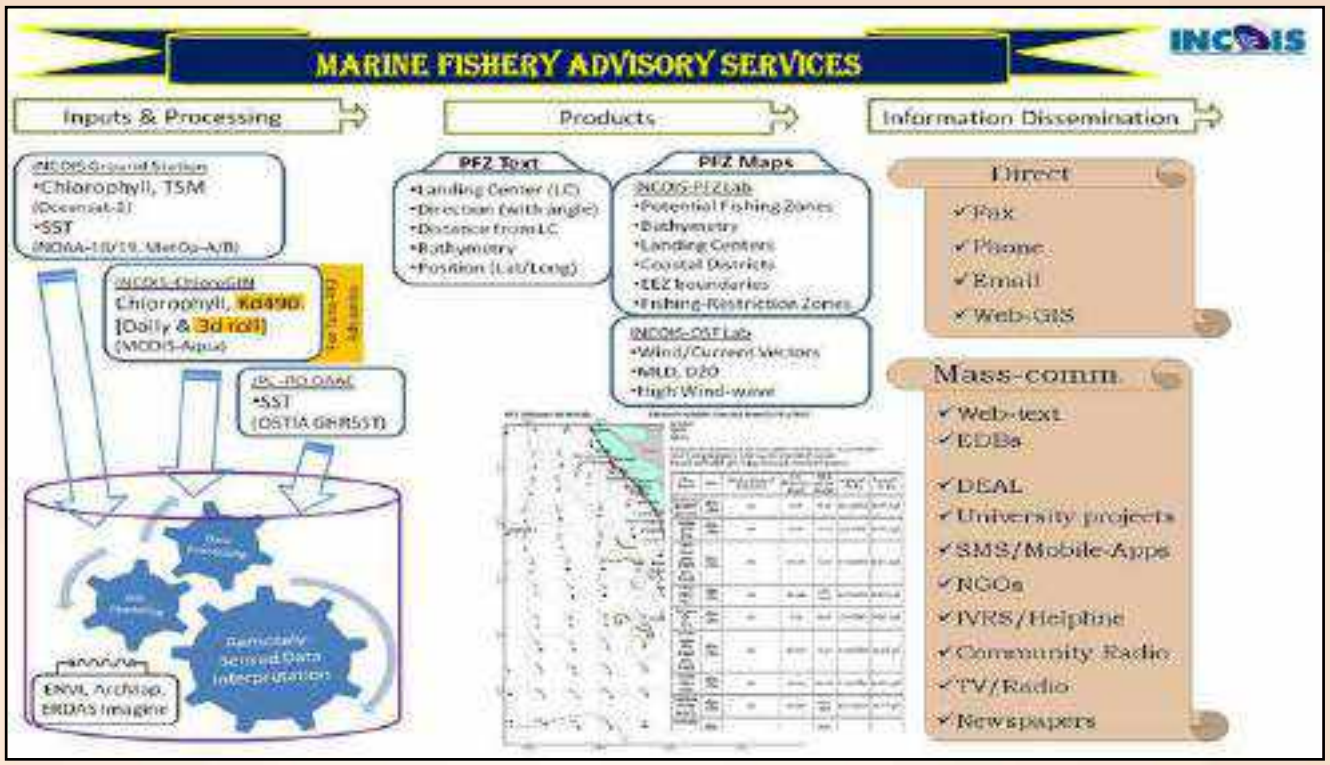

Fig.1: A schematic of daily process-flow to generate and disseminate Potential Fishing Zone (PFZ) advisories

Since tuna resources are relatively farther from the shore, the species-specific advisories needed to have rigorous research to assure their reliability. At the same time, India needed to demonstrate data-driven development of its tuna fishery. To meet these objectives, INCOIS took up satellite telemetry of YFT in the Indian seas in collaboration with CMFRI and FSI. It was the first of its kind effort on this species in the northern Indian Ocean. The outcomes were very insightful. Tagged fishes did not undertake long basin-wide migration as hypothesized based on studies in the Pacific Ocean and the Atlantic Ocean. Instead, it had strong site fidelity and moved around the tagging regions.

Similarly, it did not exhibit significant deep diving or diurnal behaviour. The fish preferred ambient (surrounding water) temperatures of 25–30°C, much warmer than studies in other basins. Further, tagged YFT were found to have movements better correlated with sea level anomaly rather than temperature range. The YFTs avoided moving below the relatively shallow oxycline depth, indicative of the stratified waters of the seas around India.

Low dissolved oxygen level at deeper waters is likely to be a limiting factor in this region for tuna movement, given their high oxygen demand. Using this peculiarity, YFT PFZ advisories are now provided as a 3-dimention (3D) advisory featuring Maximum Fishing Depth (MFD) information included as color-coded maps.The YFT PFZ advisory is a pan-India species-specific service. There is a strong demand for regional species-specific advisories. To cater to user demand, efforts are ongoing for Hilsa (*Tenualosa ilisha*, Northeast coast) and Indian Oil Sardine (IOS, *Sardinella longiceps*, Southwest coast). Under the MoES-NOAA technical cooperation for the development of predictive capabilities for fishery and harmful algal blooms (HABs), researchers from MoES institutions (INCOIS and CMLRE) and NOAA, USA, investigated environmental variates that affect the IOS landings on the southwest coast of Indian mainland.

In the case study of the latter, two environmental covariates improved the prediction of the out-of-sample data points, i.e., a subset of data points which were not used in training the model but for the validation of the prediction accuracy. The first was the average regional SST of 2.5-year before the month of fish landing. Another parameter was precipitation over land (rain-gauge data from the coastal area, as a proxy to the rainfall along the shore, which triggers IOS migration) during June–July. The most significant improvement was with the SST covariate, which improved the post-monsoon season landings prediction, with a 19%–22% reduction in mean-squared prediction error.

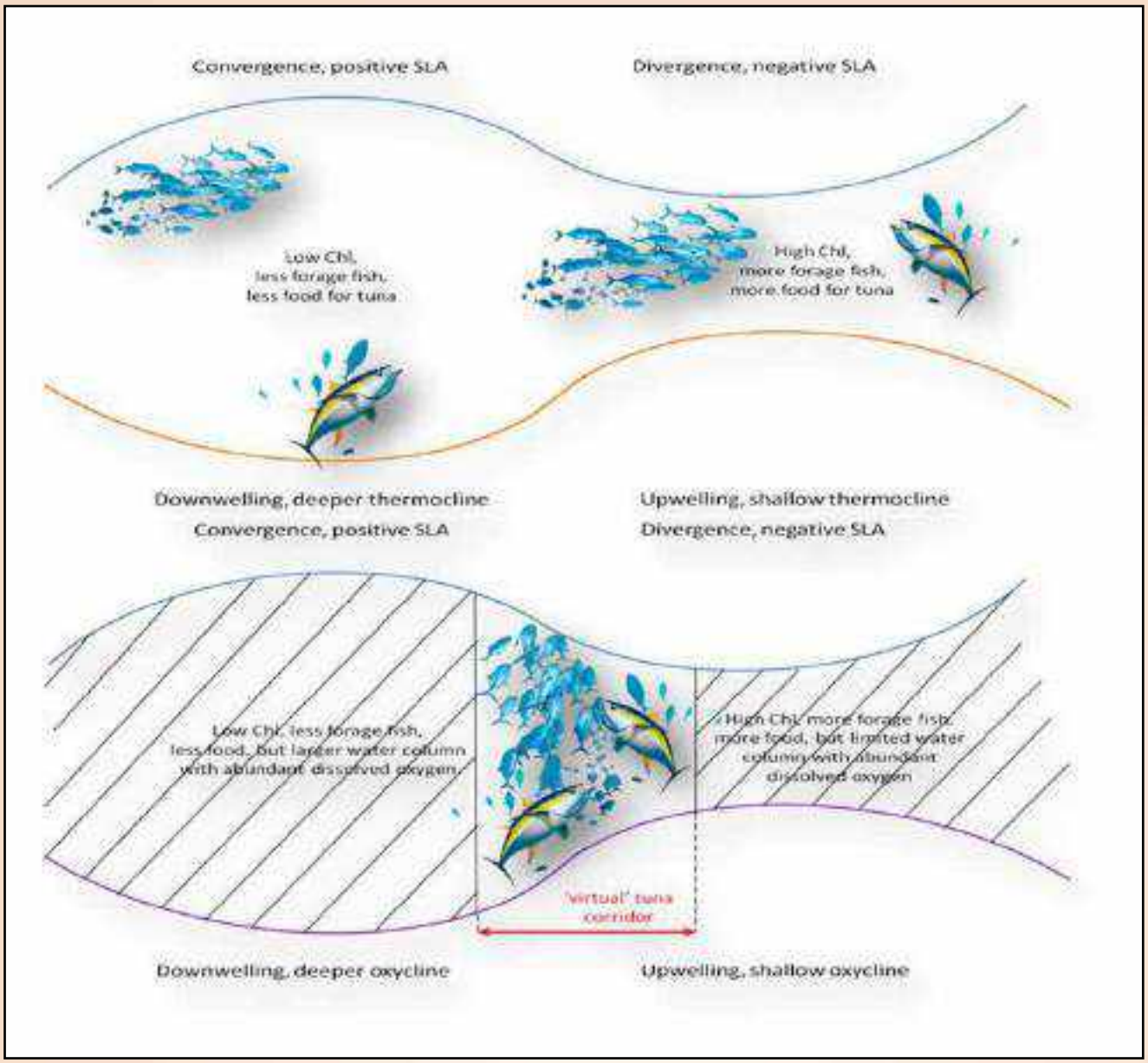

Fig. 2: Tuna vertical movements against thermocline (orange) as previously hypothesized and observed behaviour in relation to SSH a-derived Oxycline depth (purple) during satellite telemetry experiments led by INCOIS in the northern Indian Ocean

Models with the second-best covariate, i.e., monsoon precipitation over land, provided a 4%–8% reduction in prediction error. Further, an index of the Atlantic Multi-decadal Oscillation improved predictions similar to the multiyear average regional SST. The application of this work is that in future, it will be possible to predict the IOS landings a few quarters in advance, leading to informed policy decisions by the fishery resource managers. Other R&D efforts under the MFAS programme include modeling of primary productivity and service for mariculture.

While directing the fishermen to potential fishing zones, it is also essential to tell the fishermen about the expected behaviour of the sea at that location and enroute and tell them whether it is safe to venture out into the sea on that day or the next few days. The R & D efforts in that direction using the mathematical and hydrodynamic models of ocean processes led to the operational forecast of ocean state called Ocean State Forecasts (OSF) services. This service is set up to provide information on winds, waves, ocean currents, water temperature, etc., every 3/6 hours-

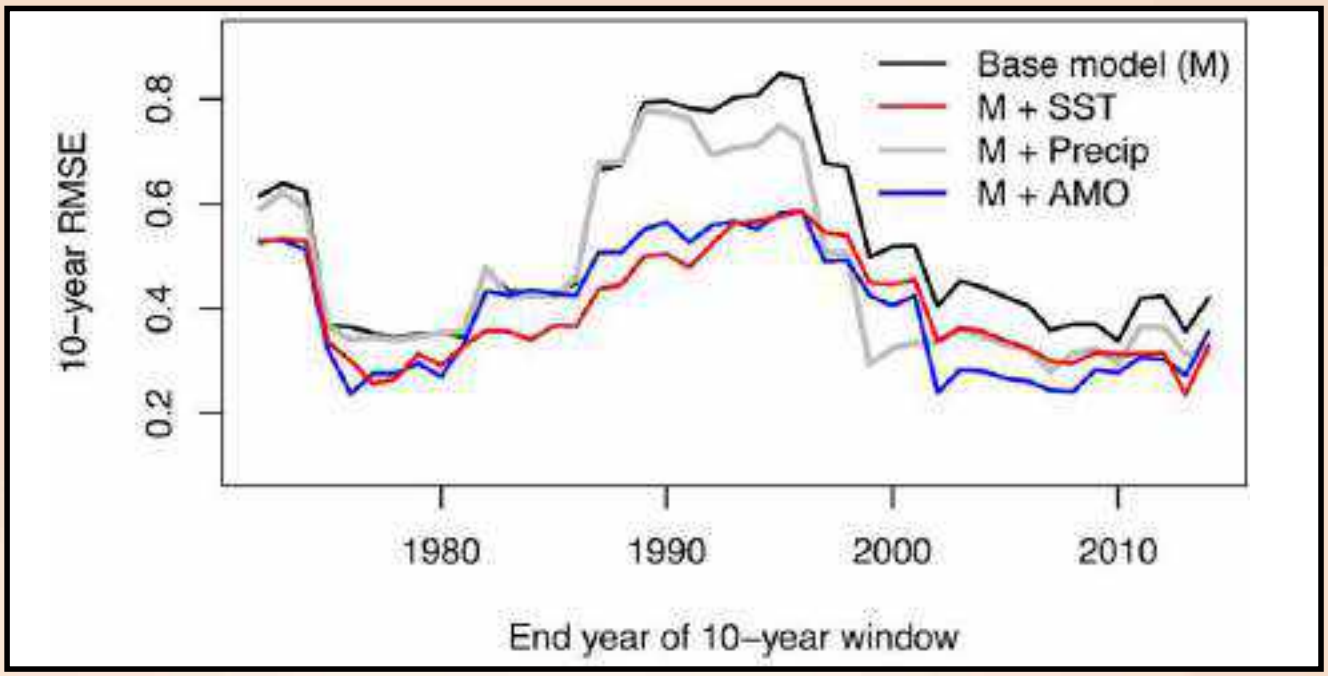

Fig. 3: The reduction in error (between predicted and observed landings) using base model and by adding covariates (important ones only shown here)

interval (depending on parameter), daily for the next five days. Together, these two services are helping the Indian fishermen in maximizing their economics and safety by properly planning the fishing activities. INCOIS extended the Ocean State Forecast services to neighbouring countries like Comoros, Madagascar, Maldives, Mozambique, Seychelles, and Sri Lanka.

