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22nd INDIA INTERNATIONAL SEAFOOD SHOW 2020

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CONTENTS

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K. S. Srinivas IAS
Chairman

Dear friends and delegates,

I am glad to greet you on the occasion of 22nd India International Seafood Show, which is being held at Kochi showcasing a variety of products and services across the seafood export value chain. The India International Seafood Show launched in 1973 as Indian Seafood Trade Fair is regarded as one among the oldest seafood expositions of the world. As the show is returning to Kochi after a span of 12 years, the marine products sector has witnessed marked changes in raw material sourcing, processing and export. However, Cochin as a city has not lost its prominence as a seafood processing hub in the country because of the innovations and interventions brought in by the export processing community here. Kerala plays a prominent role in steering the Indian seafood export industry through pioneering steps to promote value addition and to sustain the fisheries and fish processing sector. This edition of the Show, scheduled to be held in the Lulu Bolgatty International Convention Center, Kochi (Hotel Grand Hyatt) will be the biggest Seafood show ever held in India.

During the India International Seafood Show, MPEDA Export Awards are being presented to the most enterprising entrepreneurs. In order to encourage and honour more entrepreneurs, the Export Promotion Committee of MPEDA has included 3 additional commodity-wise awards this time, such as for frozen surimi, fish meal, fish oil & allied products, and marine products other than fish meal, fish oil & allied products. There will also be an award for Lifetime Achievement for an individual for the contribution provided to the seafood sector.

In addition, a special Chairman's award is also being introduced to an exporting firm, which not only excels in export performance but also contribute immensely towards social and environmental responsibilities. As the world shift towards green and sustainable protocols, and protection of mother earth and its living beings gaining importance, I am sure that such awards will always be an encouragement and pave the way for more entrepreneurs to strive for it.

It is also heartening to share that our marine products exports to China during 2019 has crossed USD 1 Billion mark, announcing the emergence of China as a prominent consumer to Indian seafood, especially shrimp. I am hopeful that we will be able to sustain the momentum in that market and should be able to use it as a plank to reach out more into the East Asian markets.

Season's greetings to all!

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'It is now time for Indian seafood industry to focus more on value addition',

says K.S. Srinivas, IAS, Chairman, MPEDA

The Marine Products Exports Development Authority (MPEDA) is setting new goals for the Indian seafood industry in the coming decade. It has helped the industry to stabilize the production and match the international competition. Now, it is time to redefine the goals and work towards it, says **K.S. Srinivas IAS, Chairman of MPEDA**, in an exclusive chat with MPEDA Newsletter (MNL) ahead of the forthcoming 22nd India International Seafood Show (IISS) at Kochi in February.

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WE HAVE DESIGNED A FIVE-POINT STRATEGY AS PART OF MPEDA'S 'VISION 2030'. THE FIRST POINT IS ON CAPTURE FISHERIES. UNDER THIS SEGMENT, WE ARE FOCUSSING ON IMPROVING THE FISHING HARBOURS AND FISHING VESSELS. BESIDES, IT IS ALSO PROPOSED INTRODUCING INDUSTRIAL FISHING VESSELS FOR DEEP SEA FISHING, WITH ON BOARD PROCESSING FACILITIES OF SEAFOOD.

MNL: What is the roadmap that you have in mind for MPEDA in the coming decade?

KS Srinivas: We have been focussing on stabilising the production side for seafood industry till now. Now, it is time for us to concentrate more on value-addition. India has been lagging behind in value addition when compared to other countries, as only 6 per cent of the seafood exported right now belongs to value-added segment. This should be compared to other seafood exporting countries where value-addition ranges from 30 to 60 per cent. We can improve the value realisation of our seafood export only through value-addition.

MNL: Where you do see MPEDA by 2030?

KSS: We have designed a five-point strategy as part of MPEDA's 'Vision 2030'. The first point is on Capture Fisheries. Under this segment, we are focussing on improving the fishing harbours and fishing vessels. Besides, it is also proposed introducing industrial fishing vessels for deep sea fishing, with on board processing facilities of seafood. This will ensure better preservation of certain quantity of the catch at sea itself, and helps to increase the unit value.

The second focus area of Vision 2030 is Culture Fisheries, which will look into improving the area used under aquaculture and increasing the available area from present 1.3 lakh hectare to at least 2 lakh hectares, increasing the unit area productivity from 5 MT to 10 MT, diversifying the aquaculture options and adding more species like tilapia, mud crab to the presently situation of depending solely on vannamei shrimp. It is not safe to rely on just one species for export.

The third focus point is quality improvement, by which mechanism for quality assurance and surveillance will be put in place, more laboratories installed and initiate steps like making National Residue Control Plan (NRCP) more effective and making Pre-Harvest Test compulsory.

The fourth point, as said earlier, is to focus on value-addition, which is the future of seafood export. As part of this, existing processing plants will be modernised besides setting up more state-of-the-art plants and skilling the persons involved. Lack of trained work force is often hampering the modernising process and efforts to increase value addition.

The final point in the Vision 2030 strategy, and most important one, is the Brand Promotion. We are planning to step up promoting Indian seafood and MPEDA brand through ad campaigns in print and social media, strengthening MPEDA workforce, ensuring compliance to international rules and regulations, launching Trade Promotion Organisations (TPOs) in potential overseas markets like China, Korea and Middle East Asian countries and initiating focussed campaigns under the 'Make in India' banner.

MNL: In the changing world trade and commerce scenario, how do you think IISS will help showcase India's position as a premium seafood industry destination?

KSS: The India International Seafood Show (IISS) is one of the oldest and big seafood events in the world, which attracts seafood traders from the major markets like USA, EU, China, Japan, South East Asia and other countries. However, the 22nd IISS to be held at Kochi from February 7 to 9, 2019 will mark the shift in our focus to value-addition in seafood industry. That is why we have chosen the theme of this IISS as 'Blue Revolution – Beyond Production to Value Addition'.

One entire section the exhibition area has been marked out for the latest machinery used in seafood industry. This has been done to introduce the new trends in the scene to stakeholders here and to promote their usage in our country. Stress is also given to IT-Enabled Services, which is now playing a huge role in improving the quality of service in seafood.

The show presents tremendous scope for tapping new avenues and introducing various technologies and products to the global market. It will pave way for foreign direct investment in India and may contribute significantly to 'Make in India' programme.

MNL: India has a coast line of more than 7,500 km. The fishing trends and patterns are also as diverse. As the prime coordinating body for seafood industry in India, how effective can interventions from MPEDA be?

MPEDA, through its regional offices in the maritime States, continuously organise interactions with the exporters and the fishermen and farmers to sensitise them about the new schemes, regulations and system improvement. These types of interactions are helpful in alleviating the apprehensions of the stakeholders about the market situations and make them aware of the market regulations. This goes a long way in bridging the knowledge gaps in the sector. Such interactions also serve as feedback points to have an update on the issues affecting the sector and help us to recommend measures of appropriate interventions.

Recently, after getting a feedback from the industry, MPEDA submitted a proposal to the Ministry of Civil Aviation about the logistic requirements in the export of marine products by air. The Ministry, in response, convened a meeting of the major airports and formed a taskforce to steer forward actionable points that helped to propel the export of live and chilled marine products

by air to different overseas destinations. It is worth to mention that 20 per cent of the global seafood trade is contributed by live and chilled marine products, whereas only 2 per cent of India's total marine product exports are contributed by live and chilled marine products.

Considering the higher unit value realisation of the cargo, we are hopeful that such interventions will be helpful in boosting the export of seafood in fresh and live forms to overseas markets. Schemes like *Krishi Udaan* announced in the budget will help to extend the avenues of export markets to the hinterland.

Another such intervention that MPEDA undertook recently was to organise a stakeholder meeting to identify the first mile connectivity gaps in the capture fisheries. MPEDA also did one-to-one consultation with the coastal States to discuss the State-specific action plan to identify and upgrade at least one fishing harbour in every State to the world class standards.

The consultations with State fisheries departments were very fruitful and the States have assured whole-hearted support for the initiative. As a next step in this direction, MPEDA has identified 25 major fishing harbours, which contribute around 50 per cent the exports from sea catch, for upgradation to international standards.

MNL: If asked, what would be the recommendations that MPEDA would like to forward to the Union and State Governments for immediate action so as to improve the status of seafood industry in India?

KSS: The immediate step for State Governments would

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be to set up more hatcheries for commercial fin fish and shell fish varieties. They shall also bring out more area under export oriented aquaculture.

As said earlier, MPEDA has already identified 25 fishing harbours for upgradation, which will call for an investment of Rs. 2,500 Crores in the next five years. Action has been initiated for two fishing harbours, the Cochin fishing harbour in Kerala and Nizamapatnam in Andhra Pradesh, and appointed a Transaction Adviser(TA) firm for this purpose. Other states may also join us in fishing harbour upgradation to the scale MPEDA envisages under the above pilot projects.

On their part, the Union Government should allocate more funds for fisheries sector. It has to increase the present allocation of Rs. 90 crore for MPEDA to at least Rs. 150 crore so that we can take up many innovative programmes.

It is a positive step that a new ministry has been formed exclusively for the fisheries sector under the Union Government.

MNL: There have been recent instances of export consignments rejected by the US and EU markets due to the presence of residue antibodies in seafood. Following this, MPEDA has gone on an aggressive campaign to make aquafarmers aware about the situation. Can you evaluate the present situation and explain the achievements made by MPEDA?

KSS: Antibiotic residues in farmed seafood undermine food safety and have become a major challenge for the Indian seafood exporters. Citing inadequate measures implemented to improve quality with reference to banned antibiotic residue in shrimp consignments exported, the EU has increased testing of samples from 10 to 50 per cent of the shrimp consignments exported from India.

Whereas, traceability requirements of USA under Seafood Import Monitoring Programme (SIMP) require exporters to furnish the details of wild catch and aquaculture harvest data to the importers before the cargo reaches the US shores. Following these developments, MPEDA is implementing various campaigns to address it.

MPEDA has established 11 ELISA (Enzyme-Linked Immuno Sorbent Assay) Labs for the Pre-harvest Testing (PHT) of all aquaculture products, which is mandatory for export to EU countries. Five more such labs will be commissioned in the near future. MPEDA has developed a GPS-based enrolment programme for export-oriented aquaculture farms to ensure traceability of the production value chain as well as to secure the interests of end-consumer. Unique ID is issued to aqua farms after physical verification with GPS, and the pre-harvest test (PHT) is also linked with this ID.

MPEDA operates the National Residue Control Plan (NRCP), which is a statutory requirement for exporting to EU countries. Under NRCP, definite sampling schedule and sampling strategies are drawn every year for monitoring the residues of substances like Antibacterial/ Veterinary Medicinal Products and environmental contaminants. Samples are collected from aquaculture farms, processing plants, hatcheries and feed-mills of different maritime states and tested for the presence of any residue/contaminants.

For testing the NRCP samples, MPEDA has set up 4 ISO, NABL and ILAC accredited Quality Control Laboratories in Kochi (Kerala), Bhimavaram, Nellore (Andhra Pradesh) and in Bhubaneswar (Odisha). The laboratories are also approved by the Export Inspection Council of India for testing of fish and fishery products intended for export (commercial samples).

MPEDA understand the need to be more proactive in containing the antibiotic residues in its farmed shrimp production systems so as to regain the lost volumes of exports to the European market. MPEDA, through its field offices and society named National Centre for Sustainable Aquaculture (NaCSA), is grouping farmers into societies and educate them to follow Better Management Practices (BMPs) in farming. We also get reports that in certain other regions, the farmers and exporters work closer to ensure the production of residue free and traceable shrimp by following the BMP's. Such networks are formed across all the coastal states so as to bring in more farming area under the network of traceability. Unless this is done, it is quite difficult for Indian shrimp farmers as well as exporters to be out of the stringent import checks in markets like EU and Japan.

MPEDA, in association with hatchery and farmers' associations, has initiated action to launch its own certification scheme for the production of antibiotic free aquaculture products based on the guidelines issued by FAO. This is a completely voluntary programme and will be launched soon.

MNL: MPEDA has been participating in many international seafood fairs, including the famous China International Import Exposition? What are the lessons for MPEDA gather from such international interactions?

KSS: In order to promote Indian seafood in various overseas markets and to penetrate into new markets, it

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has become most essential to adopt aggressive marketing strategies effectively and timely. MPEDA participates in major international seafood fairs in the world and displays a wide range of India's products, especially value-added products to generate awareness and demand.

Participation in international fairs is an effective and meaningful method to project India's array of seafood products and potential for value addition before the international buyers and consumers. By this, the Indian seafood exporters get the opportunity to exhibit their products, interact with the buyers and get confirmed orders for their products.

Please note that MPEDA chooses the fairs based on product demand in the markets, market opportunities offered, scope anticipated for strengthening our market share, markets to be developed, and on to develop and sustain trade relations. Apart from the spot orders received at the MPEDA stalls, the trade enquiries received at MPEDA pavilion and subsequent post-exhibition follow ups enable the trade to find out new trading partners and to expand the existing trade zone.

In the digital age, MPEDA's participation in the international fairs alone will not provide enough visibility to the seafood resources of the country and hence we have introduced an interactive business portal called 'Fish Exchange Portal'. This is meant to enhance the export trade between registered seafood exporters of India and buyers abroad. This portal provides a platform for buyers across the globe to interact and source seafood from the exporters registered under this Authority. Besides, MPEDA is also active on social media to disseminate information to the stakeholders.

MNL: You are leading MPEDA in many trade delegations to China and many other nations. How are these visiting translating to the industry benefits?

KSS: Trade agreements are one of the approaches to diminish unilateral barriers of several types, including tariffs, non-tariff barriers, and outright prevention, thus opening all parties to the remuneration of increased trade. MPEDA provides appropriate inputs to the Department of Commerce that supports the treaty negotiations. It also facilitates trade delegations to visit India and also organizes delegation visit to leading seafood-buying countries to strengthen the trade links. Such visits act as confidence building measures and are fruitful in enhancing the mutual understanding on market preferences and regulations. Delegations to India will get benefitted through better awareness on the strength and uniqueness about the product value chain in India. Such visits alleviate apprehensions on trade barriers and equip our export sector resulting in enhanced business.

MNL: MPEDA is generally seen as a mediating forum between farmers and industry stakeholders. At the same time, path breaking studies are happening in marine and inland fisheries sector from the Indian academic scene. How is MPEDA capitalising on these developments?

KSS: MPEDA has established a technology incubation centre called Rajiv Gandhi Centre for Aquaculture (RGCA) to fill the technological gap between lab and the land in export-oriented aquaculture. RGCA sources the technology developed in the R & D institutions and help farmers in diversification, disease diagnosis and technology upgradation.

RGCA has made breakthroughs not only in culture technologies of shrimps, but also in diversified species such as Seabass, Cobia, Pompano, Tilapia, Groupers, Mud Crab etc. With the implementation of projects such as the pilot-scale Marine Finfish Hatchery Project at Vizhinjam, Kerala, Grouper project in Andaman & Nicobar islands and Seabass hatchery and Mud Crab hatchery projects at Thoduvai, Tamil Nadu, Multi-species Aquaculture Complex in Kochi, RGCA is fully geared up to change the existing trend of our export aquaculture practices,

which is largely-centred around shrimps. MPEDA has implemented many farmer beneficial programmes in collaboration with national research institutions like CIFT, CIBA and CMFRI. The applied research pursued for the long-term sustainability of exports. Potential resources in marine, brackish water and fresh water areas especially in the hinterlands of the country could be used to supplement export oriented aquaculture

by RGCA in culture technologies of diversified species, India can now look forward to expand its export oriented aquaculture base by exporting more high-valued finfish and shellfish species, apart from the conventional ones.

MNL: Diversification is the key concept in seafood, after the major disease outbreak for Tiger Prawns in last decade that broke the mainstay of the industry. Since then, MPEDA has been in the foreground advocating diversification of species being farmed. How do you evaluate the situation?

KSS: Diversification is a broad term and in aquaculture it shall comprise of species, methods and the aquatic realms used. Depending one or two farmed species such as Pacific whilteleg (*Litopenaeus vannamei*) and Black Tiger Shrimp (*Penaeus monodon*) will not be sufficient through diversification of farmed species.

Diversification in aquaculture has been advocated for avoiding disease incidences, optimum utilization of resources and higher assured income to the farmers. Though technology development has been done in many alternate culture systems like finfish culture, mollusc culture, seaweed culture, etc. these are yet to take off on a large scale. Replacing, supplementing or rotating the shrimp farming with culture of other high-value fish species like Asian sea bass (*Lates calcarifer*), grouper (*Epinephelus spp.*), mullets (*Mugil spp.*) and milk fish (*Chanos spp.*) culture may ease the risks in mono-cropping of shrimp.

MPEDA recently introduced a new concept of Multi species Aquaculture Complex (MAC) and the first one

was established at Vallarpadam in Kochi.

The seeds from the facility are in huge demand from the farmers of Kerala as well as other States. The reports from the field indicate that the farmers are very happy with the quality of fish and shrimp seeds supplied by MAC, and are growing well. The high health seeds of Black Tiger shrimp supplied by the complex will certainly revive the black tiger shrimp farming in India, which enjoys a consistent demand abroad.

MNL: Thank you sir, for taking time out to explain the role of MPEDA in promoting Indian seafood. Before we wind up this talk, one last question. How equipped is MPEDA to take up challenges faced by the seafood industry on a global level?

KSS: MPEDA, being an export promotion body for marine products from the country, has initiated various measures to address the challenges faced by the seafood industry. It has done so in the past too. As I said earlier, this includes ensuring India's participation in international seafood shows, organising trade delegations, promotional events and buyer seller meets abroad for diversification of export markets for Indian seafood and compliance to regulations.

Traceability has become an important criterion for sustaining the exports and market access. As part of ensuring quality and traceability in aquaculture, MPEDA has established an online system of enrolment of aquaculture farms and shrimp hatcheries.

There are 71,319 aquaculture farms covering an area of 1,72,590 Ha enrolled with MPEDA. There are 356 hatcheries with production capacity of 25.7 Billion have also been enrolled. MPEDA also involved in committees on fishing and aquaculture regulations, standard formulations, and capacity building in HACCP system in seafood processing units.

In fact, MPEDA has been spearheading the campaign to amend the Marine Fisheries Regulation (MFR) Act in States, following the model set by Kerala. This is essential to stop fishing of juveniles and thus promote sustainable fisheries. Recently, Kerala has notified Minimum Legal Size (MLS) for 58 species of fishes. But the purpose of this is not served unless other States too follow the suit. MPEDA is in constant touch with all maritime States to take up the cause, while organising extensive workshops for spreading awareness among stakeholders. MPEDA-RGCA is operating the one and only Aquatic Quarantine Facility (AQF) in India for the import of brood stock and post larvae of vannamei shrimp from abroad, which has paved the way for the widespread production of this exotic species. This species contributes over 90 per cent of the total farmed shrimp production in India.

Besides other facilities, RGCA has set up the state-of-the-art technology transfer and training centre for disseminating the technologies developed by it at Sirkali, Tamil Nadu. It also has the first Aquaculture Genetics laboratory in India, which is accredited by the NABL.

MPEDA also supports resource conservation and traceability measures, and fight against Illegal Unreported Unregulated (IUU) fishing etc. to elevate the Indian seafood to higher standards in quality and responsible sourcing. It has also initiated to curb fish meal production capacity in an effort to conserve the food fish resources.

MNL: Thank you sir

'Indian marine product export aiming to touch Rs. 100,000 crore by 2030' says SEAI President

The Seafood Exporters Association of India [SEAI] is going ahead with a clear roadmap on endorsing India's position as a lead player in the seafood industry. It has got specific mission statements for 2025 and 2030, making the next decade highly focussed. In an exclusive interview given to the MPEDA Newsletter (MNL), **Jagadish Fofandi**, **National President of SEAI**, outlines the role played by SEAI in the present scenario.

MNL: How does SEAI approach IISS 2020 as a platform for showcasing the potential of India as a seafood destination in the light of the changed global industry scene?

JF: India has always been a leading exporter of marine products in the last decade and over the years it has gained prominence as the leading exporting nation of shrimps to USA. This impression has been built on the strength of quality, which is considered to be the best, and also the quantity along with the commitment of honouring the long-term contracts. IISS 2020 will be a reflection of India's performance in the recent past and also the improvements it has made on the sustainability, quality and value addition fronts.

MNL: Many international markets, like the US and EU, have brought in stringent quality measures for seafood exports. How prepared is the Indian seafood export industry to respond to that?

The stringent quality measures are not new in the markets of US and EU and other markets like China and Russia. India has dealt with these issues very aptly, understanding that protection of consumer health in any country is important not only in terms of marketing but also the huge obligation of social requirement. India has been very active and sensitive in responding to such requirements.

MNL: As the president of SEAI, how do you plan to convert IISS 2020 as a medium to bridge the industry differences existing between Indian farmers and international customers?

JF: The exporters and also the Government

organisations involved in the export of marine products, principally MPEDA and EIC, have been disseminating the international requirements of the customers and the health authorities, so much so that the enterprising and dynamic Indian farmers are looking forward to such information, and are very proactive in meeting such requirements. IISO 2020 will further strengthen this activity of spreading the knowledge on requirements of different markets to the Indian farmers, fishermen and other stakeholders of the marine product export industry.

MNL: Marine fisheries is facing a general slump in production. What are the creative interventions on the part of SEAI to overcome this crisis?

JF: There is no "creative intervention" on the part of Seafood Exporters Association of India [SEAI] to overcome the general slump in the production of the capture segment of the marine products industry. SEAI has continuously, in a sustained manner, been working closely with the Government on various conservation methods that are required to regain the lost ground of the past.

The newly formed Fishery Ministry at the Union Government is an initiative of the trade in this direction. The Fishery Ministry is now playing a very active role with a larger support of funds from the Government, on implementing the schemes laid out in a very exhaustive and well thought Fishery Policy.

This has also been followed up very closely with the Maritime State Governments for effective implementation. SEAI is confident that in the years to come the capture fisheries (ocean catches) will see a significant improvement over the performance of the last few years.

> IISS 2020 WILL BE A REFLECTION OF INDIA'S PERFORMANCE IN THE RECENT PAST AND ALSO THE IMPROVEMENTS IT HAS MADE ON THE SUSTAINABILITY, QUALITY AND VALUE ADDITION FRONTS.

MNL: What are the goals set for SEAI for the next decade, starting with 2020? Does SEAI have a Mission 2030 ready?

JF: SEAI has a mission for 2025 and one for 2030. This is not only for the marine product export sector, but also for the fishing industry in general. By 2030, Indian marine product export will cross Rs. 100,000 crores, and the total fishing industry in India will touch a production value of Rs.600 to 700 thousand crores.

Showcasing India: A Brief Overview of IISS

India's seafood history goes a long way back in time. The rich marine life on Indian waters have always provided food for the natives. But with the world opening up and ships plying across the world, the flavour and smell of Indian seafood started reaching out.

When the world come looking for what India has to offer, the nation must respond in a fitting manner. The mandate to do so has fallen on MPEDA and SEAI. For many decades now, these agencies have been doing an exemplary work in showcasing the best of Indian seafood and also bringing, stakeholders in Indian seafood on the common platform with international players.

Right now, the India International Seafood Show (IISS) is one of the oldest and largest seafood events in the world with a global recognition. This biennial show brings together India's huge potential in seafood resources in a single venue – thus making it accessible for anyone interested to get a first-hand experience of the reality. Over the years, the IISS has brought seafood traders from almost every point on the globe. The major brand names from elite markets in the USA, EU, Japan, China, South East Asia and Middle East Asia are regular visitors at IISS. In other words, the who's who of seafood industry will line up at IISS for interaction and more importantly, for doing actual business transactions.

When IISS returns to Kochi, the headquarters of MPEDA, after a span of 12 years, the scale and scope of the show has only increased. It is now opening new avenues and possibilities for stakeholders to explore in seafood, in tune with the emerging international trends. Also, the 22nd edition of IISS is redefining the goals for Indian seafood industry by giving accent to the value-addition process.

Kochi
The Land of Options

Kochi always attracted voyagers. Everyone who touched down at the shores of Kochi, got mesmerised by its charm, and left their mark here. The first reference to Kochi is perhaps found in the texts by Chinese traveller Ma Huan in the 15th Century. He was part of the treasure fleet led by Admiral Zheng He. This visit is more important in the evolutionary history, as Admiral He left a lasting mark on Kochi shores, which is still counted as a signature of this wonderful city – the Chinese fishing nets.

The history of seafood can also be traced back to this iconic structure that dot the Kochi coast. That could be the first attempt to tap into the rich marine resources of the sea. Since then, the region has come a long way in time and facilities. But still, it remains the seat of seafood industry, as the beacon of knowledge for the rest of the country.

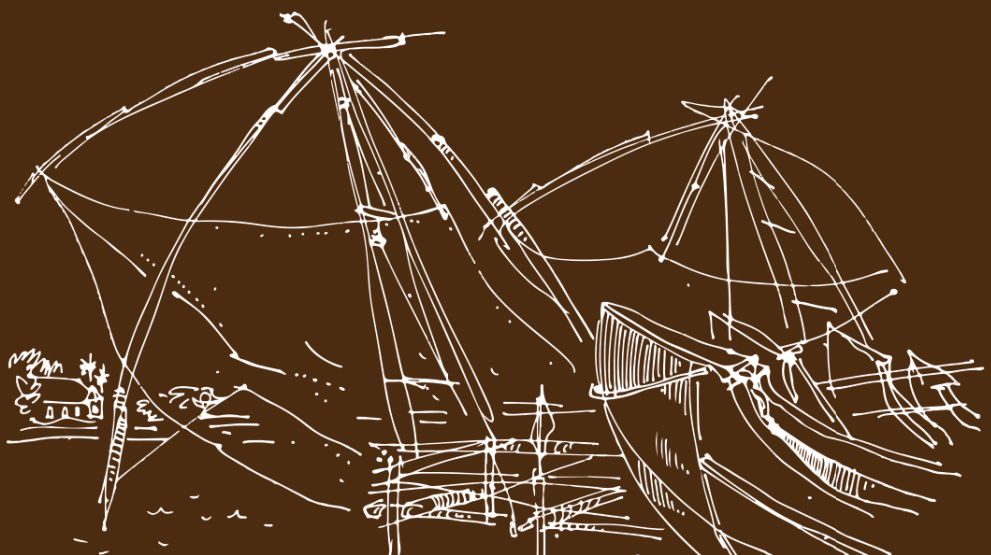
Being the most cosmopolitan city in Kerala, it was as to Kochi where the world flocked. The first Colonial settlements happened in Kochi. Only in Kochi, nowhere else in Kerala, can an organic melting pot of a spectrum of human culture can be spotted. Around fifteen ethnic communities still co-exist across a single street in Kochi.

This is a city that offers as rich options in taste as does its sea.

Why is Kochi the hub of Indian seafood industry?

As with the annals of history, penned by Ma Huan and Italian traveller Niccolo Da Conti, the recent history also points to supremacy of Kochi over others. It was indeed one small step made by an entrepreneur that set the entire export industry on a glorious journey in the country. R. Madhavan Nair and his Cochin Company exported the first consignment of frozen shrimp in 1953 to open up the wonderful world of possibilities. Around the same time, the Indo-Norwegian Project happened at Kollam. This shifted to Kochi in 1961, with the accent only on fisheries. The wave of modernisation and standardisation for fishing boats brought in by this project set the pace of fisheries development, not just in the region, but across the country. The city did not stop at that. It kept on updating its knowledge base, even while pursuing for excellence in industry standards. The academic ecosystem that has evolved in and around Kochi adds to the glory of it being the hub of seafood industry in India. Almost all leading academic institutions doing pioneering and path-breaking work in fisheries are in this part of the world.

Kochi is truly the uncrowned queen of seafood industry in the country.



Beacons of Knowledge

Kochi is renowned for its high density of premium academic and research institutions related to fisheries, which augment the rich traditional knowledge and brings it closer to the international levels. Nowhere else in India can one find such a synergy between the industry and the academia so far as fisheries is concerned. Here are the jewels of knowledge that makes Kochi an exclusive destination in seafood.

CMFRI

The Central Marine Fisheries Research Institute (CMFRI) was established by Government of India on February 3, 1947 under the Ministry of Agriculture and Farmers Welfare and later, in 1967, it joined the Indian Council of Agricultural Research (ICAR) family and emerged as a leading tropical marine fisheries research institute in the world.

CIFT

The Central Institute of Fisheries Technology (CIFT) is an autonomous organization engaged in research related to fishing and fish processing in India. CIFT has been selected as the seat for the establishment of the south zone Zonal Technology Management – Business Planning and Development (ZTM-BPD) Unit for catering to the individual and collective needs of 22 agricultural institutes of ICAR in South India.

CIFNET

The Central Institute of Fisheries Nautical and Engineering Training (or CIFNET), formerly known as the Central Institute of Fisheries Operatives (CIFO), is a marine studies centre located at Kochi. Maintained by the Department of Fisheries and Animal Husbandry of the Government of India, the institute was set up to aid research and development in the field.

NIFPHATT

The National Institute of Fisheries Post Harvest Technology and Training (NIFPHATT), formerly Integrated Fisheries Project, is devoted to all-round development of Post-Harvest Technologies. NIFPHATT envisages the best post-harvest fish utilization and consumption with the least post-harvest losses and delivery of the best quality fish and fish products.

KUFOS

The Kerala University of Fisheries and Ocean Studies (KUFOS) is a university established by the Government of Kerala, which is devoted to studies in fisheries and ocean sciences. KUFOS is the first university in India exclusively dedicated to studies in fisheries and allied disciplines.

School of Industrial Fisheries

The School of Industrial Fisheries was established in 1976 as the Department of Industrial Fisheries under the former University of Cochin for postgraduate teaching and research on all aspects of fisheries science and technology. The Department was elevated to the status of the School under CUSAT since 1995 by recognizing the progress achieved in Teaching, Research and outreach activities in various facets of fisheries.

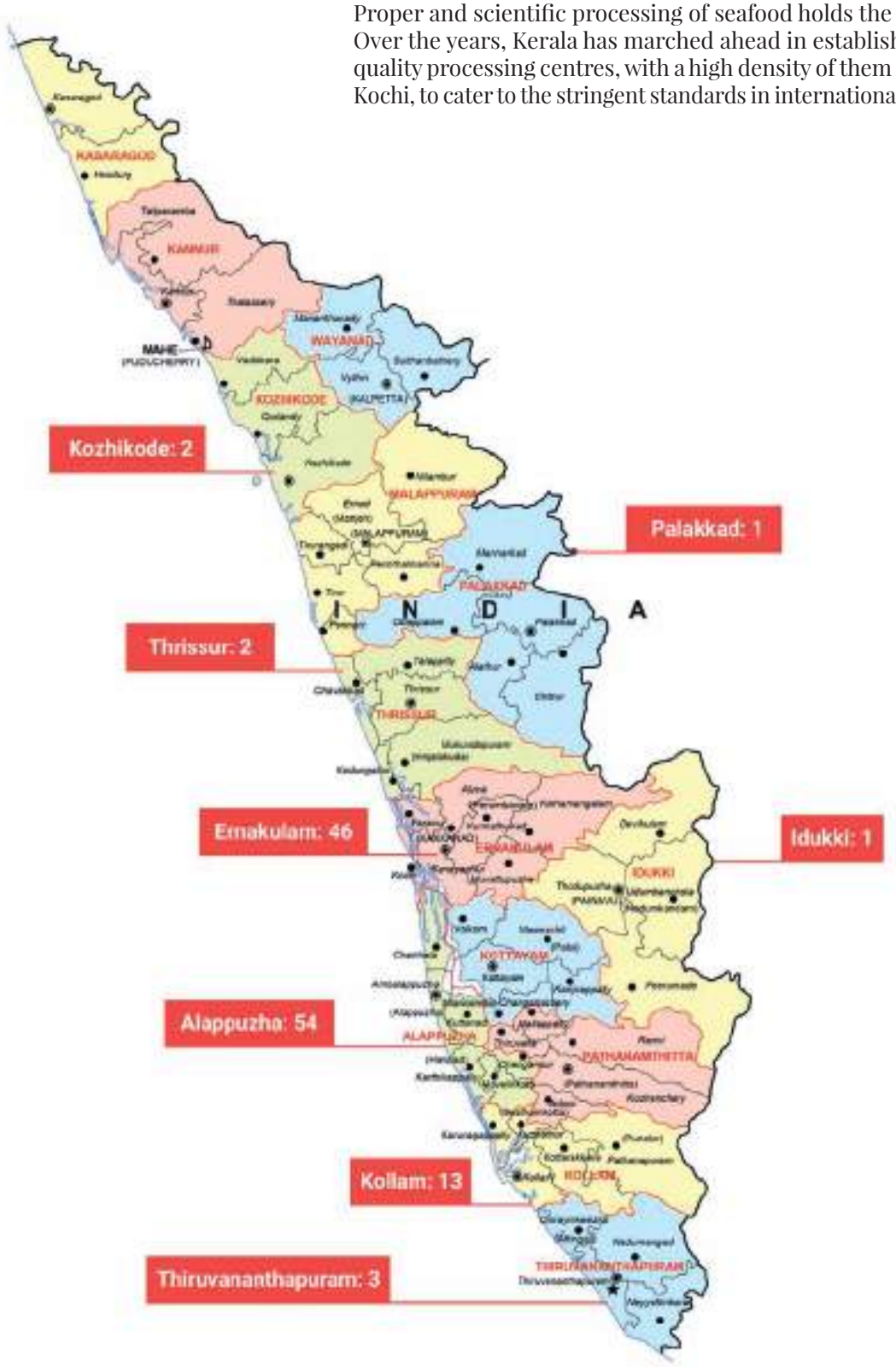
MAC - RGCA

Rajiv Gandhi Centre for Aquaculture (RGCA) is the R&D arm of MPEDA, and is dedicated to augment the Indian seafood exports through sustainable culture technologies. The organisation, which functions as a society under MPEDA, has made breakthroughs not only in culture technology of shrimps, but also in diversified species such as Seabass, Cobia, Pompano, Tilapia, Groupers, Mud Crab etc. The Multi-species Aquaculture Complex (MAC) of RGCA at Vallarpadam, Kochi offers quality seeds of Black Tiger and other finfishes such as Tilapia, Sea bass, Pearl spot and Pompano.