After the devastating great Indian Ocean Tsunami on December 26, 2004, Govt. of India established Indian Tsunami Warning Centre (TWC) at India National Centre for Ocean Information Services (INCOIS). The TWC operates on a 24x7 basis and provides early warnings to the coastal population about the tsunami and the probable vulnerable areas on the coast. Mandated by UNESCO, Tsunami early warning services are provided to 24 neighbouring countries in the Indian Ocean. To support its services, INCOIS uses the data from a variety of observation systems ranging from satellites in space to instruments in water. The data received is curated and then hosted on the INCOIS portal for use by research community. INCOIS has an impeccable international interface and is a regional hub for science and capacity building in the IO region. INCOIS hosts ITCO ocean (International Training Centre for Operational Oceanography), a UNESCO Category-2 centre. It is a Regional Training Centre (RTC) node of IODE, OTGA (International Oceanographic Data and information Exchange – Ocean Teacher Global Academy).

Many of the INCOIS scientists are registered as 'Ocean Experts' at the OTGA. INCOIS also hosts training programmes for international agencies such as IOGOOS and ISA (International Seabed Authority), POGO (Partnership for Observation of the Global Oceans), and PORSEC (Pan-Ocean Remote Sensing Conference). Through ITCOO, INCOIS has conducted 73 offline and online courses covering topics or IORA priority and cross-cutting areas. So far, 4300 participants from 96 countries across all continents and time-zones have benefited from the courses.

Socio-economic benefits of INCOIS services

PFZ advisories provide direct benefits to the fishermen in terms of improved catch and reduced search time and indirect benefits in terms of reduction in emission of CO^2. The environmental effect of savings in diesel consumption computed as carbon credit would work out to an annuity of Rs 36,200 crore or a present value of around Rs.2.84 trillion over the 25-year useful life, which is quite significant. The study estimated a reduction of 91 crore tons of carbon dioxide emission due to use of PFZ advisories [1]. In another study conducted in Raigad, Maharashtra during 2013-14, it was observed that 15% adoption level, fishermen can save up to 9,00,000 of litres (@30% less consumption), that translates to savings of Rs.468 lakhs (@52 / litre), Diesel subsidy saving of Rs.107.64 lakhs & lesser Green House Gas (GHG) emission of approximately 2412 tons [2].

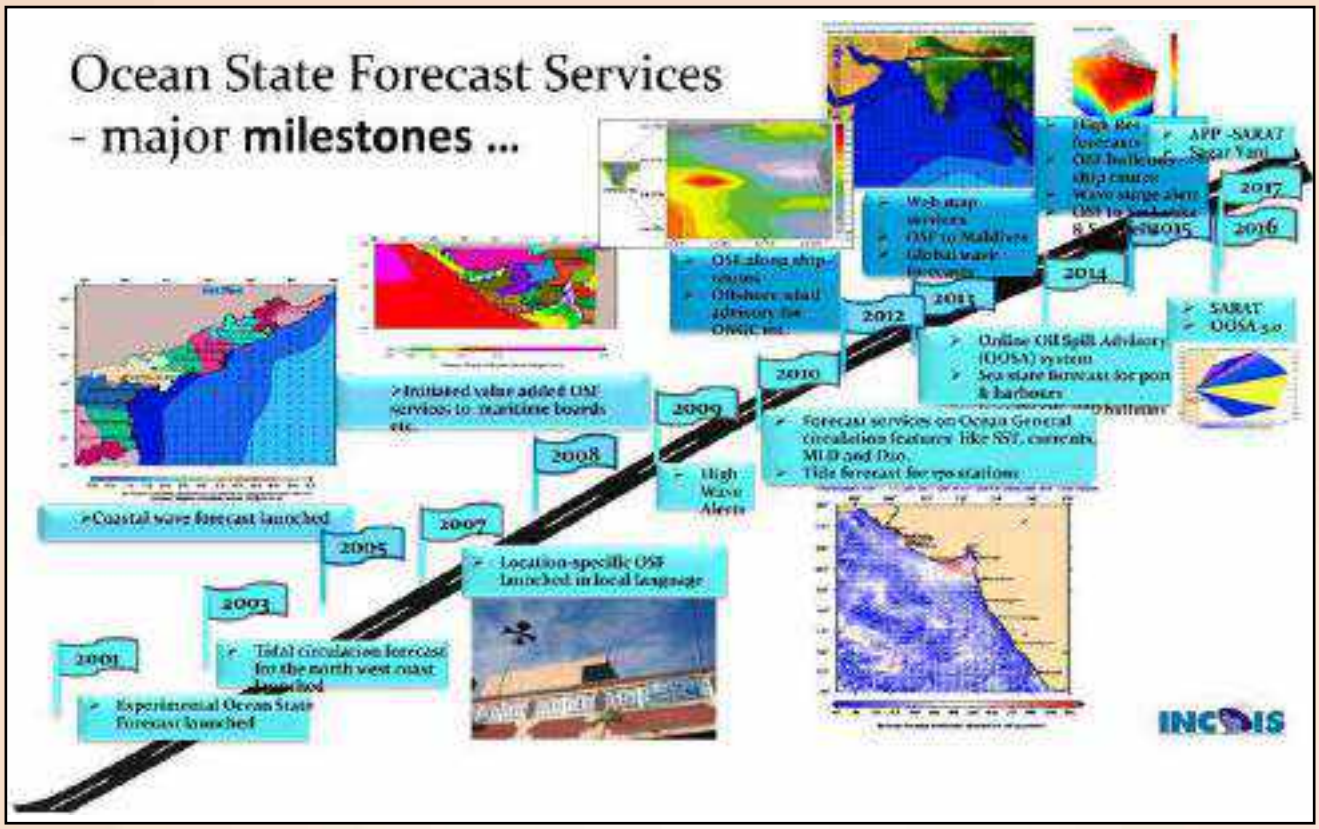

Fig. 4: A bouquet of services to enable fisher for better decision-making through sea-state forecasts up to seven days in advance

The decision to venturing into sea based on Ocean State Forecast (OSF) services has substantially improved the livelihood of fishermen by reducing operational cost[3]. As a result, almost 95 per cent of fishermen reported having avoided empty trips by following OSF, which helped them save Rs. 18.25 crores of operational costs by avoiding venturing into the sea. They also reported avoiding 9,606 empty trips during adverse sea conditions and having to end up returning mid-day without any fish catch. Mechanized boat owners saved relatively higher operational costs (Rs. 39,859) than other boat owners.The economic benefits of the Tsunami Early Warning Centre assessed by the National Council of Applied Economic Research (NCAER) by the list of undersea earthquakes in the Indian Ocean Region for which a 'No Tsunami Threat' advisory issued by ITEWC avoids relocation and rehabilitation expenditures of human settlement in the affected regions.

The report considered 23 cases from 2007-2014 where 'No Tsunami Threat' was issued and assumed an expenditure saving of around Rs 3,500 crore for one relocation and rehabilitation (calculated based on the Phailin cyclone case study due to unavailability of tsunami-led rehabilitation event) would result in cumulative savings would amount to Rs 80,500 crore. The above estimate would translate into an annuity (savings due to "No Tsunami Threat") of Rs 11,500 crore. The present value of annuity for 25 years at a 12% social discount rate of approximate Rs 90,000 crore.

Dissemination of Services

These multi-lingual PFZ and OSF advisories are disseminated during the non-ban and non-monsoon periods to the fishermen community in all the coastal states and UTs. PFZ advisories dissemination started using the traditional ways of Telephone, Fax, and Electronic Display Boards (EDB, at major fishing harbours). Soon after website, email and Web-GIS were added. Presently, mobile services are also playing a major role. ESSO-INCOIS, in collaboration with various partners (NGOs, Industry, Government and Private firms), have initiated various mobile-based dissemination mechanisms such as Interactive Voice Response System (IVRS), and mobile applications viz. Fisher Friend Mobile Application (FFMA), mKRISHI, Voice Messages / Audio Advisories / MMS and SMS in local languages, etc. In addition to this, the advisories are also being disseminated through Local Cable TV Networks, Doordarshan, All India Radio, Community Radio, FM Radio Stations, Local News Papers, etc.

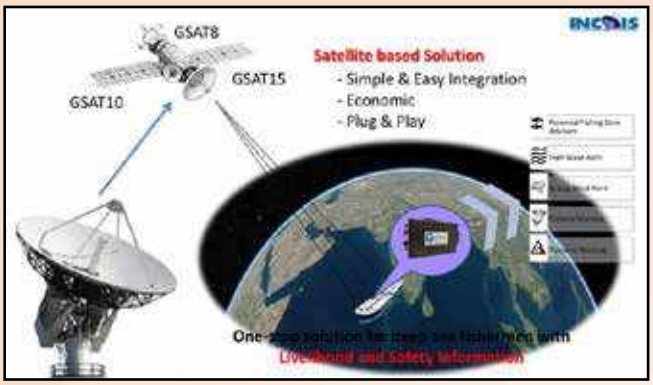

Fig. 5: GEMINI device and data delivery mechanism

ESSO-INCOIS has partnered with Village Knowledge Centres, Village Resource Centres and other NGOs for value addition and downstream dissemination of the advisories. This collaboration helps to educate the fishermen's community and assists them in understanding the advisories, thereby enabling them to use the advisories effectively. In partnership with the Industry and NGOs, a Help-line system has also been set up in a few states. The Help-line system is available on a 24 x 7 basis to provide the necessary support to the users in terms of clarification on INCOIS services. GAGAN Enabled Mariner's Instrument for Navigation and Information (GEMINI) System:The daily fishery advisory and the information on disasters (like cyclones, tsunamis, high waves, etc.) cannot be reached by the fishermen when they go beyond 10-15 km of the coast due to fading mobile signals. Communication through VHF sets is also not possible beyond these distances. Normally, the deep-sea going fishermen venture into the sea beyond 50 nautical miles or up to around 300 nautical miles and stay out in the deep sea for five or more days. Due to such limitations, the fishermen who ventured for deep sea fishing before the onset of the OCKHI cyclone could not be contacted and were instructed to return to the nearest shore immediately.

That inability in communication resulted in loss of life, major injuries, damages and loss of fishing crafts and fishing implements. As a response, development of GEMINI began on war footing.Currently no affordable system is available to communicate with the fishermen when they go to sea at greater distances from the coast (> 10 nautical miles). Though satellite phones can be used to communicate at such distances, they are expensive. The handset to be imported and the recurring expenditure for the usage is high.Considering these difficulties, INCOIS joined hands with the Airport Authority of India to use the GAGAN (GPS Aided Geo Augmented Navigation) satellite system to transmit messages to fishermen anywhere in the Indian Ocean.

Since the currently available mobile phones cannot receive the signals broadcasted from GAGAN satellites, a receiver named GEMINI (GAGAN Enabled Mariner's Instrument for Navigation and Information) has been developed. GEMINI is a handheld system that will receive the signals from GAGAN satellites and pass that to any mobile via Bluetooth.

An app developed by INCOIS, if available on mobile, will translate and display the information in the required text and map formats recognized by fishermen. The expected cost of a GEMINI device with 3 days of battery backup with marine grade casing is approximately Rs. 8700/-. This device could now be part of PMSSY with applicable subsidies for fishermen to procure.As an initial step, the following information will be made available to the fishermen through GEMINI.

Information	Frequency	Source of Information
PFZ advisories (in map and text form)	Daily	INCOIS
High Wave Alerts	Event Based	INCOIS
High Wind Alerts	Event Based	INCOIS
Joint INCOIS-IMD Bulletins during Cyclones	Event Based	INCOIS and IMD
Tsunami Early warnings	Event Based	INCOIS
Fish Market Prices Information	Daily	NFDB

INCOIS has completed primary phase of hardware and multilingual app development and controlled field testing (by providing the hardware-software to selected users). The operationalization of the GEMINI system will enable the Fishermen to receive the Fisheries and Safety Information irrespective of their location at sea in select states/UTs. INCOIS is committed to strive for better quality and delivery of services and expanding its reach for the benefit of all the strata of user communities.

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Seafood Exporters Association of India - carving its pride of place in the sector

Seafood Exporters Association of India (SEAI) was incorporated with the main objective to protect and promote the interest of the companies engaged in the seafood business and to develop the international trade of seafood from India. SEAI has its corporate base in Cochin in Kerala and Nine regional offices in Kerala, Tamil Nadu, Karnataka, Goa, Gujarat, Orissa, West Bengal, Maharashtra and Andhra Pradesh.

The Seafood Export Industry in India is over 50 years old and was initiated when the first shipment of frozen shrimp was sent from the port of Cochin in 1953 by Mr. Madhavan Nair owner of Cochin Company. Initially, canned shrimp exports were mainly focused and then due to non-availability of suitable cans in the country, the industry was shortly compelled to move to exports of frozen shrimp. The export of other varieties of Fish, Squid, Cuttlefish, Octopus, Crabs, Clams and Mussels started later in the late 1960′s.

The Indian Seafood Industry today is on a totally different footing as to what existed in the late sixties. India has taken a major stand in the Global Seafood Market and our seafood is one of the biggest foreign exchange earners. Today we have world class seafood factories following quality control procedures meeting the most stringent of international standards. Though shrimp continues to dominate our export basket, the Indian Seafood Industry has diversified its product range and its markets. For many years, Japan was India's largest export market but in the last few years United States has emerged as India's leading export market. We export mainly basic raw material for reprocessing to Japan whereas our exports to the United States consists of value added products for direct use in the American Food Service Industry and for retail sale in the supermarkets. Our seafood exports now include crabs, lobsters and other kinds of fish.

From a household industry in the early sixties to a small scale sector with an export basket of dried shrimp, fish maws etc to a miniscule market like Sri Lanka, Burma, Singapore, Hong Kong, with a capture of about a Million ton of which exported quantity consisted of only about 20,000 MT for a value of Rs. 25 million. The basket expanded with fish, squid, cuttlefish, octopus, crabs, clams etc started in late 60's.

MPEPC - to promote Marine Products was formed in 1961 which started introducing special export promotion schemes starting with a capital equipment import on priority basis. Later on, with the help of the council, many seafood exporters started participating in various global seafood fairs and the real icing was the visit of the Japanese trade delegation to Cochin which forged historic tie-ups and Japan became the largest trading partner in early years.

Some of the pioneer exporters including M/s. R. Madhavan Nair, Kuruvath Damodaran, Ambrose Fernando, P.K. Dewer, Y. M. Elias, S. M. Ibrahim Sait, B.M. Edward, M.V. Thomas, Mood Hashim Osman Sait, John. P. George, N.C. Koli, R.Madhavaraj, M.D. Naik, Jaffer Sathik Sait to name a few were enterprising and contributed to the foundation of the sprawling seafood sector.

The Council gave way to the present MPEDA in 1972, which as the apex sectoral body made its presence felt through various recommendations and policy formulations from fishing to shipment.SEAI has been proactively engaged as a guiding force behind formulation of these regulations providing timely and practical inputs.

Our seafood exports have surged each year from the late sixties right up to the late nineties when we crossed our US$1.3 billion per annum in exports. We reached a peak export level of US$1.3 billion per annum in 2001

and subsequently the industry has stagnated due to recession and the after effects of Tsunami.

This implausible export growth of the seafood sector with minimal assistance from Government is a tribute to the enterprise and resilience of the small Indian entrepreneur. The Indian Seafood Industry is compromised mainly of small and medium size family concerns and large corporate companies have almost no presence here. Even those that ventured withdrew due to an inability to manage the environment and dynamics of the industry. Very recently with the consolidation and systematization of the industry, large corporate companies have begun to invest in the Indian Seafood Industry.

The growth story continued over the decades since the 60's and has caught global attention with an annual turnover of over 7 Billion USD and has taken an enviable place of pride in the export sector.

SEAI together with MPEDA started organizing its own seafood fair with the maiden edition in November 1973 in Bombay. The India International Seafood Show has carved a prestigious place in the global arena and has been one of the most sought after fairs in terms of participation and value.

The booming market of India's seafood sustains and supports the entire fisheries sector with the annual spread of more than a lakh crores, of which over 58, 000 crores are exported. It is the value realized from exports that gives our fishing communities a sustainable steady income. What needs to be noted is that of the 50,000 crores of exports, more than 60% is from shrimp aquaculture. Today various Ministries including that of Commerce & Industry, Fisheries, and the Marine Product Export Development Authority work very closely with the industry and SEAI for the growth of India's seafood exports.

SEAI has become the voice of the industry and is counted by the policy makers as a one stop agency for its farsighted views. With nine offices in all the coastal states of the country, SEAI through its members contribute almost 90 percent of the country's turnover in the marine sector.

In any food processing industry quality & food safety plays an important role. Due to the tropical conditions existing here and the diverse nature of products handled, the quality of products has to be constantly monitored. Realizing this, the industry has adopted modern methods of handling, processing besides, adequate quality control measures to improve the quality of sea food.

In the developed countries, food safety concerns have captured the attention of the public and related offences are now regarded at Government level.

Selling, offering for sale, possessing and or advertising for sale of food that does not comply with food safety requirements are now offences as per food safety requirements. Enforcement officer have been given detailed and powerful provisions for dealing with the process, premises and equipments that contravene the legislation or pose a threat to the health of the consumer. Stringent measures have been adopted by the government to ensure food safety.

The consumers are becoming increasingly aware of the choice, quality, freshness, nutritional value and microbiological safety of food. Advances in food technology has helped to curtail microbiological risks and significant developments in laboratory are being developed viz; Polymerase Chain Reaction (PCR), High Performance Liquid Chromatograph coupled with Mass Spectrometry (HPLC with MS) etc. which facilitates not the detection of pathogens / residual levels more quickly but also to a a level of minute sensitivity. These developments have contributed to major improvement in ensuring safety of food.

SEAI has identified the areas for development and implement :

- Research and development of new projects.
- Training in new technology and inviting overseas technical experts to India.
- Imparting overseas training to technologists of Indian seafood industry in quality control.
- Monitoring of seafood quality in landing and pre-processing centres.
- Upgrading seafood quality by providing infrastructural facilities like pre-processing centres and setting up of mini labs for quality assurance.
- Evolving standards for compliance for export of fish and fishery products to various developed countries based on standards /norms / regulations prescribed by such countries.

Croaker tops among the major contributors to marine landings in July 2022

Dr. Afsal V. V. & Dr. Joice V. Thomas
NETFISH-MPEDA

NETFISH collects the real-time data on boat arrival and fish landing on a daily basis from around 100 fishing harbours/landing centres across the country to facilitate the export, fully complying with catch certificate scheme implemented by the European Union. The details of fishing vessels arriving at the harbour/landing centre and the species-wise quantity landed by these vessels, are recorded on a daily basis. The species-wise, harbour-wise and state-wise trends in marine landings observed during July 2022 are presented in this report.

I.OBSERVATION ON FISH LANDINGS

In July 2022, the marine catch data obtained from 60 selected landing sites along the main land of India totalled to 22,984.72 tons. The total catch was comprised of 11,399.99 tons (50 %) of Pelagic finfishes, 5,559.19 tons (24 %) of Demersal finfishes, 4,036.54 tons (18 %) of Crustaceans and 1,989.01 tons (9 %) of Molluscs (Fig.1).

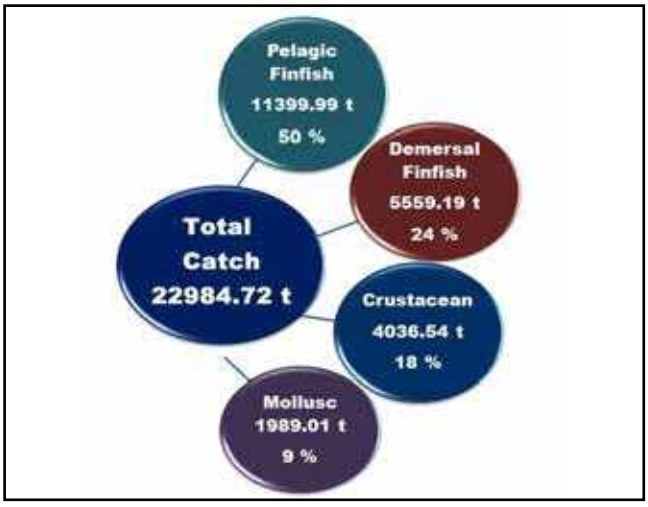

Fig.1: Catch composition of marine landings recorded in July 2022

Landing of about 230 species of sea caught materials were reported during the period, in which, major five contributors were *Johnius spp., Rastrelliger kanagurta, Sardinella longiceps, Harpadon nehereus* and *Parapenaeopsis stylifera* (Table 1).

Table 1: Major fish species landed during July 2022

Sl. No:	Common name	Scientific name	Qty. in tons
1	Croaker	*Johnius spp.*	1884.11
2	Indian mackerel	*Rastrelliger kanagurta*	1839.39
3	Indian oil sardine	*Sardinella longiceps*	1179.34
4	Bombay duck	*Harpadon nehereus*	1151.98
5	*Karikkadi* shrimp	*Parapenaeop-sis stylifera*	902.75

Considering the group-wise landing, coastal shrimps, Sardines, Mackerels, Croakers, and Tunas were the major items landed during the month (Fig. 2). These five fishery items together had formed 45 % of the total catch. The other major items reported were Bombay duck, Anchovies and Pomfrets.

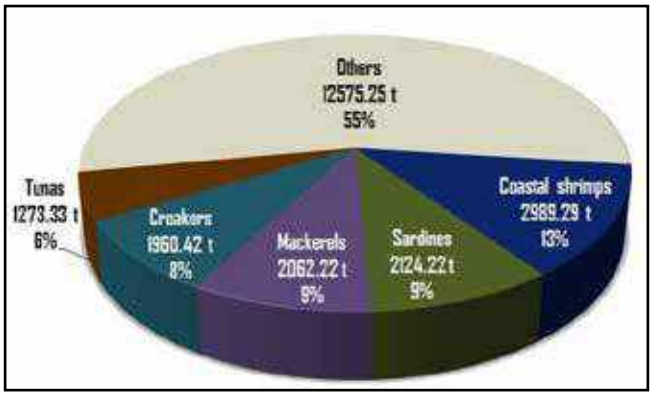

Fig. 2: Major fishery items landed during July 2022

In the case of Pelagic finfishes, Indian Mackerel, Tunas and Indian oil sardine were the highest contributors whereas, among Demersal finfishes Croakers and Pomfrets were the most landed ones. About 74 % of the Crustacean catch was comprised of different species of coastal shrimps, of which the *Karikkadi* shrimp (*Parapenaeopsis stylifera*) was the dominant species. Among the Molluscan resources, Cuttlefish and Squid were the major items landed.

State-wise landings: West Bengal recorded highest landing during the month with a share of 9,930.62 tons (43 %) to the total catch. It was followed by Tamilnadu with a landing of 6,906.38 tons (30 %) of sea caught materials.