Other academic institutions supporting the fisheries sector from the region are Central Inland Fisheries Research Institute (**CIFRI**) and ICAR-**National Bureau of Fish Genetic Resources** (ICAR-**NBFGR**).

Processing Units

Proper and scientific processing of seafood holds the key in export. Over the years, Kerala has marched ahead in establishing premium quality processing centres, with a high density of them in and around Kochi, to cater to the stringent standards in international export scene.



Unique Case of Munambam Harbour

Fisheries is perhaps one of the oldest known industries for mankind. But the management of the same was not streamlined as it happened with other sectors like forestry and agriculture, especially when it comes to managing the logistics. May be that was one reason why the fisheries lagged behind in updating itself to the changing global trends, where the industrial activities are more organised. It is here, the success story of Munambam Fishing Harbour stands out as a role model for the entire country.

Munambam fishing harbour, located in Vypeen Island in Ernakulam district of Kerala, is established alongside the Munambam estuary where the Periyar River connects to the Arabian Sea. It is 40 km north of Kochi harbour and 85 km south of Ponnani Port. Construction of this harbour started in 1989 and the harbour was commissioned in 2000.

Like all other harbours, Munambam harbour too was managed by the Department of Fisheries under the Government of Kerala. Till around 2007. It was then a revolutionary decision was taken to hand over the administration of the harbour to co-management committee.

The Munambam Fisheries Harbour Management Society (MFHMS) has District Collector of Ernakulam as the Chairman and Joint Director of Fisheries as Member Secretary. MPEDA, NETFISH, Matsyafed and Department of Harbour Engineering along with other stakeholders are part of the committee that operates the Society.

With this one move, the harbour could put in place an effective system to manage and maintain the harbour, to provide convenient landing facilities to the fishing crafts, to facilitate berthing, handling of catches, auctioning, bunkering, repair etc. and to provide and maintain hygienic conditions for handling of fish, matching international standards.

This is one-of-its-kind in the country and its effectiveness has made the fisheries industry take note of it.

Success Story of Sahyadri

Come Tuesday, the quaint village square at Shappumpadi Junction at Keezhillam, which is 7 km off the Perumbavoor-Muvattupuzha Road, becomes active. People come from Thiruvananthapuram in south to Kozhikode in north. They all are looking for drops of colours in tiny packets of water – ornamental fish. This is the only market where farmers of ornamental fish bring over their produce for buyers, without any middlemen or society meddling with prices.

Sahyadri, a company registered under the guidance of MPEDA, has been bringing about a silent revolution since 2016. It started off with 10 members in 2014 and once the weekly market started two years later, its popularity among stakeholders has been on the rise.

Right now, there are 30 shareholders with provision for farmers to join as temporary registration for six months after paying Rs. 1,000. Shareholders will pay Rs. 20,000. "On an average, we have 60-70 buyers from across Kerala coming over to collect the fish, with the total sale for the day coming to Rs. 2.5 lakh to 3 lakh," says Joy Joseph Kunnel, who heads the Company.

By stabilising the price, this market supports the farmers and encourages more to venture into the industry. The weekly market operated by Sahyadri is redefining aquaculture in Kerala in a big way.

Fisheries Cooperatives hold the key in developing post-harvest infrastructure

B.K. Mishra

The umbrella body of fishery cooperatives in India is the National Federation of Fishers Cooperatives Ltd. (FISHCOPFED) – an apex and national level cooperative organisation for the development of fishery cooperatives movement in India. Though it was registered in 1980, the Federation started its operation in 1982.

FISHCOPFED has 106 member institutions all over the country, including Ministry of Fisheries, Animal Husbandry and Dairying, Government of India and National Cooperative Development Corporation (NCDC). FISHCOPFED provides social security through insurance scheme and training extension to the poor fishers to train their skills on various aspects of fisheries. FISHCOPFED is the best service delivery system in the country in fisheries sector focusing on economic empowerment of poor fishers. FISHCOPFED is a member of the International Co-operative Alliance and also a member of the International Cooperative Fisheries Organization (ICFO) and Network for Development of Agricultural Cooperatives in Asia and the Pacific (NEDAC). FISHCOPFED is engaged in a number of activities of fish marketing in different States as retailer and wholesaler for the ease of the primary fishery cooperative societies to provide them hurdle-free marketing channels and give them better price for their produce.

In order to demonstrate fish culture in inland water, FISHCOPFED is having five water bodies in Odisha and one water body in Bihar. FISHCOPFED also manages and operates a hatchery at Bhimpur in Rajasthan to supply quality fish seeds to fish farmers of Rajasthan and supply fingerlings for reservoirs in the state.

The Group Accident Insurance Scheme, sponsored by the Union Government and implemented by FISHCOPFED, has been converged to Pradhan Mantri Suraksha Bima Yojna (PMSBY), which provided insurance cover to 28.95 lakh fishers in 16 States and 6 Union Territories in 2019-'20. The premium is of Rs. 12 per insured and is shared on 50:50 basis between Union and State governments. It is shared on 80:20 basis between Union and State governments for North-Eastern States and Hill States. There is 100 per cent central share for Union Territories covered under the scheme. The cover is of Rs. 2.0 lakh for death or permanent disability and Rs. 1.0 lakh on partial, but permanent disability due to accident.

View of the National Fish Seed Farm

Managing Director, National Federation of Fishers Co-operatives Ltd. (FISHCOPFED), New Delhi- 110 076 (India)

Present structure of Fish Cooperatives in India

Name of the State / UT	Number of Societies (level)				No. of members
	State Level	Regional Level	District Level	Primary Level	
Andhra Pradesh	1		13	2,347	2,60,579
Arunachal Pradesh				11	230
Assam	1			272	43,845
Bihar	1			510	4,10,007
Chhattisgarh	1		5	765	26,154
Goa				20	1,503
Gujarat	1		3	263	26,045
Haryana			1		11
Himachal Pradesh				45	5,837
Jammu Kashmir				1	18
Jharkhand	1		1	384	22,853
Karnataka	1		2	418	2,04,689
Kerala	1		1	651	4,60,486
M.P.	1		1	2,290	85,731
Maharashtra	1	2	36	3,315	3,32,636
Manipur	1		3	240	18,433
Meghalaya				18	611
Mizoram	1			47	1,656
Nagaland				267	9,234
Odisha	1	5		657	1,38,143
Punjab			1	1	18
Rajasthan	1		1	34	4,130

Sikkim				8	230
Tamil Nadu (TN)	1		11	1,353	6,01,620
Telangana	1		10	4,348	3,02,002
Tripura	1			142	22,967
UP	1		22	1,011	54,521
Uttarakhand				13	634
West Bengal	1		20	1,433	1,31,578
Andaman Nicobar Islands	1			41	1,361
Daman and Diu				7	3,176
Lakshadweep				6	2,910
Puducherry	1		1	64	58,525
Total	**21**	**7**	**134**	**20,639**	**32,81,736**

Water resources of India

i) Inland Water Resources of India

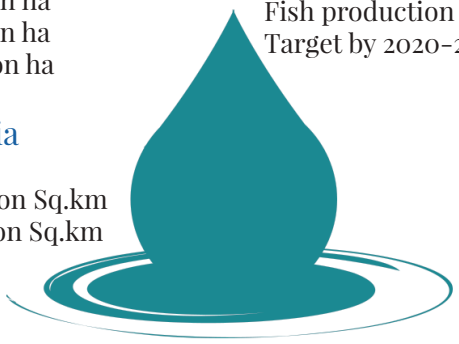
Area under reservoirs :3.15 million ha
Area under Ponds and Tanks :2.36 million ha
Area under Brackish water :1.24 million ha
Length of Rivers & Canals :0.19 million ha

ii) Marine Water Resources of India

Length of the coast line :8,118 kms
Exclusive Economic Zone :2.02 million Sq.km
Continental Shelf :0.53 million Sq.km
Number of Fisheries Centres :1537
Number of Fishing Village :3432

iii) Target Set by Govt. of India

Fish production in 1950-51 : 0.75MMT
Fish production in 2017-18 : 12.61MMT
Target by 2020-21 : 15.08MMT



Role of Fisheries Cooperatives in Aquaculture

Fisheries cooperatives play a good role in capture fisheries in coastal States. PFCS can play a very vital role in culture fisheries also by supplying quality fish seed (Tilapia, *Pangasius*, IMC, Indigenous cat fishes and exotic carps etc.) and setting up fish seed-rearing farms to supply fry and fingerlings of various improved strains of fish and also supplying brood fishes to hatcheries besides setting up fish feed mills and switching over to intensive fish farming technologies like RAS, BFT and cages fish culture etc. Fishery Cooperatives have huge potential in bringing blue revolution in India by providing aquaculture support services, bringing more water bodies in fish farming, expanding aquaculture vertically and doing marketing of fish and fishery products in domestic and international markets.

There are many cat fish/air-breathing fishes, which are commercially very important. Some of them are Singhi (*Heteropneustes fossilis*), Magur (*Clarias batrachus*), Sol (*Channa striatus and Channa marulius*) Climbing perch/Koi (*Anabas testudineus*), Pabda (*Ompok pabda*) and species of Pangasius to increase the production of fish farmers and fishery cooperatives in small water bodies and indoor tanks etc. These fishes have high consumer preference and fetch good prices to farmers. Culture of some fishes can be done with carp fishes also under polyculture system. The cat fishes can be easily cultured in intensive culture system and hence gives more production from per unit volume or area of water body.

The high yield culture system of air-breathing fishes with low input has proved to be of low risk and required simple management and is well suited to rural development. Genetically improved fish species like GIFT strain of Nile tilapia, Jayanti rohu and improved catla etc. have considerably increased the production of some fishers and members of fishery cooperatives.

Fish Seed Production and Supply

Awareness level among the farmers is still very low and there is need of setting up of hatcheries, nursery and marketing units of these species across the country. Tilapia is a fish which has huge potential in domestic an international fish market but seed availability and marketing policy are major constraints. Technology of the seed production has already been developed by Indian fisheries institutions. PFCs are required to set up hatcheries to supply seed to fish farmers, entrepreneurs and to other fishery cooperatives. Recently, FISHCOPFED has been given administrative approval for establishing GIFT seed production hatchery at its National Fish Seed Farm in Rajasthan as there is rising demand of GIFT tilapia seed from across the country in ponds, biofloc tanks, RAS and cages etc.

Tilapia

Tilapia farming goes back to biblical times – it is known as St. Peter's fish. It is a native to Africa and Middle East and is farmed in over 85 countries. There are more than 100 tilapia species out of which 10 species are farmed in fresh, brackish and salt waters. Tilapia is very hard fish, highly resistant to diseases, can feed on variety of food (Omnivore) and can tolerate poor water quality. It can be farmed in variety of production system-tanks, ponds, cages, raceways, RAS and BFT etc. Also it can be farmed in monoculture, polyculture, integrated farming and monosex culture systems. Monosex of this fish can be done by manual sexing, hybridization, hormonal sex reversal and genetic manipulation etc. Farmed tilapia contributes 87 per cent of total global tilapia production. Global tilapia aquaculture production was 4.3 million tons in 2012 and it is expected to reach 7.3 million tons by 2030. Tilapia production is mostly from SE Asia, Africa and South & Central Americas. Top 10 producers are from China, Egypt, Indonesia, Brazil, Philippines, Thailand, Vietnam, Taiwan, Colombia and Ecuador.

SPECIAL PAPERS

Tilapia is a major aquaculture species after shrimp entering in international trade, it also overtook salmon. China exported 403,600 tons of Tilapia in 2013. Major importers of Tilapia are USA, Europe, Mexico and Middle East. China is dominating world tilapia market since 2006.

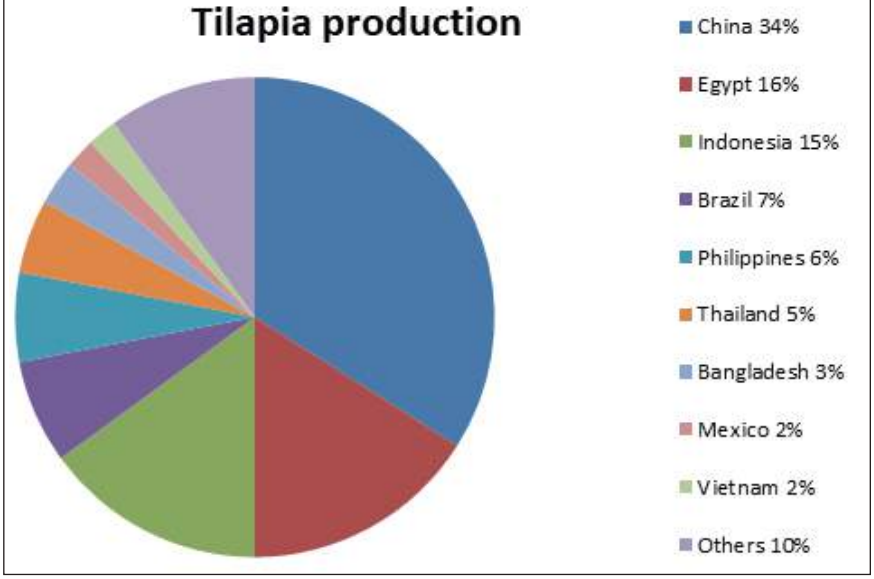
India introduced Mossambique tilapia in 1952 and Nile tilapia in late 1970s – early 1980s. Of all the tilapia cultured, 74 per cent is Nile tilapia, and 26 per cent are other species like blue, mango, tilapias nei, mossambique tilapia, blue-nile hybrids and others.

Strains of Nile tilapia: Strains of Nile tilapia are GIFT, Chitralada (Thailand), FaST (CLSU, Philippines), SEAFDEC, GMT tilapia (YY Super Male) and many others.

GIFT Strain of Nile tilapia: Genetically Improved Farmed Tilapia (GIFT) is a strain of Nile tilapia developed through selective breeding programme. Some GIFT derived strains are Genomar Supreme tilapia (GST), GBT-Excel (BFAR, Philippines), GIFTFF (Philippines), Big Nin (Thailand –Namsaifarm), Namsai strain, etc.

FISHCOPFED will start production of GIFT seed by July 2020. But farm gate price of tilapia is very low and it is to be increased by Government of India by adopting set of several measures to increase farm gate price and wholesale price of tilapia.

Country-wise tilapia aquaculture in the world in 2013



Role of Fishery Cooperatives in Post-Harvest Infrastructure

Export Oriented Tilapia Fish Processing Facilities: Availability of quality seed and networking of farmers with export-oriented fish processing facilities are keys to its expansion. Farm gate price and wholesale price in most parts of India is very low and therefore farmers do not generally go for its farming. FISHCOPED has got administrative sanction for GIFT seed production and it will start producing seed by July 2020. But to fetch better prices to tilapia fish farmers it is necessary to develop at least five dedicated tilapia fish processing facilities in various parts of the country so that farmers could get better price and India could do export earnings out of its farming. Presently, China is dominating world tilapia production and export market and USA, Europe, Mexico and Middle East are major market. India has huge potential and the potential can be trapped with a PP model with fishery cooperatives.

Domestic Marketing: Fish is a very highly perishable item and its nutritive value has to be maintained by means of fish preservation immediately after it's harvesting and until it reaches the end consumer. Hence, marketing of fish to far distant States has emerged as an issue of great concern for individual fish farmers and fishery cooperative societies. This is mostly because of lack of infrastructure, their exploitation at various level of trading by middlemen, uncertainty of market demand and lack of other infrastructure like cold storage and insulated/refrigerated trucks for transportation etc. Keeping all these things in view, FISHCOPFED is focussed in creating a marketing infrastructure (Cold Chain Development) with stable supply chain management in some metropolitan cities for fisheries sector. This can be feasible with the support of government and involvement of FISHCOPFED. Development of fish preservation infrastructure and minimization of post-harvest loss can contribute a lot to SDGs.