About 90% of the total catch was from the East coast states. Landings from the West coast states such as Karnataka & Kerala were very meagre and no landing was reported from Goa, Maharashtra & Gujarat during the month.

Fig.3: State - wise fish landings (in tons) during July 2022

Harbour-wise landings: Petuaghat Deshpran harbour in West Bengal recorded maximum fish landings of 3,196.67 tons, followed by Sankarpur and Chennai harbours, with a share of 2,401.72 tons and 1,911.20 tons respectively.

II.OBSERVATION ON BOAT ARRIVALS

15998 arrivals of fishing vessels recorded from 60 fish landing sites during July 2022. State-wise figure (Fig. 4) shows that the highest boat arrivals were in Tamilnadu (38 %) followed by West Bengal (18 %). Petuaghat Deshpran (1003) and Sankarpur (935) harbours of West Bengal topped the list in terms of highest number of boat arrivals.

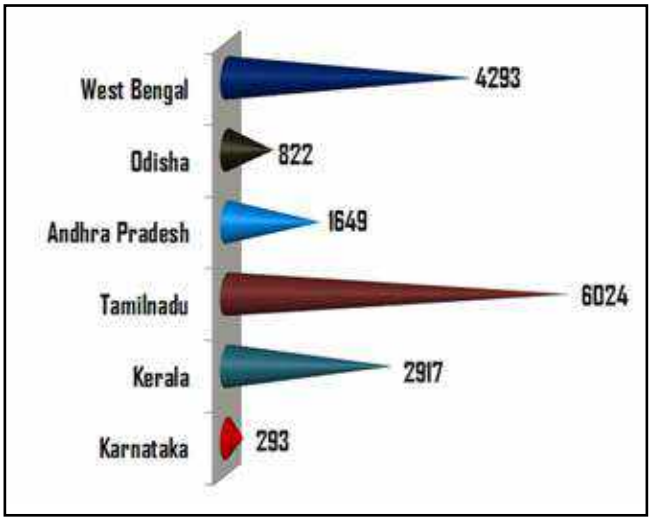

Fig.4: State - wise boat arrivals during July 2022

Summary: 22,984.72 tons of marine catch and 15,998 boat arrivals were reported during July 2022 from 60 major fishing harbour/landing centres along the Indian coast. There is an increase of about 7500 tons in catch landings and 987 boat arrivals compared to the figures of June 2022.

Though Pelagic finfish resources remained as the major contributor to the total catch, the most landed species of the month was the Croaker (*Johnius Spp*.) which is a demersal resource. West Bengal held the first place among the states in terms of total catch landed whereas Tamilnadu recorded the highest number of boat arrivals.

Among the various landing sites, the Petuaghat Deshpran harbour in West Bengal was in the top position in terms of total catch landed as well as the number of boat arrivals.

Monthly outlook forecast report

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USDINR

On 3rd Aug, the rupee depreciated 48 paise to 79.16 against the US dollar by the end of the OTC market. Market participants now await the Reserve Bank of India's monetary policy decision on 5th Aug where the central bank is expected to hike its interest rate by 25 to 35 bps. US Fed officials indicated an aggressive stance on an interest rate hike on Sep 22 amid recession fears. US House Speaker Nancy Pelosi landed in Taiwan which piled up tension between China and the United States because China claims Taiwan as part of its territory. The geopolitical development on this front led to pressure on the Indian rupee as well.

The Reserve bank of India's FX interventions should continue to limit volatility in the rupee as the central bank has zero tolerance for volatile movements in the local unit. After 9 consecutive months of selling, foreign investors have turned into net buyers and invested nearly Rs. 5k crore in Indian equities in July on softening DXY and good corporate earnings. India's benchmark index Nifty and Sensex ended positive at 0.25% and 0.37% and US treasury yields rose to 2.74%.

Brent crude futures fell 0.9% to $99.60 a barrel. The meeting of OPEC and its allies including Russia on 3rd Aug will likely keep output unchanged in September, or raise it slightly.

Just when the market participants thought that the Indian Rupee will only weaken and continue declining to fresh lows, a quick turnaround happened from 28 Jul to 2 Aug. Rupee surged from 79.845 to 78.49 – a handsome gain of 1.7% in just 4 working days. Another reversal happened today (3 Aug), when rupee again weakened intra-day from 78.69 to close at 79.16. Such volatility has forced the traders and hedgers to re-align their expectations and consequently, their trading/ hedging strategies.

A first glance on the daily candlestick chart shows a conspicuous price down gap, highlighted by the red horizontal lines: from 79.7025 (28 Jul) to 79.53 (29 Jul). Today's long green candle tends to suggest that rupee's surge has been arrested and there could be an

extension of dollar's recovery – at least towards 79.53-79.70 (to fill the price gap). An engulfing pattern formed today also validates a similar outlook. Momentum indicators have gradually cooled off towards the neutral territory. My sense is for a brief continuation of dollar's short-term uptrend. Importers can now start hedging for their liabilities, more of vanilla options and some forwards if benchmarks/budgets permit. Exporters who have adequate hedge ratios can hold for a while and target spot above 79.50 to restart hedging.

EURUSD

EURUSD started the month with a deep fall, renewing the latest bearish sentiment after noting a brief remission at the previous month-end. The currency pair withered to sustain above the 1.0485 level and fell as low as 0.9951 in mid-July, reached to its bottom level in 2 decades. It is widely assumed from the data that the Eurozone economy seems to contract in the third quarter as economic activities down-ticked in July and forward-looking indicators prompt a worse situation in the coming months. Even the ECB's decision to increase interest rates by 50 bps (against market expectation of 25 bps) was broken down to initiate the euro gain.

The global economic situation kept worsening, and speculative interest hurried into safe assets, eventually helping the greenback. The continued rise in employment data is to be expected in July but at a mean pace after 4-consecutive job increases below 400k in March-June. A tick below 1.0105 could start the parity test again, below the level, it could push to new multi-decade bottom levels. The EURUSD needs to accelerate through 1.0278 to avoid the negative stance and advance its recovery towards 1.0360.

The intraday closing beyond the 21-day EMA since late June keeps EUR/USD buyers positive, a two-month-old resistance line, at 1.0375, challenges the upside momentum. The shared currency remains in narrow range, bordered by resistance and support on the daily chart, currently testing the upper boundary of the range. EUR/USD has been under the selling pressure for a number of days and has touched the previous highs which is considered as a crucial resistance, potentially leading to a sell-off. On the other hand, there is a large area of imbalance of price between the resistance and 1.0416 for which would be mitigated in due course.

The hourly chart's trend line support could be broken at this juncture should the bulls capitulate at resistance in the forthcoming sessions. In this scenario, the market structure, will need to be broken at 1.0225.

GBPUSD

GBPUSD closed this month almost unchanged, pair remained on the back foot in the start of month but

we saw recovery in second half of month amid an extended correction in the US currency across the board due to the Fed dovish stance. Though Fed Chair dismissed that the US economy is in a recession but second straight quarter of negative US GDP data indicates a technical recession. Meanwhile inflation at 9.4% in UK and surprise higher than expected rate hike by ECB last week boosted the chance of 50 bps rate hike in Britain too by Bank of England in the next meet due early August. On the other hand, UK S&P Global PMI reports released at month end was better-than-forecasted which also ramped up bets for a 50 bps BOE rate hike. It's a quite important month ahead for the pair as composite PMI and services PMI of July month along with construction PMI and BoE interest rate decision is scheduled at the start of month itself.

Traders will also be eying the US job data for fresh trades due at the end of first week of the month. While GDP of UK and inflation data is set to release in the mid of month along with manufacturing production of June month. This month traced two different paths for the pair.

By the middle of July, pair went below 1.18, lowest level since March 2020. Pair recovered in the second half of month aided by the Fed dovish stance. We might see continuation of upward trend as ascending channel is formed on 4 hourly chart which is considered to a short term bullish pattern.

Holding above 1.22 levels could open the doors for psychological level of 1.25 while on the downside 1.2110-15 could be a good support for the GBPUSD as 50 days SMA is there. Momentum indicator RSI and MACD is trading in a neutral zone.

USDJPY

The USDJPY started the month of July with a fall of 0.31%. The currency forecast continued to tie with US Treasury rates and the economic outlook. A recession is prudently unpreventable if US consumers are shoved to decrease spending because of rate increases in food, transportation, and shelter. However, US June payrolls reduced the fear of recession and helped the US Fed's aggressive interest rate policies. The BoJ's policy remained soft and kept the Japanese economy and the yen weak. The US dollar continued its bull rally, marking a 25-year high against the yen in mid-July.

Growing concerns about a possible recession kept putting pressure on investors' moods, which was apparent from the general cautious mood around the equity markets. Japanese Ministry of Finance set aside JPY 257 billion in budget reserves to curb increasing oil prices. The currency pair started the month of August on the right foot, in the midst of fear spurred by geopolitical tensions between China and the US, caused by the US House Speaker Pelosi's trip to Taiwan, along with an aggressive push by US Fed policymakers.

Japanese Ministry of Finance announced on Friday that it has set aside JPY 257 billion in budget reserves to tackle surging oil prices. No further detailed information was disclosed on its utilization pattern. From a technical perspective, the USDJPY pair is likely to extend the latest pullback move. The pair has corrected from the lower end of the (130-130.39) zone. From here, the price could be attracted to a higher volume area on the chart. RSI recovered from the oversold territory on the chart but MACD bearish signals and the US dollar recovery are promoting the traders to build positions, where there is a price imbalance aligning with the 61.8% Fibonacci retracement levels. However, USDJPY has given a breakout below the 50-day SMA support level on 29th July before the recovery in the pair.

The trend indicated by the last 3 daily candles is reflecting indecisive sentiment due to 3rd Doji candle after recovery. USDJPY strong resistance is at 134.67 (showed in a green horizontal line) and major support is at 131.49 (presented in a red horizontal line) followed by 130.39 (portrayed with a pink line).

Quantitative evidence of the growth in fisheries and aquaculture

Bringing out the 2022 edition of "The State of World Fisheries and Aquaculture', FAO builds the quantitative evidence of the growing role of fisheries and aquaculture.

Export of fish and fisheries products is essential to the economies. Fish continue to be one of the most traded food commodities over the world. Fisheries sector plays a vital role in providing nutritional security to the food basket of the country. Enlargement of these sector requires the acceleration of transformative changes in policy, management, innovation and investment to achieve sustainability and equitable global fisheries and aquaculture.

In 2022 edition of "The State of World Fisheries and Aquaculture", FAO analyses the international policy context high-impact initiatives and actions undertaken to accelerate the Sustainable Development of the marine resources.

Global Fisheries and Aquaculture Production

The global fisheries and aquaculture production (excluding algae) has significant growth in the last seven decades with an all-time record of about 179 million tons in 2018 and annual growth rate of 3.3 percent (2020 it is estimated as 178 million tons). The total first sale value of aquatic animals in 2020 was estimated at USD 406 billion in that USD 265 billion came from aquaculture production.

The stagnation in the last two years caused a slight decline in capture fisheries and it was decreased by 4.5 percent in 2019, further 2.1 percent in 2020. The decline was due to fluctuating catches of pelagic species, the recent reduction in China's catches and the impacts of COVID-19 on the sector in 2020.

In the total production, 63 percent was harvested from the marine water, 37 percent from inland waters. Out of 178 million tons of aquatic animals, 36 million tons of algae were produced in 2020, in that 97 percent were emerged from aquaculture.

Capture fisheries production

In 2020, global capture fisheries production (excluding algae) was 90.3 million tons and a decrease of 4.0 percent compared with the average of the last three years. However, the long-term trend in global capture fisheries remains relatively stable. It is fluctuated between 86 million tons and 93 million tons per year. China is the top capture producer and accounted for almost 15 percent of global captures in 2020, China, Indonesia, Peru, India, Russian Federation, USA and Vietnam are the top seven capture producers, accounted for almost 49 percent of total global capture production.

Marine Capture production

In 2020, global marine captures were 78.8 million tons. Compared to 2019 it is decreased by 1.6 percent in 2020 because of the Covid-19 pandemic. The top seven producers hold 50 percent of the total marine capture and China became the world's top producer with 14.9 percent followed by Indonesia (8.2 percent), Peru (7.1 percent), The Russian Federation (6.1 percent), The United States of America (5.4 percent), India (4.7 percent) and Vietnam (4.2 percent).

Inland waters capture production

The total global catches in inland waters were 11.5 million tons during 2020 with a 5.1 percent decrease from 2019. India was reported the highest catches in an account of 1.8 million tons. But China continues to be one of the largest producers of inland water capture fisheries, decreased from 2.2 million tons in 2017 to 1.5 million tons in 2020. Inland water captures are more concentrated than marine captures because major producing nations are enriched with water bodies or river basins. With the same reason, the top producers of inland water captures are also more concentrated.

Aquaculture production

Global aquaculture production retained its growth trend in 2020. For animal species it grew by 2.7 percent in 2020 compared with 2019. Finfish farming maintained stability with minimal fluctuations about 66 percent with the largest share of world aquaculture for decades.

In 2020, farmed finfish attained 57.5 million tons (USD 146.1 billion) and production of other farmed aquatic animal species reached 17.7 million tons of molluscs (USD 29.8 billion) mostly bivalves, 11.2 million tons of crustaceans (USD 81.5 billion), 525000 tons of aquatic invertebrates (USD 2.5 billion) and 537000 tons of semi-aquatic species including turtles and frogs (USD 5 billion).

During the period 1990–2020, total world aquaculture is enlarged by 609 percent with an average growth rate of 6.7 percent per year. The average annual growth rate gradually decreased from 9.5 percent during the period 1990–2000 to 4.6 percent during 2010–2020. Highly populated and developing countries are the major aquaculture producing countries where the aquaculture provides more than half of the total fisheries and aquaculture production such countries are Egypt in Africa, and Bangladesh and vietnam in Asia.

Inland aquaculture

Global inland aquaculture production was 54.4 million tons in 2020 with 44.4 percent of the world total aquaculture production of animal species and algae and inland farming of aquatic animal species represented 62.2 percent of total aquaculture production.

Consumption of aquatic foods

Global aquatic food consumption, excluding algae has significantly increased. In 2019, estimated food consumption was 158 million tons from 28 million tons in 1961. Per capita aquatic food consumption was influenced strongly by increasing supplies, changing consumer preferences, advanced technology and income growth.

Of the 158 million tons of aquatic foods, Asia accounted for 72 percent of the total. Global annual per capita consumption of aquatic foods grew from an average of 19.6 kg in 2010, with a high record of 20.5 kg in 2019.

Marine fishery resources

Based on FAO, marine fishery resources are continued to decline to 64.6 percent in 2019, that is 1.2 percent lower than in 2017. But percentage of stocks fished has been increasing. Biologically sustainable stocks account for 82.5 percent of the 2019 landings of assessed stocks monitored by FAO. Anchoveta (Peruvian anchovy), Alaska pollock (walleye pollock), skipjack tuna, Atlantic herring and Yellow fin tuna are the top five species with the largest landings in 2019. The most important stocks are Tuna because of their large volume of catches, high economic value and extensive international trade and by fishing area the Northwest Pacific has the highest production among the FAO Major Fishing Areas which produce 24.1 percent of global landings in 2019.

Fishing fleet

According to the report, the total number of fishing vessels was estimated as 4.1 million in 2020. Asia holds the world's largest fishing fleet estimated at 2.68 million vessels or about two-thirds of the global total in 2020. The global total motorized fishing vessels are around 81 percent with known length classification were in LOA (Length overall) class. The majority of these were un-decked.

Employment in fisheries and aquaculture

Around 58.5 million were engaged in the fisheries and aquaculture sector, of these around 21 percent were women. In that 35 percent were employed in aquaculture and 65 percent were in capture fisheries by sector. In recent years, the employment in aquaculture sector has been flattening but the global number of fishers has reduced, particularly driven by trends in Asia.

Fishing and aquaculture sector were disrupted by restriction during the Covid-19 pandemic. In 2020, 84 percent of all fishers and fish farmers were in Asia, followed by Africa (10 percent) and Latin America and the Caribbean (4 percent). More than 20 million were engaged in aquaculture, 93.5 percent were in Asia followed by Africa (3.1 percent) and Latin America and the Caribbean (nearly 3 percent). Almost 80 percent of the 37.9 million fishers were from Asia, followed by Africa, Americas, Oceania and Europe.

Fish utilization

In 2020 about 89 percent of fisheries and aquaculture production used for direct human consumption. The remaining 11 percent was used for non food purpose. Of the 11 percent, 81 percent was reduced to fish meal and fish oil and the rest was utilized as ornamental fish, for culture, as bait, in pharmaceutical uses, for pet food, or as raw material for direct feeding in aquaculture.

Live, fresh or chilled aquatic foods continued to be largest share of fisheries and aquaculture production utilized for direct human consumption (44 percent) as the most preferred and highly priced form of fisheries and aquaculture products followed by frozen (35 percent), prepared and preserved (11 percent) and cured (10 percent) products.

Trade

During the recent decades, the International trade of aquatic products has significantly grown. This growth has lead to economic growth and cultural and technological advancement associated with globalization.

The European Union (34 percent) was the largest single market of the global value of aquatic imports in 2020. In terms of individual countries, the largest importing country in 2020 was the United States of America followed by China, Japan, Spain and France. Imports of high income countries are averaged as USD 3.2 per kilogram compared with USD 1.4 per kilogram for all remaining countries. China has to become the world's largest producer, exporter and processor of aquatic products. During 2020 China exported USD 18 billion worth of aquatic products with 12 percent of the global total.

Norway is the second largest exporter of aquatic products, exported USD 11 billion with 7.4 percent of the global total. Vietnam has been the third largest exporter, exported USD 8.5 billion worth of aquatic products, accounting for 5.6 percent of the global total. Chile, the fourth largest exporter, with USD 5.9 billion exported, accounting for 3.9 percent of the global value. Supported by strong shrimp production growth, India had become the fourth major exporter in 2017. However, India was overtaken by Chile in 2020 as the value of India's exports has been on a downward trend since 2018. In 2020, the total value of India's exports of aquatic products reached USD 5.8 billion, down from USD 7.2 billion in 2017. In 2020, the total value of India's exports of aquatic products reached USD 5.8 billion.

Blue Transformation

Blue Transformation is the vision and the process by which FAO, its Members and partners can use existing and emerging knowledge, tools and practices to secure and maximize the contribution of aquatic (both marine and inland) food systems to food security and nutrition and affordable healthy diets.

Objectives of Blue Transformation

Blue Transformation has three objectives:

1. Sustainable aquaculture expansion and intensification – to support global food security targets and satisfy global demand for nutritious aquatic food and equitable distribution of the benefits.

2. Effective management of fisheries – to deliver healthy stocks and secure livelihoods.

3. Upgraded value chains – to ensure the social, economic and environmental viability of aquatic food systems, and secure nutritional outcomes.

Sustainable Development Goals

The 2030 agenda for sustainable Development continues to build the strategies of countries, International organizations and civil society, striving for a fair, prosperous and sustainable world and the Agenda acknowledges the key role of food and agriculture, in fighting hunger and food insecurity and reducing poverty. In 2019 (UNSD, 2022b), sustainable fisheries accounted for just under 0.1 percent of gross domestic product (GDP) worldwide, 0.46 percent in SIDS (small island developing States) and 0.88 percent in LDCs (least developed Countries).

Reference

- SOFIA 2022

Compiled by: Sneha Sajeev, Bhushan Patil & Dr. T. R. Gibinkumar, MPEDA, Kochi -36, India

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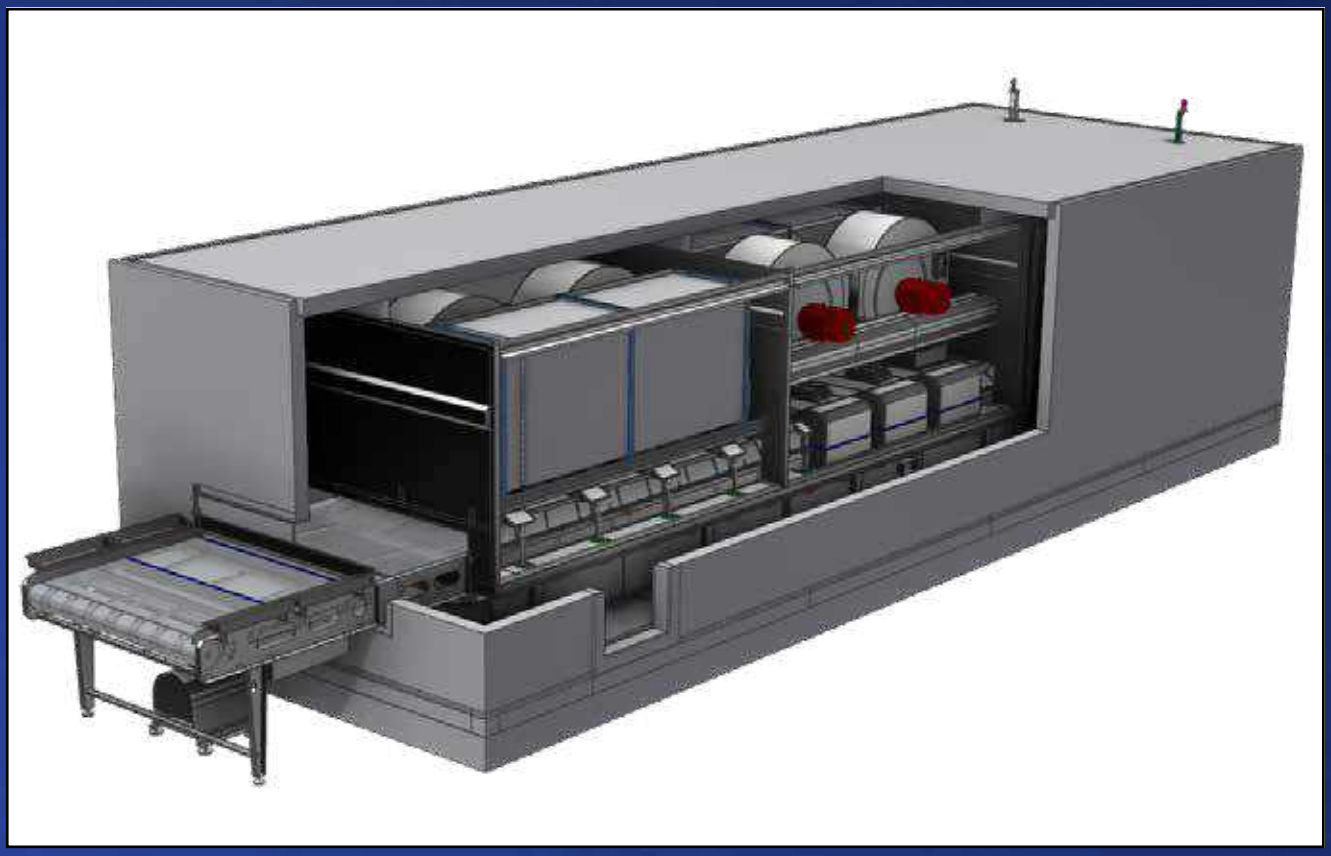
-Mr Benny Thomas, Jinny Marine Traders, Gujarat



Cochin Food Tech-MultiJet IQF is a "MultiJet airflow" impingement freezer which has a very innovative and energy efficient design. It helps in faster freezing of products with lower refrigeration power requirements .

MultiJet IQF freezer gives great flexibility in terms of different types of products which can be frozen on the same line. The line can continuously run for 22 hrs without stopping for defrosting this maximizes production output and at the same time reduces the total cost of ownership.

Unique Design Features :

MultiJet IQF has separate chambers with multiple blowers directly guiding the airflow on top of a perforated air duct which routes the air through multiple bottom

duct channels. The product on belt gets full exposure to air from top and bottom so that the individual product uniformly achieves required core temperature .

This feature reduces power consumption on account of low power blowers used, thus aids in offering the most energy efficient IQF available in the segment. Based on years of customer insight, process study and continuous improvement mindset, we have developed and implemented an unique automation feature in the MultiJet IQF freezer.

The key advantage of this feature is; the ability to process different types of products with different product heights back to back (including 2kg trays) with minimal manual intervention or adjustment .