It is not feasible for the government to establish ice plants, cold storage etc. without the support of fishery cooperative societies in Inland States, which are producing large quantities of fish. The Government of India should consider establishing at least 100 fish collection centres with ice plants and chilled stores near the big reservoirs in inland states and other fish production areas being managed by fishery cooperative societies. From nearby fish farms too, the fishes can be brought to these centres and collected from there having all those facilities for washing, grading, loading/unloading, icing and transportation etc.

Training Centre of FISHCOPFED at Bhubaneswar, Odisha to improve skill of fish farmers and members of PFCS on various aspects of aquaculture

Retailing through Mobile Fish Parlours: FISHCOPFED also doing marketing of whole fish, semi-processed fish (ready-to-cook fish fillets etc.), and ready-to-eat fishery products in the retail markets and directly to end users of non-maritime States like Delhi and NCR at their doorstep. There is a vast demand of fish in Delhi and NCR but due to the outlying location of retail/wholesale markets in Delhi, the people are deprived of this healthy food. The vendors and retailers do not cover sufficient parts of Delhi and NCR.

People from government and private institutions, residential complexes, apartments, hostels and hotels etc. generally approaches FISHCOPFED for delivery of fish and fish products. The whole fish could be easily supplied through mobile vans from the fleet of 20 ton capacity refrigerated trucks reaching Delhi or from the wholesale market but for semi processed/processed fishery products, a processing plant (or can say a big kitchen) should be setup in NCR with cold storage and other processing and cooking facilities. The cold storage is used to store and preserve whole fish and processed fishery products in separate chambers with proper arrangement to check the cross contamination. From this centralised-kitchen at least 50 mobile fish parlours can be run in Delhi and NCR to supply semi-processed, ready-to-cook and ready-to-eat fishery products.

The fish brought in iced and refrigerated condition from fish

farmers/members of PFCS to the processing plant shall be processed as per demand of the customers. Pre-processing like sorting (species wise) and grading etc. can be done manually then it is de-scaled, be-headed, filleted, and final packed in polythene pouch for marketing in consumer packs. Further, cooking faculties shall be used to prepare ready to eat products.

Retailing through Hygienic Fish Retail Outlets: FISHCOPFED has two fish retail outlets in Delhi and some retail outlets in other cities of different states of the country. There is a need to open up more fish retail outlets on Mother Dairy pattern. It can be possible only if government support is there in terms of leasing shops to fishery cooperatives in shopping complexes, markets etc. There is also need of policy to remove hurdles in getting license from several authorities to sell fish in town and cities.

A fish retail outlet of FISHCOPFED at New Moti Bagh, New Delhi

Benefits to Food Value Chain Through Fishery Cooperatives

- Fishery Cooperatives are group of fish farmers who band their resources and mechanize their farms to enhance production. They have larger water bodies and can ensure regular supply of fish. While the individual fish farmer lacks infrastructure, knowledge and skill required at various level of aquaculture, capture and marketing of fish etc.
- Cooperative fish marketing system can ascertain supply of wholesome fish from farm gate/landing centres to freeze or customers of distant states through cold chain development.
- Producer cooperatives/fish farmers can get better prices for their produce through cooperative fish marketing by elimination of middlemen like transporters, multi-level traders etc.
- Employment generation, cold chain, food security, enhanced per capita fish consumption, removing malnutrition, popularity of fish and fishery product and strengthening of marketing networks can be achieved through fishery cooperative.

Conclusion

Around 3.2 million people are being benefited economically through primary fishery cooperatives in India. By strengthening these cooperatives through cooperative fish marketing with sufficient infrastructure and organized marketing channels, FISHCOPFED can, to a large extent strengthen 3.2 million people of these societies and can play a good role to keep the pace of production and supply to the tune of increasing population and its food demand in the country.

FISHCOPFED with its mobile vans can be able to provide fish to the people at their doorsteps and increase the graph of popularity of fish in the market.

There is an urgent need of setting up of a small processing plant in big cities of inland states, specifically for semi-processed fishery products like fish fillets, ready to cook and ready to eat products etc. for local marketing through mobile vans. With the results of the nationwide fishery cooperatives survey in our hands, FISHCOPFED has also speeded up its work to promote these cooperative societies in a sustainable manner through various means like marketing, processing, insurance, trainings and technology transfer etc. With increased demand of fish in various forms, production of fish will also come up making fisheries more profitable venture for these cooperatives. Hence, the role of fishery cooperatives has to be considered at every level in the changed economic scenario and it should be supported with funds to develop infrastructure for sustainability.

Packaging technology for seafood goes hi-tech

Sreejith S., Mohan C. O., Ravishankar C. N.

Among the different categories of food, seafood ranks third with respect to consumption. This more than explains the importance of fish. Fish is a vital source of nutrients for people across the globe. It is the most important single source of high-quality digestible protein, providing approximately 16 per cent of the animal protein consumed by the world's population. By any measure, fishes are among the world's most important natural resources.

Fish is also one of the highly perishable items which will damage if sufficient care is not taken. Various preservation methods have been in place to overcome the spoilage of fish. Proper packaging along with appropriate preservation methods will help in improving the keeping quality of fish. Packaging is considered as an important aspect for improving the shelf life and marketability of the fish and also packaging is one of the most dynamic, competitive, and developing markets.

The age of passive protective barrier functions that packaging was originally designed for is over. It is now time to be more functional and innovative. Consumers demand increased product information, traceability, and innovations in the packages.

Traditional packaging

Traditional packaging for seafood was designed to provide the four primary functions of protection, communication, convenience, and containment. Packaging protects the food product inside from environmental contamination and influences. Packaging communicates ingredients, nutritional facts, and marketing— which are all displayed on the exterior. Packaging also provides convenience for the consumer such as dispensing and resealing features, ease of handling, product visibility, and uniqueness as well as extra features, like the ability to cook and eat the product within its specific packaging. Packaging offers cost effective containment during transportation and storage that maintains food safety and minimizes environmental impact, while complying with industry requirements and meeting consumer demands.

Smart Packaging Technologies

Conventional packaging concepts are limited in their ability to prolong the shelf-life of fish products. They offer limited protection and communicate only through the labelling. It will not provide any information about the quality and safety of the product.

ACTIVE AND INTELLIGENT PACKAGING, WHICH IS REGARDED AS SMART PACKAGING TECHNOLOGIES, ARE ADVANCED PACKAGING TECHNIQUES.

Active and intelligent packaging, which is regarded as smart packaging technologies, are advanced packaging techniques. This is finding its way in the preservation of various food systems including fish and shellfish. Active and intelligent packaging enhances the protection and communication functions, respectively. The market for active and intelligent packaging systems are fast growing and their demand is projected to reach USD 10.5 billion by 2021, fuelled by the development of new generations of products and more cost competitive prices. This will definitely spur greater market acceptance for many products.

Active Packaging

Active packaging is an innovative concept that can be defined as a type of packaging that changes the condition of the packaging and maintains these conditions throughout the storage period to extend shelf-life or to improve safety or sensory properties while maintaining the quality of packaged food. Active packaging (AP) performs some desired role other than providing an inert barrier between the product and external conditions and combines advances in food technology, bio-technology, packaging and material science, in an effort to comply with consumer demands for 'fresh like' products. This involves incorporation of certain additives into the packaging film or within packaging containers with the aim of maintaining and extending product shelf life. Active packaging technique is either scavenging or

ICAR- Central Institute of Fisheries Technology, Kochi, India

emitting systems added to emit (e.g., N2, CO2, ethanol, antimicrobials, antioxidants) and/or to remove (e.g., O2, CO2, odour, ethylene) gases during packaging, storage and distribution.

Oxygen scavenger sachet

O2-scavengers: Fish products are highly susceptible to oxygen as it leads to the growth of aerobic microorganisms and oxidation which causes undesirable colour changes (like discolouration of pigments such as myoglobin, carotenoids), off-odours and flavours (as in rancidity as a result of lipid oxidation) and leads to loss of nutrients (for example oxidation of vitamin E, beta-carotene, ascorbic acid).

All these adversely affect the quality. Therefore, control of oxygen levels in food package is important to limit the rate of such deteriorative and spoilage reactions in foods. By use of an O2-scavenger, which absorbs the residual O2 after packaging, quality changes of O2-sensitive foods associated with low residual oxygen levels can be minimised.

CO2-emitters: High CO2-levels (10-80 per cent) are desirable for moist food products like fish, shellfish and meat products, which inhibit surface microbial growth and thereby extend shelf-life. The overall effect of CO2 is to increase both the lag phase and the generation time of spoilage microorganisms.

A carbon-dioxide generating system can be viewed as a technique complimentary to Modified Atmosphere Packaging (MAP) to overcome the drawbacks. The potential of CO2 in MAP and more recently generation of CO2 inside the packaging system have been explored in relation to a number of commodities for their successful preservation. Such systems are based on sodium bicarbonate, ferrous carbonate, ascorbate, citric acid etc.

Moisture regulators: Seafood products are wet food, which has a high vapour pressure. If it is not removed, this moisture will be absorbed by the product or condense on the surface, which cause microbial spoilage and inferior consumer appeal. Controlling of this excess moisture in packages is important to lower the water activity of the product, thereby suppressing microbial growth. Apart from this, removal of drip from chilled fish and melting water from frozen fish and shellfish makes the package more attractive to the consumer. An effective way of controlling excess water accumulation in a food package is the use of high barrier film material to water vapour permeability and use of moisture scavenger, such as silica gel, molecular sieves, natural clays, calcium oxide, calcium chloride or modified starch. Such drip-absorbent sheets consist of a super absorbent polymer in between two layers. The preferred polymers for absorbing water are polyacrylate salts and graft copolymers of starch.

Antimicrobial packaging: Antimicrobial packaging is a fast-developing active packaging technique, especially for fish and meat products. Since microbial contamination of these products occurs primarily at the surface, due to post-processing handling, the use of antimicrobials in packaging can be advantageous to improve safety and to delay the spoilage. The principle action of antimicrobial films is based on the release of antimicrobial entities into the food, which extends the lag phase and reduces the growth phase of microorganisms in order to prolong shelf life and to maintain product quality and safety. To initiate antimicrobial activity, antimicrobial agents may be coated, incorporated, immobilised or surface modified onto package materials. The classes of antimicrobials range from acid anhydride, alcohol, bacteriocins, chelators, enzymes, organic acids and polysaccharides. Apart from these, various plant derivatives and derivatives from shellfish waste like chitosan can be incorporated into the packaging system as antimicrobials. This technology is not as widely accepted or utilized, due to strict regulations surrounding the use of antimicrobial substances for human consumption.

Intelligent Packaging

Intelligent Packaging monitors the food and environment inside the package and communicates the relevant information regarding quality, whether that is to the end consumer or anywhere throughout the flow of seafood in the supply chain. It is functional and it records, detects, senses, traces, and communicates information about the food product to extend shelf-life, improve quality, and identify any safety concerns. The three major types of Intelligent

Packaging are indicators, sensors, and data carriers.

Indicators

Indicators can only provide qualitative information about the food inside the package, most commonly in the form of an irreversible colour change that provides data to the consumer. Different types of indicators include freshness indicators, and time temperature indicators (TTI), all providing information about the quality and safety of the food within the package. TTIs have become very common as many food manufacturers and distributors are including these on the boxes or inner packaging of refrigerated and frozen products to track mishandling and temperature abuse through the supply chain.

Freshness indicator for seafood

Time-temperature indicators (TTI)

TTIs work on the principle that the quality of food deteriorates more rapidly at higher temperature due to biochemical and microbial reactions. Operation of TTIs is based on mechanical, chemical, electrochemical, enzymatic or microbiological change usually expressed as a visible response in the form of a mechanical deformation, colour development or colour movement. The visible response gives a cumulative indication of the temperatures to which the TTI has been exposed. TTIs consist of small tags or labels that keep track of time-temperature histories to which a perishable product like fish is exposed from the point of production to the retail outlet or final consumer. Their use in fishery products offers enormous opportunities where monitoring of the cold distribution chain, microbial safety and quality are of paramount importance.

Freshness indicators

Freshness indicators are based on the detection of volatile metabolites produced during ageing of foods, such as CO_2, diacetyl, amines, ammonia and hydrogen sulphide. Freshness indicators provide direct product quality information resulting from microbial growth or chemical changes within a food product. Normally, the freshness indicators are incorporated into the packaging film, which reacts with volatile amines and other indicating agents produced during the storage of fish and other seafood, and the freshness is indicated by a colour change.

Sensors

The sensing part of a sensor is often referred to as the receptor and is capable of quantitative measurement, whether that is activity, concentration, composition, etc. The receptor sends its data signal out to a transducer, which measures the result. Transducers can be either passive, which do not require external power for measurement or active, which require power. Determination of headspace gases provides a means by which the quality of a fish and meat product and the integrity of the packaging in which it is held can be established rapidly and inexpensively. The monitoring of these gases in the package helps in establishing the food quality. Portable headspace gas analysers use minimally destructive techniques but are not applicable to real-time, on-line control of packaging processes. An optical sensor approach offers a realistic alternative to such conventional methods. They can be used as a leak indicator or to verify the efficiency of O_2-scavenger, CO_2-emitter or MAP systems. Most of these indicators assume a colour change as a result of a chemical or enzymatic reaction.

Data Carriers

The most common and simplest type of data carrier is a bar code, which has been used on packaging for decades. Barcodes are still used for identification, but have progressed to QR codes and the more advanced radio frequency identification (RFID). RFID tags have a microchip attached to an antenna and communicate through electromagnetic waves. RFIDs can be passive (no battery, powered by electromagnetic waves emitted by the reader); semi-passive (use a battery to emit electromagnetic waves or store information); or active (powered by an internal battery to run internal data management and broadcast it to a reader). Originally designed as tracking devices used for identification, traceability, counterfeit protection, and warehouse automation, RFIDs have advanced tremendously and progressive technology combining sensors with RFID technology are

resulting in monitoring capabilities allowing food quality to be recorded and communicated throughout the supply chain. This ensures freshness, quality, and safety of the food products.

Data carrier tag on Tuna

Conclusion

Seafood packaging has to provide the essential functions to the seafood for which it was originally designed. But with the recent advances in technological breakthroughs, smart packaging is fast evolving and becoming main stream. By combining the existing technologies of active and intelligent packaging, a new and exciting field of smart packaging can be emerged, which can provide a complete solution to the sea food industry by monitoring both the product and its environment in real-time. Smart packaging can also be a valuable tool in seafood safety risk management. As the technology behind these packaging techniques continues to advance at a rapid pace, simultaneously driving costs down, what once seemed out of the realm of possibility will become a standard practice in the seafood industry.

Food Safety and International Trade: An insight

Prof (Dr.) A. Ramachandran

Fish is an important food commodity and is relished extensively throughout the world. Fish has assumed wide acceptability for its nutritional significance, particularly for its superior protein quality and higher content of omega-3 fatty acids. It is reported that fish contributes to approximately 16 per cent of the animal protein consumed by the world population and about one billion people across the globe consume food as primary protein sources (FAO, 2000).

The consumption of fish across the globe shows an increasing trend. The per capita consumption of fish was to the tune of 20.4 kg during 2018 and the per capita consumption of fish in India has increased considerably from 5.68 kg in 2013 to about 8 kg in 2018. It is a significant increase and is attributed to the nutritional and health significance associated with fish.

It is also estimated that the global trade of fish and aquatic products is estimated to be 171 billion in 2018 (FAO, 2018), of which 53 per cent comes from the total capture fisheries and the remaining from the aquaculture sector. The increase is on a continuous basis with 40 million during 1986 to about 110 million in 2010 to the present level which is about four-fold increase. It is also interesting to note that out of 171 million tons of fish produced in 2016, about 88 percent (over 151 million tons) was utilized for direct human consumption, a share that has increased significantly in recent decades.