This feature enables operators to select product type from the HMI screen and the system will automatically adjust the air duct height to suit the selected product, maintaining the required gap for air flow dynamics.The IQF in feed conveyor belt is extended out for easy product setting to give a safe working zone away from the cold freezer inlet.

Best in Class Components :

MultiJet IQF freezer is an Innovative product, designed and developed in India, supported by best in class global vendors for critical components.CF-Tech uses heat exchanger coils from Thermofin Germany which are specially custom designed to extend the operating time between defrost processes and ensure an efficient operation of the unit. We also use specially designed insulation panels from DC System Denmark, known for their hygienic and air tight panels that can sustain and provide durability under harsh low temperature operating cycles in freezer applications,CF-Tech is committed to Innovation, Quality and Service in every project we do. In a short time we have gained trust of more than 50 satisfied customers.

Contact us to schedule technical discussions and to conduct line audit :

Cochin Food Tech Pvt Ltd, Udayamperoor PO Ernakulam, Kerala-682307 India .

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www.cftech.in, Social media: @cochinfoodtech

The Fascinating Swimmers of Lake Tanganyika

V. K. Dey

V. K. Dey has over three decades of experience in diverse sectors of seafood industry in Asia-Pacific region. He was the Deputy Director of MPEDA and then associated with INFOFISH, Malaysia. As part of INFOFISH, he was involved in several studies related to seafood industry in the Asia-Pacific region and beyond, including setting up of Aqua-technology Park for ornamental fish. MPEDA has published Living Jewels, a collection of his articles on ornamental fish.

Lake Tanganyika, is the home for a diverse range of endemic cichlids numbering around 200 species. Many of them are quite small, reaching only 10 cm or less. The species include, goby cichlids *(Tanganicodus, Eretmodus and Spathods sp.)*, Julies *(Julidochromis sp.)* and similar species *(Chalinochromis and Telmatochromis spp.)*, Lamprologines *(Lamprologus, Neolamprologus, Altolamprologus and Lepidiolamprologus spp.)*, including princes and lemon cichlids, featherfins and sand sifters.

It also has mid water schooling cichlids *(Cyprichromis and Paracyprichromis spp.)*, colour morphs *(Tropheus sp.)*, Frontosa *(Cynotilapia sp.)* and Haplochromines *(Astaotilapia sp. and Petrochromis sp.)*. Though these cichlids are available in the market, they are not well known among many of the hobbyists due to its higher value and the fact that they are not as productive as other cichlids while the growth to reach marketable size takes several months. Among the various species of Tanganyikan cichlids, *Julidochromis spp., Lamprologus spp., Neolamprologus sp*. and *Tropheus sp. are popular among hobbyists.*

In general, cichlids of Lake Tanganyika can be divided into four groups based on their habitat, as shell dwellers (e.g. *Neolamprologus* sp.), cave spawners (*Julidochromis, Variabilichromis, Altolamprologus*), mouth breeders *(Tropheus and Xenotilapa)* and mid water spawners *(Cyprichromis sp.).*

Lake Tanganyika cichlids require water temperature between 22°C to 28°C with an ideal average of 25°C, and the pH ranging from around 8 - 9. The water should be hard, around 8 -15 dH and should not drop below 8 dH. Many of these fishes can be kept in water with a neutral pH and in water that is not so hard. However, they do not prefer sudden fluctuations in water quality or temperature. A moderate to high carbonate hardness is recommended to keep pH stable. A good filtration system will ensure that the water is kept clean and devoid of accumulating metabolic products. Plants are not recommended in an aquarium condition, as there are hardly any plants in the natural habitat. It would be better to provide rock caves instead.

In general, Tanganyikan cichlids are territorial and peaceful except *Tropheus spp*. which are aggressive towards each other but considered less aggressive towards other fish. Aggression is rare and usually only occurs during spawning. Females guarding eggs or fry may become aggressive against intruders while shell dwelling varieties will defend their territories. Species like *Frontosas, Lepidiolamprologus* and *Altolamprologus* should not be kept with other small fish, as they are predatory. Other species can be kept in certain community tanks provided the water condition is suitable. Shell and cave dwelling Tanganyika cichlids mix well with many mid and top level swimming fish.

Based on the breeding nature, they are grouped as mouth breeders or shelter brooders. Mouth breeding groups are goby cichlids, featherfins and sandsifter while others are shelter breeders. Shell dwelling lamprologines as well as few other species usually make use of shells as spawning site, while other shelter breeders prefer caves. While Cypriochromis are mouth breeders, their spawning takes place in mid water. In general no particular water condition is required for spawning, provided water quality is good and pH is maintained within the desired range. Although these fishes breed in community tanks, success is often seen when they are kept as a single breeding pair.

Biofloc Technology (BFT): An in-situ bioremediation for increased aquaculture production

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Introduction

The demand for seafood continues to increase with an increase in the human population and subsequent requirements for protein in diets. Aquaculture is presently one of the most significant sectors with the potential to meet the growing demand for aquatic food. Aquaculture accounts for almost 50% of the world's food fish production, bridging the gap associated with static fish landings and the rise in consumer demand.

Aquaculture is currently the fastest-growing food-producing sector in the world. The sector is highly diverse and consists of many species, systems, practices, people, environments, and operations. With the continuous human population explosion, food production industries, especially aquaculture, need to expand continuously and sustainably as a cheap protein source.

Aquaculture often comes under environmental scrutiny due to the discharge of effluents loaded with high nutrient content posing severe threats to eutrophication. Various attempts have been made to treat aquaculture effluents and convert them to useful resource inputs. Biofloc technology is a microbial-based zero or low water exchange rearing system that can be a sustainable technology for increased fish production.

Biofloc

Biofloc technology (BFT) has been described as an autonomous biotechnological unit capable of purifying aquaculture wastewater and manufacturing fish food simultaneously by balancing carbon and nitrogen in the system.

In places where water is scarce, or land is expensive, such intensive types of aquaculture can be adopted for increased production in a small area. Minimal or zero water exchange system such as biofloc technology was introduced in aquaculture for biosecurity and economic purposes.

Principle

This technology utilizes heterotrophic bacteria and algae co-culture as flocs under controlled conditions within the culture pond. This microbial biomass utilizes the unconsumed feed, fish excreta, and inorganic nitrogenous products, converting them into microbial protein. The carbon-nitrogen ratio is the major driving force for the intensive growth of heterotrophic bacteria.

History / Status of Biofloc

Biofloc technology (BFT), initially known as bacteria floc, was initiated in tilapia farming by Yoram in the late 1980s. It was commercially first applied in 1988 on Sopomer farm in Tahiti and later in shrimp farming in Belize in the late 1990s by McIntosh. The biofloc technology has been scaled up to a commercial scale since late 2002 in Indonesia and Malaysia.

The biofloc technology was first tested in aquaculture ponds where both autotrophic and heterotrophic microorganisms interact, wherein the algae and bacteria have a range of stimulatory or inhibitory effects on each other, resulting in the complexity of water quality dynamics.

Aims of Biofloc

1. Biofloc systems were developed to improve environmental control over production.

2. To develop intensive farming in places where water is scarce or land is expensive for cost-effective production

3. For water treatment

4. For prevention and introduction of disease to a farm from incoming water

5. Reducing water exchange

6. Reduced feed cost

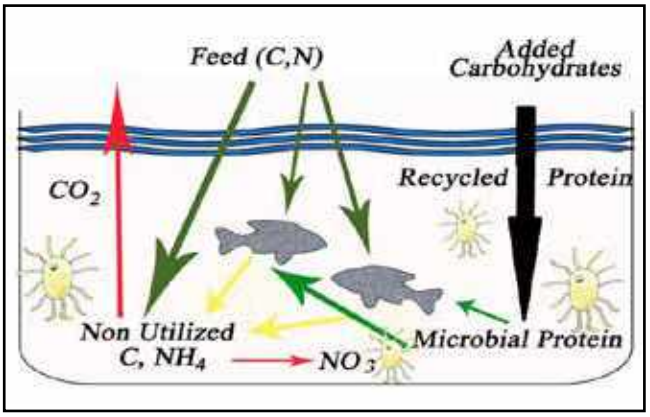
Types of biofloc Systems

There are a few types of biofloc systems used in both commercial aquaculture and for extensive research purposes.

Among these systems, two basic biofloc systems are those exposed to natural light (outdoor, lined ponds or tanks) and those not exposed to natural light (indoor biofloc).

The outdoor system is composed of a complex mixture of algal and bacterial processes that helps to control the water quality. Hence, these systems are also referred to as the "green-water" biofloc systems due to the algal community's green discoloration of the water.

The indoor system with no exposure to natural light operates as a "brown-water" biofloc system where only bacterial processes control the water quality in the system.



Scheme of Biofloc Technology

Biofloc system of fish farming

Biofloc system of shrimp farming

Development of biofloc with C/N ratio manipulation

By adding a carbon source to the culture medium in limited-discharge systems (i.e., by changing the C:N ratio), it is possible to obtain a significant enhancement of bacterial growth and of the fixation of toxic nitrogen metabolite species. Controlling the C/N ratio by manipulating the carbon levels is a potential control method in biofloc systems. For floc development, the carbon: nitrogen (C/N) ratio needs to be balanced in the system, which is achieved by adding different carbon sources to ensure carbon requirements for the heterotrophic bacterial biomass formation are met. When the total ammoniacal nitrogen concentration reaches 1.0 mg/l, the C/N ratio is to be corrected to 10:1 because for each gram of total ammoniacal nitrogen, 6.0 g of carbon is needed for the conversion of nitrogen into bacterial biomass. The determination of the required amount of carbon to reduce the total ammoniacal nitrogen was calculated as follows:

(Correction (g) = (TAN) ×C: N × (EF) ×Volume of tank (L) ÷ 1000

Where TAN = total ammoniacal nitrogen concentration mg/L), C:N = C/N ratio and EF = equivalence factor.

Nutritional composition of Bioflocs

The microbial bioflocs are themselves rich in nutrients. Sequential Batch Reactors (SBR) and Membrane Based Reactors (MBR) by Kuhn have shown ranges of dry-matter nutritional values as: crude protein, 35 - 49%; carbohydrates, 22 - 36%; crude fiber, 13 - 18%; total ash, 12 - 28%; and crude fat, 0 - 1%. Various studies have observed that bioflocs and biofilms contain high-quality lipids, polyunsaturated fatty acids (PUFA), highly unsaturated fatty acids (HUFA), and protein. In addition, they contain high levels of vitamins and minerals. High protein, polyunsaturated fatty acid (PUFA), and lipid content are the most important parameters determining the feasibility of using bioflocs as feed in aquaculture.

Criteria of species selection for Biofloc-based culture systems

• The technology also works best with fish that can derive the nutritional benefits by directly consuming the flocs with preferably omnivorous and filter feeding habits such as tilapia and shrimps.

• The nutritional quality of biofloc is appropriate for herbivorous and omnivorous fish species, including tilapia.

Species suitable for Biofloc Culture

Biofloc technology is a technology for increasing the ecological and environmental sustainability of prawn and fish farming, such as:

• Air-breathing fish like Singhi (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Pabda (*Ompok pabda*), Anabas Koi (*Anabas testudineus*), Pangasius (*Pangasianodan hypophthalmus*)

• Non-air-breathing fishes like Tilapia, Pacu, and milkfish

• Shellfishes like Vannamei (*Litopenaeus vannamei*) and Tiger Shrimp (*Penaeus monodon*)

Advantages and benefits of bioflocs in aquaculture

The sustainable approach of BFT is based on the growth of microorganisms in the culture medium, benefits from the minimum to zero water exchange required, and the co-culture of the crop species in the same system.

The biofloc (microorganisms) has significant roles:

(i) Maintains water quality by the uptake of nitrogenous compounds to generate microbial proteins on-site.

(ii) Increases culture feasibility by reducing feed conversion ratio through higher protein utilization and lower inputs of commercial feed.

(iii) Biofloc technology also offers aquaculture a sustainable tool to simultaneously address its environmental, social, and economic issues concurrent with its growth.

(iv) The benefits of biofloc-based cultures are related to the better use of nutrients, diminished production of wastewater, reduction in farm surface area, lesser environmental impacts, and reduced dependence on fish meal.

(v) Lesser usage of water helps to reduce the cost of water exchange in aquaculture, which could become a limiting factor in intensive aquaculture operations.

Conclusion

Biofloc technology (BFT) is a green technology that enables aquaculture practices towards an environmentally friendly approach. With emerging disease problems and escalating costs for energy, biofloc technology can be an innovative strategy for disease prevention and control in contrast to usual tactics such as antibiotic, antifungal, pro-biotic and pre-biotic applications.

The use of chemicals and other medicines could easily be avoided, having a negligible environmental impact. The availability of natural food in the form of microbial biofloc compensates for the higher protein requirement of aquatic species. Biofloc technologies have the potential to revolutionize the aquaculture sector.

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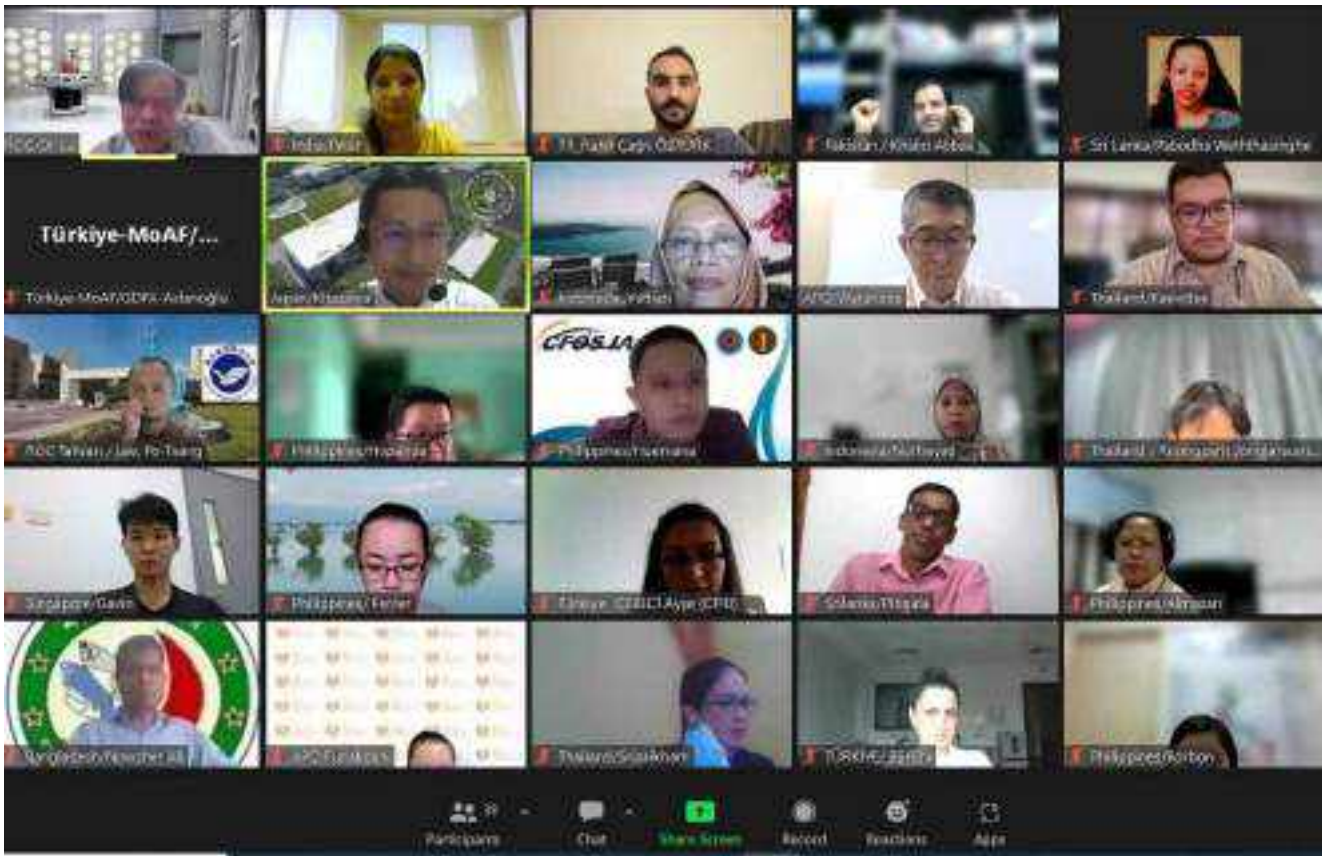
Details of the SPF *P. vannamei* brooders imported & quarantined at AQF during July 2022

Sl.No	Name of the stakeholders	State	Country of origin/ supplier	Date of receipt of the lot at AQF arrival	Broodstock imported (nos)		
					Male	Female	Total
1	Sarada Hatcheries - Unit I	Andhra Pradesh	SIS; Florida	02.07.22	200	200	400
2	Vaishale Prawn Hatchery	Tamil Nadu	SIS; Florida	02.07.22	150	150	300
3	Saran Saai Hatcheries	Andhra Pradesh	SIS; Florida	03.07.22	300	300	600
4	Sandhya Aqua Exports Pvt. Ltd	Andhra Pradesh	SIS; Florida	03.07.22	300	300	600
5	Sree Gayathri Hatchery	Andhra Pradesh	Sea Products; Texas	05.07.22	300	300	600
6	NGR Aquatech Pvt. Ltd	Andhra Pradesh	SIS; Florida	08.07.22	300	300	600
7	AR Shrimp Hatchery	Tamil Nadu	SIS; Florida	08.07.22	200	200	400
8	Sree Hatchery	Andhra Pradesh	Sea Products; Texas	09.07.22	100	100	200
9	Meenakshi Hatcheries - Visag	Andhra Pradesh	SIS; Florida	09.07.22	600	600	1200
10	The Water Base Ltd	Andhra Pradesh	SIS; Florida	09.07.22	200	200	400
11	Royal Hatcheries	Tamil Nadu	SIS; Florida	10.07.22	300	300	600
12	Sri Sai Hatchery & Prawn Culture Pvt. Ltd	Andhra Pradesh	SIS; Florida	13.07.22	300	300	600
13	Seven Staar Aquatech	Tamil Nadu	SIS; Florida	15.07.22	200	200	400

14	Ravi Hatcheries LLP	Andhra Pradesh	Kona Bay; Hawaii	18.07.22	300	300	600
15	Sun Hatcheries	Andhra Pradesh	Kona Bay; Hawaii	18.07.22	200	200	400
16	Makineedi Hatcheries	Andhra Pradesh	Kona Bay; Hawaii	18.07.22	600	600	1200
17	Srinivasa Hatcheries	Andhra Pradesh	Kona Bay; Hawaii	18.07.22	400	400	800
18	Lotus Sea Farms	Tamil Nadu	SIS; Florida	20.07.22	300	300	600
19	Geekay Hatcheries Pvt. Ltd	Andhra Pradesh	SIS; Florida	20.07.22	400	400	800
20	SM Gold Hatcheries - Unit I	Tamil Nadu	SIS; Florida	23.07.22	300	300	600
21	Apex Frozen Foods Ltd	Andhra Pradesh	SIS; Florida	24.07.22	450	450	900
22	Samudra Hatcheries Pvt. Ltd	Andhra Pradesh	SIS; Hawaii	25.07.22	80	79	159
23	Pavani Hatcheries	Tamil Nadu	Kona Bay; Hawaii	25.07.22	300	300	600
24	Amaze Shrimp Hatchery	Tamil Nadu	Kona Bay; Hawaii	25.07.22	250	250	500
25	Srinivasa Hatcheries - Unit II	Andhra Pradesh	Kona Bay; Hawaii	25.07.22	300	300	600
26	Venkata Sai Hatcher-ies	Andhra Pradesh	Kona Bay; Hawaii	25.07.22	600	600	1200
27	Raj Hatcheries Madras Pvt. Ltd	Tamil Nadu	Syaqua; Florida	27.07.22	300	300	600
28	Jay Jay Aqua Tech	Tamil Nadu	Syaqua; Florida	27.07.22	300	300	600
29	BMKN Aqua	Andhra Pradesh	Benchmark Genetics; Florida	28.07.22	400	400	800
TOTAL					8930	8929	17859

Digital multi-country training course on innovative approaches in aquaculture



Trainees from APO member countries

Global seafood production has continued to increase annually, reaching 178 million tons in 2020. While production from capture fisheries has remained almost unchanged since 1990, the increase in seafood production is primarily attributed to aquaculture.The member countries of Asian Productivity Organization (APO) are listed among the top aquaculture producers in the world, with Vietnam, India, Indonesia, Thailand, and Bangladesh, among the top 10. This development has resulted from several advances in aquaculture technologies, availability of specific pathogen free and fast-growing species, technological advances in post-harvest handling and quality assurance of the produce.

The APO Secretariat organized a training course on Innovative Approaches in Aquaculture from 2nd to 5th August 2022 in partnership with the Central Fisheries Research Institute, Ministry of Industry and Technology, Turkey. Thirty-six participants from 12 APO members attended the online course, conducted by three resource persons from Japan and Turkey. Mrs. Neenu Peter, Deputy Director, MPEDA attended the training course from India.

The four-day training course was aimed at introducing innovative approaches and technologies in aquaculture, promoting the smart transformation of aquaculture, and enhancing productivity in the sector to support local economies. The resource persons engaged with participants through live plenary discussions on environmental impacts, best aquaculture practices and genetic technology in aquaculture.

Government of Goa constituted task force committee for prevention of antibiotic use in aquaculture

Yet another positive outcome of the collective efforts being taken by the Government and the stakeholders for producing safe aquaculture products for consumption.

Government of Goa has issued an Order notifying the constitution of Task Force Committee for prevention of banned antibiotic usage in aquaculture in the State. The Task force Committee (TFC) is empowered to conduct raids in shops of aquaculture inputs and aquaculture production units for un-authorized possession of products, to collect samples of various inputs and to take action on the defaulters. TFC will ensure that aqua shops do not sell veterinary grade products and encourage sales of aqua grade drugs registered with the Coastal Aquaculture Authority (CAA) only. TFC will also inspect the labelling information of the products.

If any veterinary grade products are found in use/sale for aquaculture, the products will be seized and penalty of Rs. 25000/- will be imposed on first offense. If repeated, the license of the aqua shop will be cancelled and a penalty of Rs. 50000/- will be imposed. The TFC, which is multi-disciplinary in nature is also entrusted with the conduct of regular awareness campaigns among the stakeholders on the impact of indiscriminate usage of antibiotics in aquaculture and encourage them to register their products with CAA.

Training on "Adoption of BMPs in shrimp culture & species diversification in aquaculture" for SC/ST farmers

REGIONAL DIVISION BHUBANESWAR

Participants of the 5 day training programme conducted at Ganjam district

Training on 'Eco Friendly and sustainable aquaculture through species diversification'

REGIONAL DIVISION KOCHI

Mr. Johnson D' Cruz, Deputy Director, MPEDA- RD Kochi, interacting with the participants of the training programme at Kannur, Kerala

Mr. Bijimon Peter, JTO (Aqua) RD Kochi, during the training session

Participants of the training programme

Visit of the trainees to the Heterotropic Autorecycling Aquaculture Technology (HAAT) farm

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Microwave vacuum drying: towards value addition of dried seafood

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Fish is an important source of high quality protein, essential fatty acids, minerals and vitamins. Drying is a traditional method of fish preservation which reduces the moisture content and arrest/reduces bacterial and mould growth. Dried fish represents the cheapest source of concentrated protein for people in hilly areas or in places where there is no water body. Commonly, fishermen dry the fish openly under sun which ultimately gives a product of low hygienic quality because of the uncontrolled process as well as by product contamination through the entry of flies, birds, dogs etc.

Up gradation of this practice is very much essential to make safe, hygienic and good quality products. Several methods of mechanical drying have been developed including hot air oven drying, combination of solar energy and mechanical drying, smoke drying, freeze drying, vacuum drying etc. Microwave vacuum drying is an emerging technology for drying heat sensitive products. Through microwave vacuum drying, high product quality can be achieved at relatively low temperature and by rapid energy transfer of microwave heating.

The combination of vacuum and microwave has the potential to reduce drying time, improve product quality and decrease energy consumption. Additionally, it can be used a tool for developing value added dried fish products which normally cannot be achieved by traditional drying methods due to its technical constraints. Value addition in dried seafood products can be a promising approach to enhance the acceptability and marketing potential of dried products.