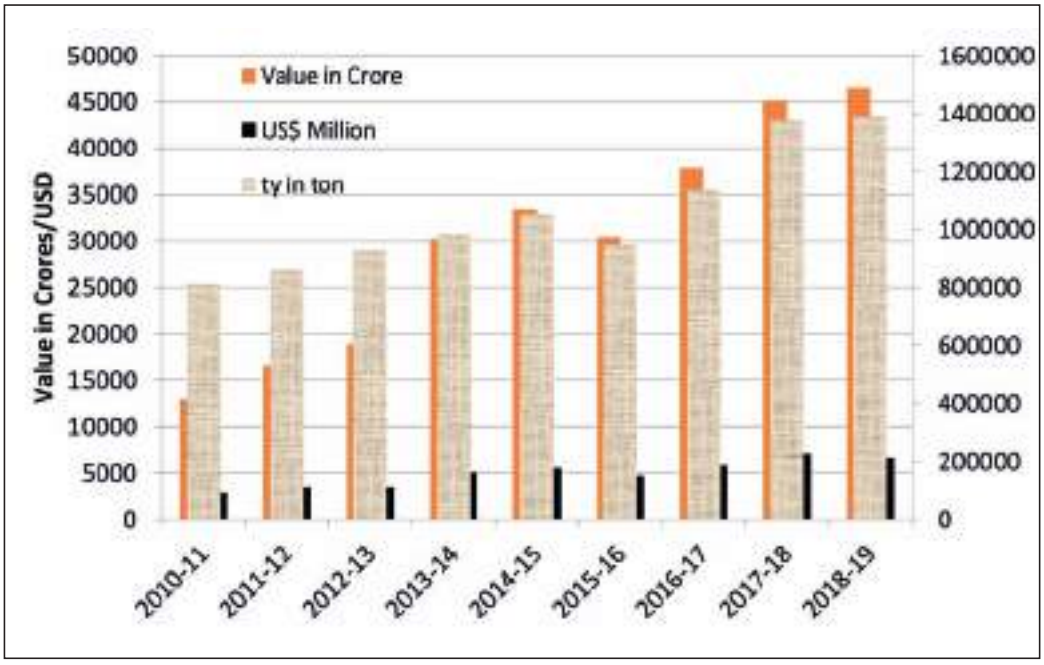


Fig: 1 Fish trade from India during 2011-2019

Fish and trade

Fish also contributes to economy of a country. The international trade in fish contributes to the utilisation of the fish world over thus contributing to solve the issue of availability in one place or other. Thus, fish and fish products play an essential role in boosting fish consumption, besides providing employment opportunities for millions of people working in a

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range of industries and activities concerned with fish around the world. Fish and fish products are one of the most traded food items in the world today, with the exports increasing from the meagre 18 million tons in 1970 to about 60 million tons in 2016. This indicates that about 35 per cent of the global fish production entered the international trade.

In India, the export of fish has shown phenomenal growth. The export during 2011-'12 was 8,13,091 tons worth Rs. 12,901 crore (USD 2856.92) and the export during 2018-'19 showed an increase of about 42 per cent in term of quantity with an increase of over 3 folds with over Rs. 46,000 crores (USD 728.5) (Fig 1). This clearly indicates the increasing demand of seafood in the international market. Report from Worldfish Centre (2008) clearly indicates the increase in volume of seafood export in the international market and indicate the increased share from developing countries.

Fish spoilage and Food safety

It is known that fish is a commodity with over 60-70 per cent water in the body, depending on the species. This makes fish extremely difficult to store without any preparation or processing. It is a commodity which requires extreme care and adoption of cold chain protocol make it safe for human consumption.

Quality deterioration or spoilage leads to development of not only alterations in the colour, odour and taste but also leads to accumulation of chemicals and provides space for the multiplication of bacteria of health significance. In the absence of appropriate control, it will undergo spoilage rapidly and post-harvest handling, processing, preservation, packaging, storage and transportation require particular care to maintain its quality and nutritional attributes and avoid wastage and losses. It is in this circumstance the fish becomes totally unsafe for human consumption and useless compromising safety requirements.

Food safety is receiving increasing attention worldwide in recent times primarily because of the realisation of the importance of nutrition and health. Also, along with increasing trade, the food safety becomes a shared concern irrespective of the country or region and health is considered supreme for the well-being of the people.

Food is an international commodity and its movement across the borders is on the increase. The growing movement of people; trade of live animals and food products across borders; urbanization phenomena across the globe; increasing numbers of immune-compromised people; changes in the food handling and consumption pattern; emergence of new pathogens and development of antimicrobial resistance among the people are some of the important issues contributing to increasing food safety risks.

FOOD BECOMES UNSAFE WHEN IT CONTAINS HAZARDOUS CHEMICALS OR AGENTS WHICH EITHER CAUSE ILLNESS OR INJURY TO THE CONSUMERS IN THE ABSENCE OF ITS CONTROL.

The trend in food consumption pattern is shifting from home cooked food to ready-to-eat food purchased from market and increased consumption of newly emerged products without proper screening are the main reason for increased risk among the consumers. These trends have altered both the nature and incidence of food safety risks in the world's interdependent food production and marketing system. Concerns about intentional adulteration of food from bio-terrorism have also increased attention to food safety.

Food becomes unsafe when it contains hazardous chemicals or agents which either cause illness or injury to the consumers in the absence of its control.

The contaminants can enter food at many different points in the food production process, and can occur naturally or as a result of poor or inadequate production practices. Institutions dedicated to standards and regulations have been established over the years and hazard identification, analysis and control measures are now an important part of food processing value chain.

Microbial hazards called pathogenic microorganisms received much attention from the point of view of food safety. The microorganism themselves or the metabolites produced by them such as antibiotics are critical elements of concern.

Hazardous agents that are receiving attention from policy makers include microbial pathogens, zoonotic diseases, parasites, mycotoxins, antibiotic drug residues and pesticide residues. All countries have almost similar concern in this regard but the risk varies from country to country as a result of the difference in the climate conditions, food habits, cooking patterns and consumption pattern besides many other reasons.

Certain foods particularly high moisture food such as fish meat are susceptible to the sanitation and hygiene conditions of the production system and production line; the cold chain and water quality, thus adding pressure to the supply chain to address the issue.

Food undesirables

The food undesirables can be classified in to four categories namely, naturally occurring hazards, those formed during the storage and processing, food additives and contaminants. The naturally occurring toxins are generally the toxins produced by fungi, formed by moulds which grow on crops/ foods under certain conditions and become toxic to humans and animals. The most prominent mycotoxins which cause health concerns in humans are aflatoxin, deoxynivalenol, ochratoxin, fumonisin and patulin. The concern is more on these toxins because of the chemical nature as most of these are produced by fungi as secondary metabolites, resistant to heat and can cause toxic damage to cells of humans and animals. Both chronic effects such as various cancers, immunosuppression, growth retardation, birth defects, renal dysfunction as well as serious long-term effects even at small concentrations have been reported. These are not often a problem in the case of fish and fishery products but there is concern in fish based newer low moisture products.

In the marine animals, there is a similar situation due to the accumulation of certain toxins or due to either in *situ* production or decomposition of certain biomolecules and formation of metabolites. When certain fish (scombroid fish i.e. tuna, bonito and mackerel) start to decompose due to lack of temperature control, histidine, one of the amino acids present in the system is converted into histamine by an enzyme produced by certain bacteria.

Though histamine is required in small doses for certain body functions, at higher does it may trigger severe allergic reactions such as rash, nausea, vomiting, diarrhea, headache, dizziness, burning throat, stomach pain and itchy skin, when consumed by susceptible population leading to Scombroid Poisoning. Similarly, many marine toxins are produced and accumulated in fish and shellfish muscle due to ingestion of certain types of algae and some of the common toxins of human concern are given below:

Illness	Toxin	Seafood associated
Paralytic shellfish poisoning (PSP)	Saxitoxin	Oysters, clams, scallops, mussels, cockles
Amnesic shellfish poisoning (ASP)	Domoic acid	Bivalve molluscan shellfish, clams, mussels, oysters, scallops
Ciguatera poisoning	Ciguatoxin	Tropical fish such as barracuda, amberjack, red snapper, grouper
Diarrhetic shellfish poisoning (DSP)	Okadaic acid	Various shellfish, cockles, mussels, oysters
Tetrodotoxin poisoning	Tetrodotoxin	Pufferfish, California newt, parrotfish, octopus, starfish, angelfish, and xanthid crabs

Fig 2: Common toxins of human concern

Environmental contaminants

Environmental contaminants are chemicals that accidentally or unintentionally enter the environment, often, as a result of human activities. Some of the contaminants manufactured for industrial applications are very stable and do not break down easily. These contaminants namley agricultural chemicals, pesticides, fungicides, herbicides, fertilizers, and polychlorinated biphenols, antibiotics and growth hormones, prohibited substances (21 CFR, Part 21.189), ammonia, formaldehyde, etc. are toxic elements reported beyond tolerance limit in seafood. Similarly, compounds like lead, zinc, arsenic, mercury, cyanide and secondary chemicals such as lubricants, cleaning compounds, sanitizers, paint may enter the food chain leading to dangerous situation when consumed. In this context, the protection of natural water bodies free of such contaminants is very important. These chemicals and toxic substances enter in to fish body from this type of contaminated water and subsequently become part of the food consumed by humans. Unfortunately, the chemicals once enter the fish cannot be taken back or removed and the toxicity remains in the product. This is the largest concern to the entire safety system as far as seafood is concerned.

Food Additives

The next group of chemical contaminants are food additives. A food additive is any chemical substance that is added to food during preparation or storage and either becomes a part of the food or affects its characteristics for the purpose of achieving a particular technical effect. Some of the

compounds include food colours (natural and synthetic), pH adjusting agents, preservatives, bleaching agents, food enzymes, glazing and polishing agents, emulsifiers and gelling agents. Though these contaminants are not essentially part of the whole fish and shellfish, could be a matter of concern in value added products where some of these chemicals find their way.

Due to the chemical nature as persistent organic chemicals, the compounds will accumulate in the fat deposits of fish and animals and will accumulate along the food chain. The modern foods production systems use some of the chemicals to improve the texture which becomes a chemical of concern in the final product.

It is worth mentioning here the recommendations of Codex document of GSFA for use of additives (GSFA, 2001). The GSFA clearly indicate the type of food additives permitted for use in foods in conformance with the provisions of this Standard and clearly tell set the conditions under which permitted food additives may be used in all foods, whether or not they have previously been standardized by Codex. The standard also tells about the foods in which food additives are not allowed or are restricted to permitted levels. This is to ensure that the intake of a specific additive does not exceed the acceptable daily intake.

Microbial Hazards

The next category of concern is the microbial hazards. This often leads to foodborne illness in the consumers. The food borne illness is any illness resulting from the consumption of contaminated food, pathogenic bacteria, viruses, or parasites that contaminate food, rather than chemical or natural toxins and this usually arises from improper handling, preparation, or food storage making sanitation and hygiene an important aspect of the food value chain. Unsafe sources, improper storage temperature, poor personal hygiene, contaminated equipment and inadequate cooking are some of the important reasons for the occurrence of foodborne illness.

The food safety issues due to microbiological hazards could be elaborated either due to the presence of pathogenic microorganism per se or due to certain chemical elaborated by the microorganism. The former one is usually referred to as food-borne illness and the latter as food-borne intoxication and in either case it is reason for concern as far as food safety is concerned.

Bacterial food borne infections include cholera, salmonellosis, typhoid fever, shigellosis, yersiniosis *Escherichia coli infection* campylobacteriosis, *Vibrio parahemolyticus* and *Listeriosis*. The examples of mycotic food borne infections include *Candida spp*., *Sporothrix spp*., *Wangiella spp*., etc while infection by Hepatitis A, Norwak and poliomyelitis virus are examples for viral food borne infections. *Closteridium botulinum* is a classic example of food-borne intoxication as the accumulation of botulin toxin leads to life threatening situations in the consumers.

What are the options?

The contamination of food can occur at several points along the food chain starting from the farm or in the field or along the value chain. It is inevitable that a strategy needs to be in place to have a hazard free or minimum hazard fish for human consumption. Preventive strategies based on thorough analysis of prevailing conditions are much more likely to provide an assurance of fish quality.

Some of the strategies such as HACCP system, Good Manufacturing Practices, Good Hygiene Practices, Good Aquaculture Practices certificated by an Internationally Accepted Agency could be used for effectively controlling the hazards and to produce a safe fish for human consumption.

HACCP, the hazard analysis critical control point is a science-based preventive strategy. HACCP eliminates the food safety hazards from the environment where the food is processed and made available to the consumers.

The seven principles such as Hazard analysis and risk assessment, namely determine critical control points, establish specifications for each CCP – Critical limit, monitor each CCP, establish corrective action for deviations, establish record keeping system and establish verification system which if effectively implemented in the production and value chain system will effectively control the inclusion of hazards and make a safe fish for consumers.

But for initial implementation of HACCP, the initial sanitary requirements are safe water, condition and cleanliness of food contact surfaces, prevention of cross contamination, personal hygiene (hand washing, hand sanitising, etc.), control on additives and prevention of adulterants, labeling, storage and use of toxic compounds, employees' health condition, and exclusion of pests are mandatory and it is the responsibility of the party concerned to establish the requirements for effective implementation.

The initial investment is an issue which can be very well managed by the fact that quality manages the risk and hence better returns.

The five key principles of food hygiene proposed by WHO to prevent foodborne infection and intoxication are the following:

- Prevent contaminating food with pathogens spreading from people, pets, and pests.
- Separate raw and cooked foods to prevent contaminating the cooked foods.
- Cook foods for the appropriate length of time and at the appropriate time to kill pathogens.
- Store food at the proper temperature.
- Use safe water and raw materials

These principles have to be adopted to have a clean food safety regime in the production line.

The basic conditions which favour the control of biological hazards are time and temperature control; heating and cooking process, cooling and freezing process, fermentation and /or pH control, addition of salt and preservatives, drying and source control.

Good Manufacturing Practices (GMP)

GMP regulations require a quality approach to manufacturing, enabling food producing establishments to minimize or eliminate all legal issues. The ten principles of GMP namely - scrupulously following procedure, documenting, Traceability, designing facility including equipment, maintaining equipment, validating procedure, competency of employees, sanitation and hygiene, component control and auditing for compliance provide effective utilization of resources for making a hazard free system.

Food safety regulations

The food safety hazards and the life style of consumers are directly related. There were no reports of any food related illness as early as 1960s. But as technologies developed, industrial production of food started and concomitantly life styles changed, food habits changed the ingredients that goes in to the food preparations changed so also the method of preparation and other related activities. The incidence of hazards becomes more pronounced and hence the life style diseases as well as food borne illnesses.

The food safety is viewed as important as the globalisation and trade of food commodities started a new domain and export and trade are given importance without compromising the consumer's health. The United Nations Food and Agriculture Organization (FAO), established in 1945, and the World Health Organization (WHO), founded in 1948, shared the responsibility to address the issue and established Codex Alimentarius Commission in 1962, to protect the health of consumers and ensure fair practices in food trade. The development of various general and commodity specific standards, guidelines, code of practices, and other food safety-related recommendations followed and the views of international community was heard for harmonising the standards and for effectively implementing the general food guidelines. The HACCP was recommended by CODEX in the year 1996 and the hitherto voluntary requirement has become the mandatory requirement for food safety purpose.

Again, it was clearly indicated in the World Fish Centre report (2008) that continued access to the markets of developed countries would play an important role for developing countries in the light of the stricter food safety regulations imposed in developed countries. Some of the recommendations put forth clearly signifies the recent trend in the trade and food safety scenario internationally and suggested that developing countries should take it up more seriously by implementing the food safety standards along the supply chain besides achieving compliance to HACCP.

There has been a growing use of HACCP in public regulations, and it has become an SPS measure that has been and will continue to influence international trade. Countries exporting fish and other agricultural products are required to comply with the HACCP norms and other CODEX recommendations. Countries intending to export fish and fishery products to the EU, Japan, and the USA must follow the standards fixed by these countries. Appendix 1 details the standards and conditions imposed by the EU, the USA, and Japan on fish and fish products from Thailand, as an example.

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Marine Polysaccharides as Bio Preservative in Sea Food Products

Kasturi Chattopadhyay, Ramakrishna Reddy, K.A. Martin Xavier*

Seafood products have become a major trade commodity in the international market. Every year million tons of seafood are exported outside the nation that fetches a high economic profit. Seafood is highly perishable due to the presence of large quantities of free amino acids and volatile bases in the muscle matrix that creates a greater chance for microbial spoilage. Hence, keeping quality of the food remains a major issue in the long-term preservation of the exported products.

> INCREASING DEMAND FOR HIGH-QUALITY NUTRITIOUS SEAFOOD PRODUCTS HAS SPURRED THE NEED TO FIND NOVEL WAYS FOR BETTER PRESERVATION OF FISH PRODUCTS USING NATURAL PRESERVATIVES.

Increasing demand for high-quality nutritious seafood products has spurred the need to find novel ways for better preservation of fish products using natural preservatives. Food industries in recent era utilises several polysaccharides from non-marine sources commercially like Gum arabic, konjac flour, locust bean gum, methyl cellulose and hydroxyl propyl methylcellulose, microcrystalline cellulose, xanthan, curdlan, gellan, pullulan, dextran, and pectin1. Being natural derivatives, these valuable components provides several advantages like being eco-friendly, easily biodegradable, low cost, and easily available. However, there exists several other polysaccharides derived from marine resources that possess novel types of polymeric material, which have a huge potency in versatile sectors of the food economy. As the present decade population is more concerned about the health hazards associated with consumption of synthetic additives, they look for foods having natural additives. So, utilization of these polysaccharides from explored and unexplored sources may enhance the marketing capacity of seafood in the international market and can fetch a higher economic price.