Hygienically dried seafood products

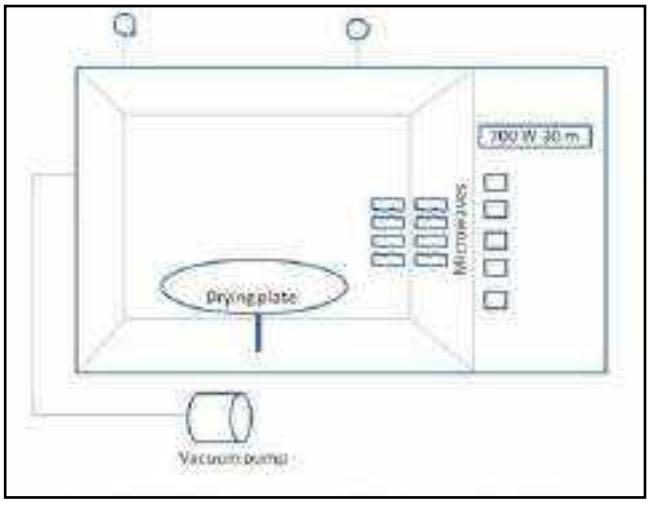
Microwaves are electromagnetic waves of frequencies varying from 300 MHz to 300 GHz; smaller frequency waves having high penetration power. Microwave processing has extensive applications in food industry for heating, cooking, pasteurization, sterilization, drying etc. Microwave drying is being adopted for drying vegetables and fruits. Because of the strong penetrable power of microwaves, both interior and surface of the food is heated at the same time along with an increase in temperature.

Many studies have been reported on the advantages of microwave drying of food. Non uniform heating of microwave is reported to be one of the main disadvantages of microwave drying. Microwave heating assisted by hot air or vacuum is being practiced in the food industry so as to improve the drying rate and quality of final dried product. Under vacuum, increase of temperature is inhibited as water molecules get carried away to the surface and evaporate at a lower temperature. Hence, the adverse effect of temperature is controlled and a high product quality can be achieved through microwave vacuum drying.

Mechanism and advantages of microwave vacuum drying

Microwave vacuum drying is solely based on volumetric heating. High frequency electromagnetic waves generate heat within the material; the vapour thus generated is transported to surface of food material intensely owing to an internal vapor pressure gradient. By combining vacuum with microwave, we can avoid the high temperature produced by microwave but retain the speed of heat transfer. In conventional dryers, water from the centre of food moves to outer surface and evaporates; which is very slow and rate limiting. In microwave drying, water evaporates within the food and moves to surface as water vapour in a fast process.

Drying rate is majorly determined by the microwave power and dielectric properties of the food material. Under normal pressure, water evaporates at a higher temperature but under vacuum, boiling point of water is low and hence, one can avoid high temperatures. The chief advantage of this technology is the saving in drying time. Studies shows that 10 times reduction in drying time can be achieved by microwave vacuum drying compared to conventional drying methods. Shrinkage of the product is minimum in microwave dried product as the rate of drying during falling rate period (crucial period during drying causing shrinkage) is faster. Microwave vacuum drying creates a spongy arrangement inside the dried product that enhances the product quality by reducing hardness and shrinkage and by increasing crispiness and rehydration properties. Because of the porous structure, the product can absorb more water during rehydration, which is considered as the best property of a dried product. A schematic drying of microwave vacuum dryer is given in below..



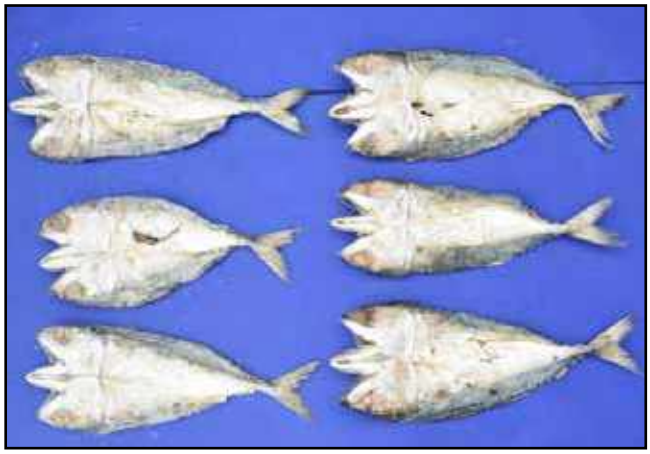
Schematic diagram of microwave vacuum dryer

Value added dried fish products by microwave vacuum drying

ICAR-CIFT Visakhapatnam Research Centre has attempted microwave vacuum drying technology for rapid drying of different seafood. Physicochemical quality of hot air dried and microwave vacuum dried Indian mackerel (@650 W) was compared to evaluate the effects of microwave. Microwave vacuum dried mackerel was superior to hot air dried mackerel in its color and appearance and other sensory attributes. Mackerel dried in microwave vacuum dryer had higher rehydration rate and lower hardness than that dried in hot air oven.

Blanched (10 min at 600C in 3% brine), and unblanched shrimp were dried in microwave vacuum dryer at different power levels (600 watts and 700 watts) for 45 min where increase in microwave power led to further reduction in moisture content. In another study, effects of microwave vacuum drying and conventional drying methods on the physicochemical and microstructural

properties of squid shreds were evaluated. Browning of dried squid was controlled by microwave vacuum drying compared to sun drying and hot air drying processes. Instrumental textural parameters like hardness, springiness and chewiness of both dried and rehydrated squid shreds were lower in microwave vacuum dried samples. Scanning electron microscopic image of the muscle fibre indicated muscle shrinkage and more toughness in SD samples whereas the MVD squid shred indicated a spongy arrangement.



Microwave vacuum dried mackerel

Dried squid shreds

Microwave vacuum drying technique was also used to develop high value dried products from fish. Boneless Tuna chunks were marinated using spices and were dried in microwave vacuum dryer at different power levels (600 W (T1), 650 W (T2) and 700 W (T3)) for 2 h. Increasing microwave power level resulted in reduced moisture but higher hardness in dried tuna chunks. Color and appearance of 650 W dried chunks was superior to other samples. Dried fish fingers were prepared from restructured mince of Tilapia. Nutritional value with respect to protein and fat content of dried fingers was markedly higher to fresh fingers prepared from Nile Tilapia. In addition, the coating performances like coating pick up, cooking yield, adhesion degree etc. was also appreciably higher in dried fingers after battering, breading and frying. Microwave assisted hot air drying of goat fish could help in reducing the drying period from 18 h (hot air drying) to 12 h (30 min drying at 700 W and further drying in hot air oven).

Dried tuna chunks

Dried fish fingers

Conclusion

Drying time can be significantly reduced compared to traditional drying methods in microwave vacuum drying without compromising the quality. Additionally, an array of dehydrated value added products can be prepared by microwave vacuum drying technique.However, the operational cost of microwave vacuum drying is slightly higher compared to conventional air drying methods. Nevertheless, considering the potential of microwave vacuum drying technique to develop novel value added dried products and traditional dried products with unique characteristics, this technology can attract great interest among seafood exporters.

Fast changing food habits of consumers driven by the demand for easy to prepare food and functional food will definitely widen the scope for microwave vacuum drying.

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MPEDA- NETFISH conducted training programme on "COVID-19 guidelines, hygiene and sanitation practices"

Dr. Girija Phadke Behere, State Coordinator, MPEDA-NETFISH, during the training programme at M/s. Castlerock Fisheries Private Limited, Thane

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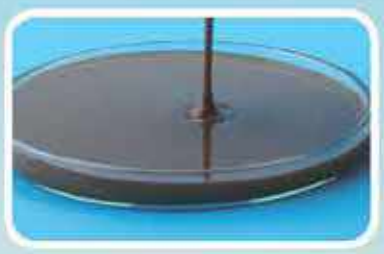

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Pisciculturist to set up north India's first shrimp processing facility

Punjab's efforts to promote shrimp farming in zero-earning saline areas got a boost as a Muktsar-based pisciculturist is planning to set up north India's first shrimp processing-cum-storage unit.

Palwinder Pal Singh Dhillon, who has been cultivating saline water fish at Jandwala village, said the upcoming 30-tonne facility under Pradhan Mantri Matsya Sampada Yojana would enable Punjab fish farmers to process and store shrimp.

"Shrimp is an export-oriented crop that is shipped from Tamil Nadu, Andhra Pradesh and Maharashtra. Traders buy the produce from the farm gate but on occasions. A delay in transportation means financial losses to farmers. The ₹ 1.60 crore project will produce ice and give farmers to earn from the leftover produce by storing it. It will also provide employment as sorting and storing headless shrimp is done manually," said Dhillon, who has been in saline fish farming since 2017. Muktsar deputy commissioner Vineet Kumar said the facility, a subsidised initiative to establish a comprehensive framework and reduce infrastructural gaps in the fisheries sector, will bring a new lease of life to pisciculturists.

This year, the state fisheries authorities expect the production of over 4,000 tonnes than 1,500 tonnes in 2021.Shrimp farming was introduced in 2016 to tap large tracts of lands in the south Malwa belt marred by chronic waterlogged and seepage-hit land. Due to high salinity levels in soil, several areas of Fazilka, Muktsar, Bathinda and Mansa were unfit for conventional farming. After successful experimenting with shrimp farming in saline areas, enterprising adopted aquaculture in 2017 with 37 acres. Official data says, in 2021 about 800 acres were used for shrimp and this year more than 1,300 acres in expected to be covered for aquaculture. Assistant Fishery Director posted at Muktsar Kewal Krishan said as stocking is in the final

stage, the district has recorded about 600 acres under shrimp, the highest in the state, against 278 acres in 2021."Within six years, farmers have reposed faith in the blue revolution. Shrimp farming involves capital investment but a farmer can earn a handsome amount," he added.

A shrimp farmer from Fazilka said there is a huge potential in the 120-day-long shrimp farming as the US and China have major import markets.

"Per acre cost input of shrimp stands at ₹ 6 lakh and a farmer can get a yield of 3-5 tonnes from it. A farmer can earn ₹ 4 per lakh per acre and this aquaculture requires strict biosafety monitoring. Farmers must ensure that the entire pond area is protected against birds or stray animals and that only sanitised people enter their farm. Firms from coastal states of south India buy the crop at the farm-gate in Punjab and salinity-hit areas can be converted into the remunerative zone," he said.

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Pacific whiting skin has anti-aging properties that prevent wrinkles, research suggests

Pacific whiting is caught in large volumes in the United States but consumers have little familiarity with the mild, white meat fish also known as hake. It is popular in Europe, though, where it is the eighth most consumed species. In the U.S., the 10 most-consumed species account for 77% of total per capita seafood consumption and Pacific whiting is not among the top 10.

By studying Pacific whiting. Jung Kwon, an assistant professor at Oregon State's Seafood Research & Education Center in Astoria, Oregon, is looking to change that and alleviate pressure on stocks of those 10 species, which include salmon and tuna.

She studies marine organisms and their potential to improve human health and is particularly interested in the benefits from parts of marine organisms such as fish skin, which many U.S. consumers choose to discard rather than eat.

"Fish skins are an abundant resource that we already know have valuable nutritional properties," Kwon said. "But we wanted to find out what additional potential value might be found in something traditionally considered a byproduct."

In a paper recently published in the journal Marine Drugs, Kwon and a team of researchers looked at molecular pathways that contribute on a cellular level to the wrinkling of skin. That wrinkling is promoted by chronic exposure to ultraviolet light, which breaks down collagen in the skin.

The researchers extracted gelatin from Pacific whiting fish and then looked at what impact it had on anti-oxidant and inflammatory responses and pathways known to degrade collagen and promote synthesis of collagen.

They found that the Pacific whiting skin:

- Reactivated to a certain level the collagen synthesis pathway that had been suppressed by UV radiation.
- Prevented activation to a certain level of the collagen degradation pathway that had been accelerated by UV radiation.
- Promoted additional anti-oxidant activity. Antioxidants are substances that can prevent or slow damage to cells.
- Promoted additional anti-inflammatory effects.

Kwon cautioned that these are initial results obtained in her lab through a human cell model system. Further research is needed using animal models.

"We saw some potential with a positive response in the cell model system," she said. "This gives us good evidence to take those next steps."

Co-authors of the paper are Elaine Ballinger of Oregon State and Seok Hee Han and Se-Young Choung of Kyung Hee University in South Korea.

The research was funded by Pacific Seafood, a harvester, processer, and distributor of seafood.

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