Polysaccharides in Quality Enhancement of Seafood products

Marine polysaccharides from Seaweeds

Export of frozen products often undergo textural alterations under frozen conditions and exhibit thaw drip leading to product loss. Seaweeds harbour a rich source of valuable polysaccharide particularly *carrageenan* and *alginates*, that retains the better functional properties in products and helps in textural modification in fishery products. Alginates and Carrageenans of all the 3 types improved the water holding ability of cooked gels of surimi from Atlantic Pollock[2]. Remarkable gelling ability of these polysaccharides also makes its applications in restructured shrimp and crab meat analogue fish products from mince and surimi[3].

Reduction in oil uptake during frying of battered and breaded fishery products has been reported by the application of Carrageenans and alginates in coating medium4,5. Alginates also function as cryo-preservative in frozen fish products to control protein denaturation and to maintain the textural deterioration during frozen storage. This can minimize the utilization of commercially-used STPP as croprotectant[6].

Marine polysaccharides from Crustacean shells (Chitosan)

Crustacean shell waste derivatives, mainly chitosan, has been of greater interest in the recent years for the development of edible coating films as well as like a dip treatment in developing fish products with extensive shelf life. Chitosan due to its inherent antimicrobial attributes, has been reported to have reduced the total plate count and psychrotrophic counts in frozen seafood products during storage thereby increasing the shelf life. Export of high value nutritious fish like Salmon as fillets is not much feasible due to its higher fat content in the muscle that causes oxidation phenomenon leading to quality deterioration. Chitosan incorporation as solution 1 per cent (w/w) for glazing skinless salmon fillets reduced the lipid oxidation

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rates under frozen storage as well as exhibited significantly higher yield and lesser drip loss compared to fillets glazed with lactic acid or distilled water[7].

Chitosan can also be used as an effective emulsifier due to its ability to interact with lipids particularly in emulsified fish sausages from medium fatty fish like Pangas.

This can pave way for effective utilisation of low value fishes in functional product development [8]. Water holding capacity has been reported to have increased upon chitosan additions (as solution as well as hydrogel) when stored at low refrigerated temperatures[9]. Enrobed fish sticks having a higher export value has been reported to have higher oil uptake during frying. This phenomenon has been reduced by the use of chitosan gel in the batter medium during product preparations.

Marine Exo- polysaccharides from microorganisms

Many of the marine microorganisms are capable of producing several exopolysacharides with better rheological properties that are comparable with exopolysaccahrides from non-marine organisms commercially used.

Exopolysacharides from marine organisms like *Spingomonas paucimobilis* are comparable to commercial gellan and a marine Bacillus is comparable to commercially important xanthan in rheological properties.[10] There exists much more marine species, which poses novel compounds but are under explored due to difficulties in their extraction in sufficient quantities at cheaper price.
Further research in improvement of the extraction procedures may increase the utilisation of these marine organisms for production of exopolysacharides.

Polysaccharides as a source of natural dietary fibre

Consumer demand for healthy food stuffs has directed the food industries to search for natural additives that can fortify the final product. Hence, fortification of seafood products with soluble dietary fibres like alginates, carrageenan, chitosan can enhance the wholesomeness of the fish products in terms of nutrients[11].

Conclusion

Utilisation of marine resources as food preservatives will not only extend the shelf-life, but will also ensure consumer safety by reducing the risk of health hazards associated with the use of commercially-available synthetic additives. This creates an urge to explore more valuable resources and their derivatives from the marine environment for incorporating as natural additives in fish and fish products. This bio-technologies can make the seafood sectors flourish more in accordance to consumer safety.

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Fish meal industry: a perspective towards food security and focused research needs

Sruthy I. S., Anju and Ram Mohan M.K.

Introduction

Aquaculture is a feed-based industry with over 60 per cent of operational cost alone from the feed source. Feeding of fish with balanced diet is very essential and excess feeding will cause not only financial loss but also disturb the pond water quality. Since the traditional feed mixture is not nutritionally balanced there is a need to use complete diet which provides the required essential nutrients and energy, necessitating an understanding of the basic requirements in order to formulate cheap and nutritionally balanced diets.

Fish meal and fish oil are the major ingredients for aqua feed production. Fish meal provides the basic crude protein content. Aquaculture utilizes about 43 per cent of global fish meal production and 85 per cent of fish oil. Fish meal is also used in compound foods for poultry, pigs, pets etc. It is far too valuable to be used as a fertilizer now.

Every year billions of edible fish caught in the wild are diverted from direct human consumption and used to feed the voracious aquaculture industry instead, through the production of fishmeal and fish oil (FMFO). Virtually, any fish or shellfish in the sea can be used to make fish meal. The nutritional value of proteins from vertebrate fish differs little from one species to another.
The types of fish destined for fish meal and fish oil production are mainly species lower down the marine food chain, which are often in high abundance and tend to form dense schools. They are generally plankton feeders and are preyed on by larger predators for food. They include not only small pelagic 'forage' fish (such as anchovy, sardine, her-ring and mackerel) but also invertebrate species (such as krill). All of them play an important role in the marine environment because the entire marine food web depends on them; they are the principal means of transferring energy from plankton to fish, marine mammals and seabirds. Overfishing down the food webs is therefore unsustainable, and can have large impacts on the ecosystem. These fish are also a major source of protein for millions of people living in poor coastal communities, especially in West Africa, where the FMFO industry's demand for small fish competes with demand for direct human consumption. Today, almost 70 per cent of landed forage fish are processed into FMFO, representing roughly 20 per cent of the world's total catch of wild fish.

Global trade of Fishmeal and Fish oil

IFFO reports that the total world production of fish meal in 2016 is 4,445,000 tons. Peru, China, USA, Vietnam, Thailand, Denmark, Chile, Japan, India, Norway, Ecuador, Morocco, Russia, Iceland and Malaysia are the top 15 fish meal producing countries around the world. Blue whiting, Anchovy, Sand eel, Sardine, Capelin, Norway pout etc are the major foragic fishes which are used for the production of fish meal. Fig.1. &2 indicates the top exporting and importing countries of fish meal around the world.

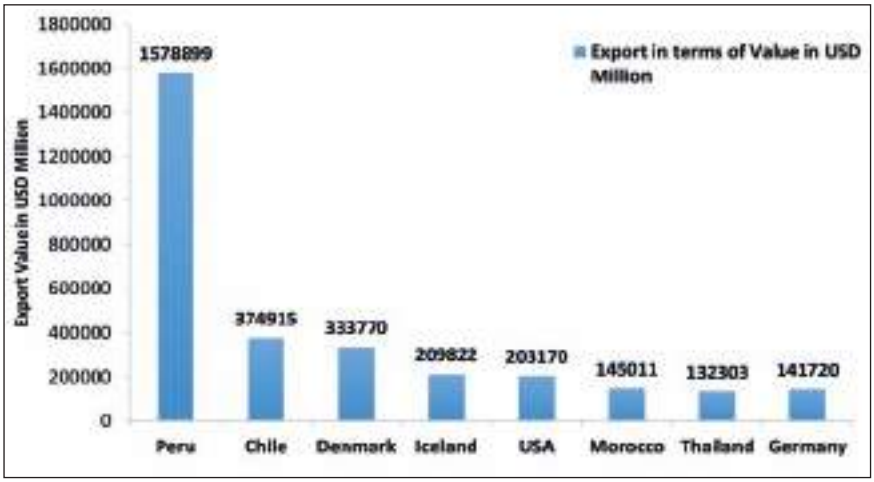

Fig1. Fish meal exports by top countries in 2018 in terms of export value (Source: United Nations Statistics Division: COMTRADE cited on 22/01/2020)

Marine Products Export Development Authority, Kochi – 682 036
Email: ho@mpeda.gov.in

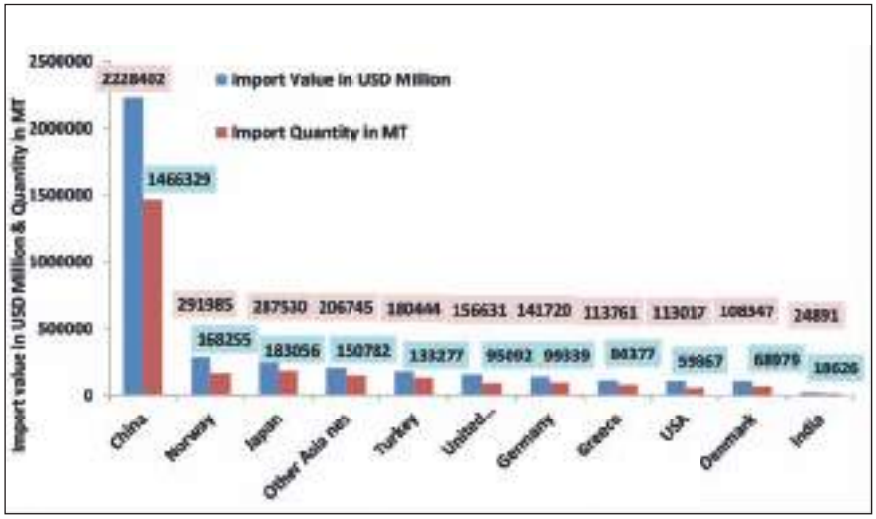

Fig.2 Fishmeal imports by top countries in 2018 in terms of value and quantity (Source: United Nations Statistics Division: COMTRADE cited on 22/01/2020)

Peru leads the table in fish meal and fish oil supply, followed by Chile, Denmark and Vietnam. 77 per cent of the Peruvian fishmeal is destined for the Asian markets. China is one of the major importing markets for fish meal and oil.

India occupies 21st position in the list of countries importing fish meal and 11th position as exporting country for the same product.

As per Globefish Highlights July 2019, landings of raw material during the first six months of 2019 around the world have dropped significantly, which has affected the total production of fish meal and oil. In Peru fish meal production has decreased by 45 per cent and fish oil by 49 per cent when compared to 2018. Other countries also reported the same trend.

Nearly 20 Mt of raw material is used annually for the production of Fish Meal and Fish Oil, of which around 14 Mt comes from the whole fish.

Measures taken to sustain Peruvian Anchovy fisheries

Peruvian anchovy is rich in EPA & DHA, when compared with other fish species and majority of the fish used to produce fish oil capsules and fish feed for aquaculture industry. The major reason this is the fragile nature and distinct flavour of Peruvian anchovy which discourages its use as food fish. Peru is the largest fish meal industry in the world and yet has found ways to maintain a sustainable fishery. The steps taken in this regard includes fishing ban, quota allocation etc. The first anchovy fishing season of 2019 in Peru began on 4th May with a total allowable catch set at 2.1 million tons about 36 percent less than for 2018. Peru's ministry under the guidance of IMARPE, fishery managing authority, announced ten day ban to protect the sustainability of stock resources and juveniles. Other management control included mesh size regulation, landing size regulation and temporal closing done when the juvenile catch is more than 10%.

Fish meal production in India

India is the world's leading aquaculture producer after China and holds a dominant role in global fisheries. According to the National Fisheries Development Board, in India, more than 50 different types of fish and shellfish products are being exported to 75 countries around the world. While carp production is likely to remain the biggest share of fish production, India is also the world's second-biggest exporter of shrimp after Ecuador.

Andhra Pradesh, the heart of Indian aquaculture production, is the country's largest aqua feed-consuming state. India produces a considerable quantity of fish meal, by the units registered under MPEDA.

There are about 49 fishmeal and 44 fish oil production units registered under MPEDA, with a total capacity of 3,224.50 tons and 877.68 tons per day respectively.

Table 1 shows the total no of fish meal and fish oil production units in India and their production capacity.

Table 1. Number of fish meal and fish oil production units registered with MPEDA and their production capacity

STATES	TOTAL			
	No of Fish meal Units	Capacity (Tons per day)	No of Fish Oil units	Capacity (Tons per day)
KERALA	5	134.00	5	29.68
KARNATAKA	20	1,842.50	21	587.5
MAHARASTRA	6	492.00	5	196
GOA	1	50.00	1	15
GUJARAT	5	210.00	1	2
WEST BENGAL	2	28.00	-	-
TAMIL NADU	10	468.00	11	47.5
TOTAL	**49**	**3,224.50**	**44**	**877.68**

(Source: MPEDA)

The fish meal produced in India is domestically consumed as well as exported to markets such as EU, Saudi Arabia, Taiwan, Bangladesh, Canada, Japan and Vietnam. One estimate of 2012 shows that about 65,000 t of fish meal and 34,000 t of fish oil are annually produced in the three states of Karnataka, Kerala and Tamil Nadu. However, this has to be considered as a production in the early phases of vannamei culture boom in India. As per the installed capacity, these 49 units above has a capacity to produce an estimated 6,65,000 tons of fish meal per annum considering an average 200 working days a year.

However, there is no authentic data available about the actual production, as the output is utilized both in domestic and export markets. There could also be crude units engaged in fish meal production those are not engaged in exports, but supplying to the domestic demand only, and for which no data is available.

Export trade of fish meal and fish oil from India

The market-wise exports of fish meal and fish oil from India are given in Table 2 below (MPEDA, 2019).

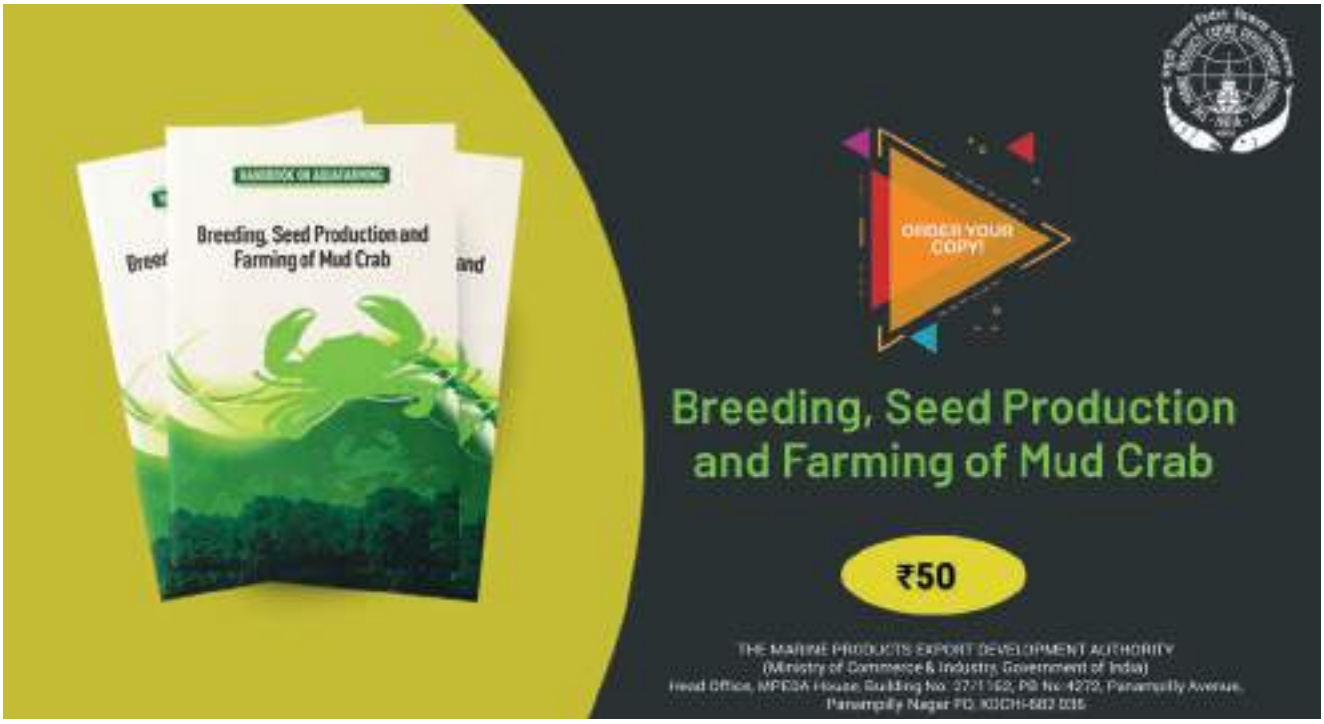

Table 2. MARKET - WISE EXPORT DETAILS OF DRIED FISH MEAL AND FISH OIL
Q: Quantity in Tons, V: Value in Rs. Lakh, $: US Dollar Million

		2014-15	2015-16	2016-17	2017-18	2018-19
JAPAN	Q:	7396	1982	2904	2904	6485.2
	V:	13455.94	2332.93	2426.65	2426.65	5724.12
	$:	22.22	2.44	3.81	3.81	8.023
USA	Q:	0	0	257	1,197	200
	V:	0.00	0.00	113.81	805.66	364.06
	$:	0.00	0.00	0.17	1.26	0.52
EUROPEAN UNION	Q:	0	297	217	2,484	340
	V:	0.00	288.19	228.98	2,114.33	256.8
	$:	0.00	0.42	0.34	3.32	0.37
CHINA	Q:	9212	1,808	3,250	6	0.1
	V:	6730.99	1,451.60	2,876.26	63.41	7.60
	$:	10.92	2.24	4.28	0.10	0.01
SOUTH EAST ASIA	Q:	42117	16642	37855	40320	43914
	V:	37219.43	14860.76	32181.18	29656.43	39207.28
	$:	60.8	22.86	48.4	46.46	55.62
MIDDLE EAST	Q:	7312	3720	4638	17117	9519
	V:	6846.14	3436.39	3861.12	13250.87	8621.99
	$:	11.18	5.38	5.81	20.79	12.13
OTHERS	Q:	22523	21359	16752	27056	18800
	V:	16120.5	15244.34	13076.33	22185.15	15513.65
	$:	26.37	23.44	19.71	34.93	22.52
TOTAL	**Q:**	**88559**	**45809**	**63546**	**91084**	**79259**
	V:	**80373**	**37613.82**	**53164.6**	**70502.5**	**69695.5**
	$:	**131.49**	**57.98**	**79.97**	**110.68**	**99.19**

During 2018-'19, the total export of fish meal and oil was 79,259 tons worth USD 99.19 million. The export showed a decrease of 15 per cent in terms of quantity compared to 2017-'18.

The reduction in value was slightly over 10 per cent during this period. South East Asia, Middle East and Japan are the major markets of Indian fish meal and fish oil. Quantity-wise fish meal and fish oil exports during the last fiscal to South East Asia and Japan showed an increase of 8 per cent and 55.2 per cent respectively. Value-wise the exports to Japan rose by 110 per cent, while that to South East Asia registered around 20 per cent increase.

However, there was considerable reduction in the fish meal and fish oil exports to other markets such as Middle East, USA, EU and China.

Fish meal production and resource utilisation

The Indian oil sardine (*Sardinella longiceps*) is the most important single-species marine-fishery resource landed along the Indian coast, in terms of volume. It accounts for approximately one by fifth of total marine fish landings in India, the

Solidaridad
ASIA

MISSION

Solidaridad, an international civil society organization dedicated towards creating sustainable supply chains. Solidaridad's mission is to bring together supply chain players and engage them with innovative solutions to improve production, ensuring the transition to a sustainable and inclusive economy that maximizes the benefit for all.

Solidaridad has been instrumental in strengthening the linkages of the farmer groups with the government financial schemes and also with world class knowledge partners. Farmers have benefitted with improved linkages with MPEDA and CAA in India with increased exposure to export markets. Solidaridad aims to tap the immense market potential of Indian shrimp farmers for quality produce through sustainable aquaculture practices which are will bring higher economic, environmental and social resilience and improvement.

Solidaridad has an extensive engagement in the entire value chain of the shrimp and fish sector in India and Bangladesh with more than 30,000 farmers for the last 7 years.

500 producer groups have been organized in Bangladesh 250 Lead Farmers are supporting farmers' extension support, backward and forward market linkages for improving efficiency in the farm productivity. 93% aquaculture farmers have experienced increased fish production by various percentages ranging from 13% to 40% on different selected aquaculture species.

In India, Solidaridad has been working with farmers in Andhra Pradesh, Odisha and West Bengal and has engaged with more than 2000 farmers organized in more than 25 groups since 2015.

majority of which takes place along the country's southwest coast in the states of Kerala, Karnataka and Goa. Oil sardine is a staple food throughout southwestern India, and is also highly prized by the FMFO industry. Species such as mackerel, Thread fin breams, Carangids, croaker's flat fishes, lesser sardines, anchovies etc., are also used in FMFO industry when comes as trash or by catch.

Annual landings of CMFRI for the year 2018-'19, shows fall by 9 per cent recording 3.49 million tons compared to 2017-'18. The commonly observed species in landings include oil sardines, Indian Mackerel, croakers, ribbon fishes, small cephalopods, threadfin breams etc. Offal from processing factories is also used, though in lower quantities.

Analysis of lesser sardine landings in India for the last few years shows that there is an increasing trend in the overexploitation of the stocks and the decreasing trend in the underexploited stocks give cause of concern. In contrast to the decreasing trend in marine resource landings, an increasing trend in aquaculture production of various fin fishes and shell fishes was observed in these years. In India shrimp aquaculture production is more than other fin fish aquaculture, especially *Vannamei* shrimp culture. In 2018-'19, the total production of shrimp was 6, 80,801 tons.

The graph below indicates the estimated fish meal requirement according to the *Vannamei* shrimp production in the country calculated based on an average Feed Conversion Ratio (FCR) of 1.4:1, and the utilization of major resources for the same.

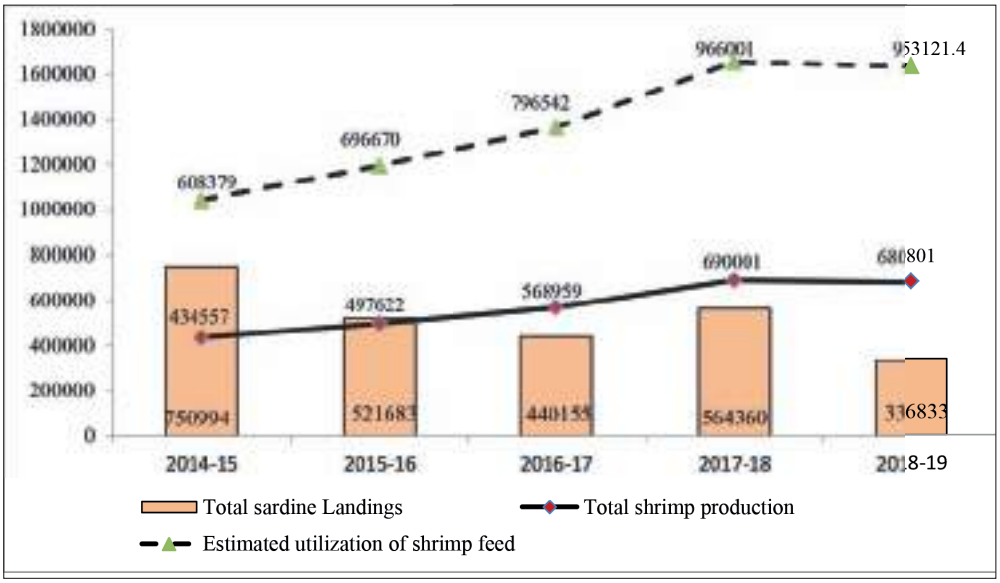

Fig.3. Trend analysis in sardine production and utilization of shrimp feed in aquaculture

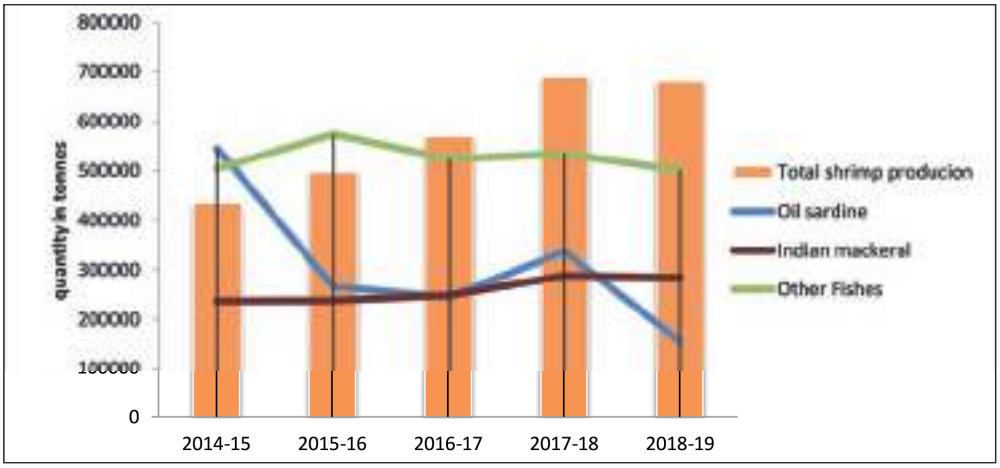

Fig.4. Trend analysis in landings of marine resources used for the production of fish meal and fish oil and Aquaculture shrimp production

Fig.3. above indicates a widening gap between the sardine landings and the shrimp feed production, indicating a shift in the species utilised. As given in Fig.4, oil sardine landings drop sharply in 2018. It is now well recognized that marine resources are generally over-exploited as the use of fishmeal and fish oil for aqua feeds has increased as the culture of carnivorous species has expanded. The aqua feed industry is taking an increasing proportion of the supply. Commercial shrimp diet typically contains 25 per cent of fish meal and there is a trend towards lower inclusion levels as the feed manufacturers look for alternate sources. The average fish oil inclusion level was found to be 2 per cent. Based on the average inclusion level of fish meal the quantity of fish meal used for feed production was estimated as given in the table below.

Table 3. Estimated quantity of fish meal used for feed production in India annually based on the shrimp production

Year	2014-15	2015-16	2016-17	2017-18	2018-19
Annual shrimp production (MT) Ref: MPEDA Annual Report, 2018-19	4,34,557	4,97,622	5,68,959	6,90,001	6,80,801
Estimated FCR	1.4	1.4	1.4	1.4	1.4
Estimated quantity of feed utilized (MT)	6,08,378	6,96,670	7,96,542	9,66,001	9,53,121
Estimated quantity of Fish meal used in shrimp feed (25% inclusion rate)(MT)	1,52,094	1,74,168	1,99,135	2,41,500	2,38,280
Estimated quantity of raw fish used to produce fish meal (@1 kg fish meal from 4 kg raw fish)(MT)	6,08,376	6,96,672	7,96,540	9,66,000	9,53,120

Considering a maximum yield of 1 kg fish meal from 4kg raw fish in India, the raw material used for production of 2,38,280 tons of fish meal is around 9,53,120 tons or even a million tons. This will go up depending on the protein ratio of the feed vis-à-vis the protein supplementing capacity of the fish raw material.

Fig.5. below is a graphical representation of export and import of fish meal and oil in India.

Fig.5. Graphical representation of export and import of fish meal and oil in India. (Source: MPEDA, Fish Exchange, COMTRADE)

As the import and export data of fish meal and fish oil for the five years is analyzed, it could be seen that there is an increasing trend in the export as well as import, barring the dip in 2015 on exports and that in 2017 for imports. In the year 2018-'19, India had a total export of 74,716 tons to overseas market. While the exports rose 6 per cent in 2018 compared to 2017, imports rose sharply by 144 per cent during the same period.

The estimation given in Table 3 is based on the estimated export oriented shrimp production only. However, the estimated aquaculture production in the country in 2017 amounts to 6.1 million tons (FAO, 2017). In addition, fish meal is also used in other feed manufacturing sectors such as poultry, livestock and pets. Hence, it is left to one's imagination about the actual quantity of fish meal produced and used in this country, and the quantum of food fish resources exploited and utilized for the production.

While analyzing the landing data of fishes mainly using for fish meal production by the CMFRI, it is evident that the landings of sardines are on a decline. Oil sardine and lesser sardines, which were once the dominant resources in India, shows a decreasing trend over these years due to over exploitation for fish meal production than that for domestic demand. Catch data of oil sardine in 2018 shows that the catch plummeted 1.55 lakh tons from 3.37 lakh tons in 2017. The demand for better quality

fish meal from domestic and export markets have prompted the units to turn largely to sardine for meal and oil production compared to other low value and trash fishes.

There is increased fishing pressure on many of these resources, and sardine is the most affected one. These resources are supposed to supplement protein and other nutrients to the under nourished population of our country. The increased demand for aqua feed with the increased production of *vannamei* shrimp has propelled mushrooming of fish meal factories over a decade. As the sardine catch increased from targeted fishing, new fish meal plants sprung up not only in Tamil Nadu but also in Maharashtra, where the fish is very popular for cuisine. Likewise, the existing plants also have increased their capacity.

There have been steps taken to sustain the depleting sardine resources includes fishing ban, fixing of Minimum Legal Size for species and also mesh size regulation but there is no uniformity in the application of the same. The extent of support from fishermen and state authorities will form a major factor for sustainability of resources.

A study in India, Vietnam and Gambia by Netherlands-based Changing Markets (CM) Foundation also highlights the hazards caused due to the present functioning of these industries. Tons of fish, including juvenile and edible ones, are being caught, processed and exported to various countries resulting in the collapse of fish stocks and marine ecology, imbalances in food security and causing severe environmental issues, pollution and overexploitation. The study said that these fish meal and fish oil companies are causing the decline of local fish stocks. Various articles and media cites reporting that as the fish meal and fish oil industries buy waste fish or by catch (fish or other marine species caught unintentionally while catching certain targeted species) from the fishermen, the trawlers intentionally go for waste fish including juveniles and non-edible species of fish which were not earlier targeted for fishing. It is widely acknowledged that the use of low-value fish species in fish feed industry is becoming a matter of concern as it can lead to overfishing of such species and by-catch, and could undermine the integrity of the marine ecosystem.

The spread of fish meal plants in some coastal States and their overwhelming demand for small pelagic (e.g. oil sardines) has led to overfishing, resulting in reduced stocks of small pelagic in some parts of the country. The Government of India would like to take steps to control and regulate proliferation of fish meal plants. As a first step, MPEDA, the nodal agency under the Ministry of Commerce and Industry to promote the export of marine products, has brought in a moratorium on the registration of new fish meal / oil units and also on the expansion of production capacity of existing units from January 1, 2020.

Conclusion

Globally, the users of farmed products are concerned about the non-judicious exploitation of food fishes for aqua feed. Many retail chains are insisting for certifications that demand sourcing of fish meal from sustainable fishery resources. A preliminary assessment by private certification bodies has made it evident that the fishery that support the fish meal industry of the country can never achieve the Sustainable Development protocols in the near future, casting a shadow over the market aspirations of not only the fish meal companies, but also on the products made out of aqua farming. The companies are now forced to look out for possible fishmeal replacers, and imports from certified resources. The price of fish meal and fish oil in the domestic market range from Rs. 80-99 per kg and the demand is always high compared to the export market. Since this industry has better profit in the domestic market, it will be very important to take steps to put in measures to control the unabated growth of the industry in the domestic market. It is observed that the major portion of the fish meal produced is marketed in the domestic market and only when the price in the overseas market is competitive export happens. However, there are data gaps that pave way for further research not only from resource point of view, but also on socio economic linkages associated to the industry. Under such circumstances, the move by MPEDA bringing a cap over the production of fish meal and oil, limiting the use of food fish resources has to be viewed as a first step in the right direction towards sustainable use of fish resources in fish meal production. There is also need for creating awareness among fishermen to adopt measures to conserve the available stock resources and also protect the juvenile fishes.

It will also prompt the feed manufacturing sector to actively look towards and use other resources for protein. There shall also be efforts to collect and utilize offal or rest raw material from various primary process centres, restaurants and households to convert into to fish meal.

There are advanced equipments available to extract leftover meat on bones while filleting, which can well be used as raw material by the sector. Collective efforts by all the stakeholders are essential to bring down the exploitation levels of food fish for fish meal production, and divert it to address the nutrition of mankind.

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Brackish water aquaculture sector in India and the Role of CIBA - A critical review (1970-2020)

K.K. Vijayan and T. Ravisankar

The first-ever Indian shrimp export consignment was flagged off by Mr. Madhavan Nair, owner of a Kochi Company, from Port of Kochi in 1953. Only canned shrimp was exported initially, and later the industry switched to frozen shrimp along with other seafood items. The money brought in by exports of the seafood, especially shrimp, in the late 1960s, made many policy makers, officials and farmers to take a serious note of the export potential of the brackish water aquaculture sector.

Historical overview of brackish water aquaculture in India

Brackish water aquaculture in India was in vogue as traditional practice in *Pokkali* paddy fields along the Kerala, traditional earthen ponds of Orissa and Goa, *Bheries* of West Bengal. Traditional aquaculture systems facilitated mostly one crop only in a year. The feed used was natural feed like rice bran and oil cakes, and the crop season was usually from December to April. No diseases were reported particularly. The yields were low, averaging around 150 to 200 kg/ha. The shrimp exports consisted mostly of sea capture and culture contributed negligible quantities.

The 1970s started with a new hope and fervour. Scientific shrimp farming started in the country with the work

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of experimental brackish water fish farm in Kakdwip, West Bengal, by the Central Inland Fisheries Research Institute under the Indian Council of Agricultural Research (ICAR) in 1973. Concurrently, shrimp seed production studies were initiated in Narakkal, near Kochi, in Kerala, by the Central Marine Fisheries Research Institute of ICAR. Narakkal village, under the Kochi-based Central Marine Fisheries Research Institute, which did pioneering investigations into shrimp breeding and seed production. Indian Council of Agricultural Research started an All-India Coordinated Research Project on Brackish Water Fish Farming (AICRP on BWA) in 1975, with centres in West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, and Goa.

The feed technology was improvised with preparation of farm made feeds as balls or pellets using fish oil, fish by catch and other plant sources like Ground nut oil cake etc. The diseases reported were bacterial and fungal, which were effectively cured by application of recommended chemicals. The yield was 1000-1500 kg/ha.

In the late 1980s, progressive farmers started import of technology from South East Asian Countries along with technicians. The use of machineries like aerators came into existence. Imported pellet feed were found to give higher growth and better yields. Semi-intensive farming was initiated in many pockets of Andhra Pradesh and Tamil Nadu. The AICRP on BWA became an entity itself as ICAR - Central Institute of Brackish Water Aquaculture on April 1, 1987. In the same year, Hindustan Lever's Sandeshkali unit in West Bengal achieved the 3.5 t/ha/crop and Victory Aquafarm, Tuticorin harvested a yield of 8 tons per ha of Indian white shrimp, with use of imported pellet feed. These reports ignited the interest of aqua-farmers in shrimp farming. In the late 1980s, MPEDA established the Andhra Pradesh Shrimp Seed Production Supply and Research Centre (TASPARC) based in Andhra Pradesh and Orissa Shrimp Seed Production Supply and Research Centre (OSPARC) based in Orissa which provided assistance and paved the way for the establishment of a number of private hatcheries. The farmers used imported pellet feeds and were happy with the performance. Though bacterial, fungal, and parasite issues were there, the situation was manageable. India started getting attention from major import destinations of the USA, Europe and Japan.

The decade of the 1990s started with the grand entry of tiger shrimp (*Penaeus monodon*) in the aquaculture space of the country. A semi-intensive culture technology was demonstrated in a pilot-scale project by the MPEDA funded by the Department of Biotechnology. The semi-intensive farming technology demonstrated production levels reaching 4–6 tons/ha. Credit facilities from commercial banks and subsidies from the Marine Products Export Development Authority helped to boost the shrimp farming sector. The corporate sector jumped in and NABARD, insurance companies supported the industry assiduously. In addition, a number of Central Sector development schemes were initiated; including setting up Brackish Water Fish Farmers Development Agencies (BFDA) in the maritime States for the development of shrimp farming. This paved the way for the establishment of a number of shrimp hatcheries and farms in the coastal states in the early nineties. Foreign feed and chemical inputs were relied upon mostly. India witnessed an extraordinary increase in the area under shrimp farming which occurred till 1995.

The legal imbroglio and dreaded White Spot Syndrome Virus (WSSV) brought stellar growth to a grinding halt. Many of the major shrimp producing countries of Thailand and other South-East Asian nations, multiple shrimp diseases were reported. The global production started dwindling. All efforts were put to contain shrimp diseases. India could ensure the survival of shrimp farming against many odds, with the use of Polymerase Chain Reaction (PCR) screening of seeds and cluster farming with the adoption of Better Management Practices (BMPs).

The period from 2000 to 2010 saw the continuation of revival efforts which partly helped, farmed shrimp production recorded over a five-fold increase from 28,000 tons in 1988-'89 to 1.5 lakh tons in 2006-'07. The lull in the first decade of the new millennium was broken by the introduction of Specific Pathogen Free - Pacific white shrimp; *Penaeus vannamei* (SPF- PV) in 2009, after intense debate and conduct of a scientific import risk assessment study lead by ICAR-CIBA.

The brooders were quarantined and vertical transmission of OIE listed diseases was prevented. The crops were successful with farmers' adherence to bio security measures. Feed sector saw the adoption of indigenous feed technology from ICAR-CIBA to an extent of 5-10 per cent of the total area. Indian feed companies started performing well. The growth rates were high. The stocking densities were restricted and many farmers took a harvest of 8-10 tons and average national productivity rose to 4 – 5 tons. The introduction of SPF-PV helped the aquaculture sector to increase the production by 4.6 times from 1.5 lakh tons to 7 lakh tons compared to the pre-SPF-PV scenario. An industry estimate puts the total Indian shrimp production currently stands at close to 700,000 metric tons (90 per cent is *Vannamei*) from an area of 172,000 hectares, with average productivity of 4,070 kg/ha/crop in 2019.

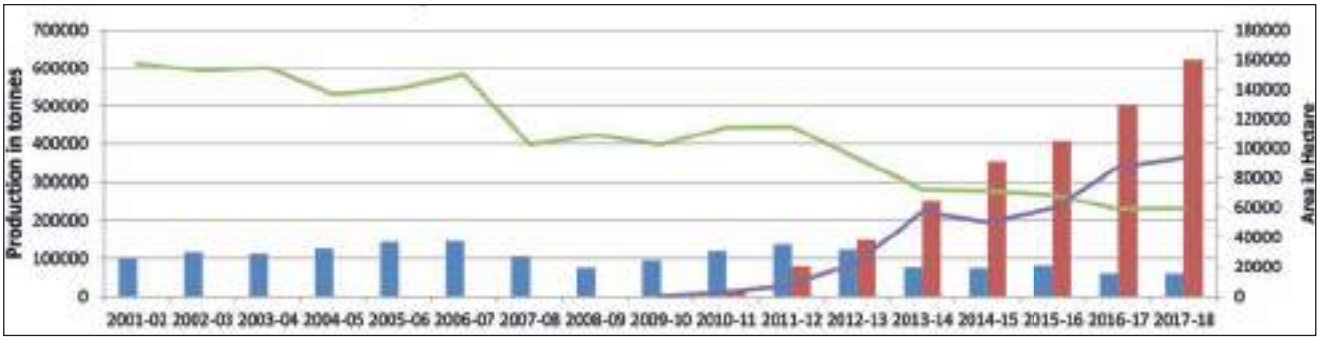


Figure.1. Area and production trends of P. monodon and P. vannamei.

As the brackish water aquaculture sector has come through the ages of many ups and downs, the resilience needs support with more sustainable technologies from Research and Development, promotion, and policy agencies. ICAR- Central Institute of Brackish water Aquaculture has always been at the forefront in developing new technologies and supporting the sector in policy meetings with scientific data and other inputs.

Role of CIBA in the sustainable development of the sector

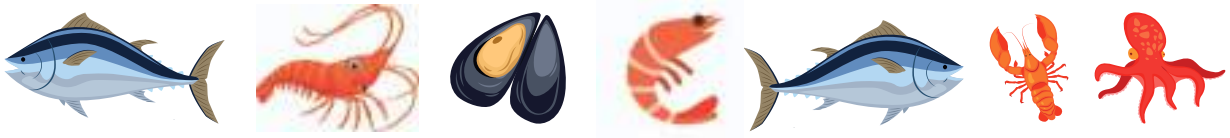
ICAR Central Institute of Brackishwater Aquaculture is the Research and Development arm of ICAR dedicated to the sustainable development of the brackish water aquaculture sector in the country. The mandate of ICAR-CIBA is as follows:

- Basic, strategic, and applied research for techno-economically viable and sustainable culture systems for finfish and shellfish in brackish water.
- Species and systems diversification in brackish water aquaculture
- Act as a repository of information on brackish water fishery resources with a systematic database.
- Human Resource Development, capacity building, and skill development through training, education, and extension.

ICAR-CIBA is headquartered in Chennai and has two regional centres in Kakdwip and Navsari, along with a Field Experimentation Station at Muttukadu. Sixty-seven scientists belonging to different disciplines are working towards sustainable technology development for shell and finfish breeding, culture, nutrition, health management, and socio-economic aspects. The vision for the R&D work of the institute is to develop technologies that are economically viable, environmentally stable, and socially acceptable technologies for brackish water aquaculture.

ICAR considerably contributed to shrimp farming since the 1970s. The backyard hatchery, development of breeding techniques like unilateral eye stalk ablation, improved methods of farm-made feed preparation and standardisation of shell fish and fin fish culture technologies. Intense efforts were put on development of human resource and capacity building of State and national-level officers in fisheries departments and other line departments like banking and insurance personnel. Many officials from SAARC and ASEAN countries were also trained at ICAR-CIBA facilities.

ICAR-CIBA also established close relationship with international agencies like Network of Aquaculture Centres in Asia and Pacific (NACA), Norwegian Agency for Development Cooperation (NORAD) and French Research Institute for the Exploitation of the Sea (INFREMER), which helped in conducting research on topical areas of research.



Thematic Areas of Research

The seven thematic areas in which ICAR-CIBA focuses the research efforts are:

- Reproduction, breeding, and larval rearing
- Brackish water production system research
- Brackish water ornamentals and aquariums
- Nutrition, feed technology, bio-prospecting
- Aquatic animal health and environment
- Genetics, genomics, transgenic, and biotechnology and
- Social science and development

ICAR – CIBA Technologies for sustainable brackish water aquaculture

Indigenous Technology for the Hatchery Seed production and Farming of Asian Seabass

Indian brackish water aquaculture requires diversification of fish species for increasing fish production. Seabass is a fast-growing, high value, and carnivorous fish ideal for Indian conditions. ICAR - CIBA made a technology breakthrough in the year-round breeding of seabass under the captive condition in 1997, followed by a novel system of farming.

Highlights of the expertise/technology

- Induced breeding, larval rearing, nursery rearing, and grow-out
- Formulated CIBA feed for hatchery, nursery, and grow-out
- A seabass hatchery of 5 million fries per annum with Rs. 2.5 Crore investment can generate Rs.1 Crore per annum.
- Packages available for different rearing systems such as ponds, cages, tanks, and recirculating aquaculture systems.

Impact of the seabass seed/farming technology from CIBA

- CIBA and the technology recipient RGCA produce about 4 million seeds /annum worth Rs.1 Crore
- Farming expanded from 20 ha in 2000 to 2500 ha in 2018
- Estimated production to a tune of 5000 tons worth Rs. 200 Crore, with a market price of Rs. 300 to 400/kg
- About 30,000 people are employed and a high potential for growth

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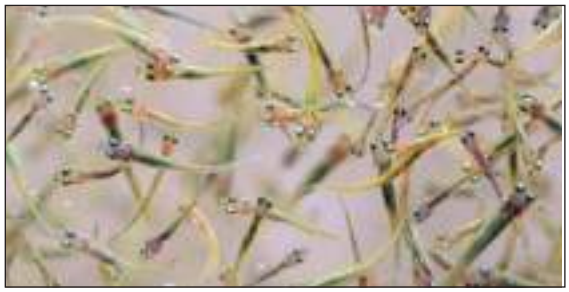
Sustainable farming of seabass in open brackish water cages in a three-tier model: an alternate livelihood for coastal fishers

- The juveniles (100 g) were grown to 900 g - 1.25 kg in 6 months
- The productivity of 460 kg/cage, was realized in two partial harvests in one cycle
- The production cost Rs.190 per kg of fish, and the sale price was Rs. 380 per kg. The BC Ratio was 2.0

Indigenous technology for milkfish Breeding, nursery rearing and grow-out



Milkfish is a fast-growing brackish water food fish ideal for farming with low input costs. Lack of fish seed for want of hatchery seed production technology has been the bottleneck. For the first time in this country, induced breeding of milkfish was achieved by ICAR-CIBA on June 8, 2015 as a milestone in the history of Indian aquaculture development.

Highlights of milkfish technology

- Captive breeding in tanks by implantation of combined hormones
- Grown to 500 g in six months from 3-4 g juvenile on low protein feeds
- The cost of production is Rs. 80 to 90/kg and the sale price was Rs. 170 to 200/kg
- Package of technology for seed, feed and grow-out production in various systems – Ready for adoption by the state government and private stakeholders

Impact of the milkfish technology

- Milkfish is a brackish water fish with a low cost of production.
- Over 500 farmers in South Gujarat are involved in milkfish farming, along with about 100 acres of farms in Kerala. This technology attracted many farmers nationwide for diversification and immense scope for a farming area to increase along the coastal waters.
- Marginal, low, and medium farmers with limited resources see milkfish as a choice due to the low cost of production, and ready market demand.

Modular hatchery technology for Pearl spot fish, *Etroplus* spp

Pearl spot is a native fish of India, which is a popular food fish, most sought-after in Kerala and an ornamental fish. It can be farmed with low inputs, being an omnivorous fish. Its complex parental care and low fecundity were challenging in seed production and farming. ICAR-CIBA developed a simple modular hatchery and technology of breeding and larval rearing for homestead, Self Help Groups and farming families.

Highlights of pearl spot modular hatchery

- A simple, low-cost portable, modular system with water recirculation
- Process of breeding using single pairs and intervention in parental care
- Repeated spawning
- An indigenous brood stock feed (*EtroBroodPlus*) parental nutrition
- Fry yield of 4000 to 6000/pair/annum
- Larval rearing without parental care

Technology Benefits/impacts

- Livelihood option for small scale fish farmers and self-help groups as homestead activity. Small ponds and brackish water enclosures can be used for farming.
- Excellent scope for export and local market as aquarium fish.
- Region-specific farming in the states such as Kerala as a sought-after food fish with Rs 300-350/kg.

Comprehensive hatchery and farming technology for five potential shrimp species

At present, exotic *vannamei* is a significant crop in brackish water ponds. Considering the risk of emerging diseases, monopoly by overseas brood stock suppliers, and unsteady export market, as a step in the diversification of species, ICAR-CIBA has standardised hatchery seed production and farming technologies for five shrimp species including *vannamei*. ICAR-CIBA is committed to putting the technologies in place to ensure the sustainable production of valuable shrimp in this country.

Highlights of the technologies

- Hatchery technology for tiger, Indian white, banana, kuruma and vannamei farming technologies in diversified systems: ponds/ IMTA/ Biofloc/ RAS, etc.
- Captive maturation and genetic selection
- Indigenous feed technology for nursery/grow-out/maturation
- Water quality and environmental monitoring and advocating remedies
- Disease diagnosis and monitoring; referral lab for screening OIE listed pathogens

Prospects/ impacts

- CIBA had its 10 million seed capacity pilot hatchery operational from 1996, for R&D and capacity building; Guided many hatcheries /farmers in the past two decades, including technology partnership through MoUs and Consultancies
- Farming technologies extensively demonstrated in farmers' ponds across the country

Technology for crab farming in 'Three-tier or zero stocking' model

Mud crab (*Scylla* sp.) is high-value seafood most suitable for low intensive brackish water farming. But its long rearing period (10-12 months; 1 g to above 500 g), poor survival, and associated production loss is always discouraging for the farmers. To avoid these, a three-tier modular farming system or zero stocking model has been developed by ICAR-CIBA.

About the technology

- It comprises a three months' nursery, four months of pre-grow-out, and three months of grow-out phases.
- Involves cages and ponds, cost-effective formulated grow-out feed from CIBA
- Survival more than 80 per cent; 1.1 ton/ha production in grow-out phase
- Farmers can realize the benefits at every three months' intervals
- Minimum resource input and infrastructure
- Low risk due to disease and water quality

Technology Benefits/impacts

- Farming is popular in Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Orissa, and West Bengal
- Farming reducing the pressure on natural stocks and boost stocks.
- Better livelihood option for tribal families
- Ready market demand, Rs 1,000 to 1,400/kg in the export, live crab exports, done by air from Chennai and Mumbai; valued Rs 220 Crore per annum

Indigenous shrimp feed technology

The feed is a critical input related to the growth and cost of production of shrimp. In the early 1990s, the Indian shrimp farming sector was utterly dependent on imported shrimp feeds. ICAR-CIBA developed and commercialised indigenous shrimp feed manufacturing technology as a pioneer in India.

Highlights of the expertise/technology

- Compressed pelleting using indigenous ring die pelletizers
- Technology package: establishing feed mill, formulation, auditing of the formula, feed manufacturing, and evaluation of feed.
- This technology uses a low cost and locally available ingredients.
- Cost-effective and customizable formulation.
- Technology is optimized for processing needs and nutrient requirements.
- Suitable for all the life stages in different particle sizes.

Impact of the feed technology

- The sector with six feed mills in the 1990s grown to more than 25 big mills and 15 small ones, increasing the production volume to 9 lakh tons per year and worth Rs. 6500 Crore.
- The number of Hi-tech fishmeal plants improved from 12 in 2008 to more than 40 in 2015 with a total production of 1.2 lakh tons and worth Rs. 1,000 crores
- Even by meeting just 2 to 3 per cent of demand, CIBA feed served as a benchmark for pricing and performance
- Employment: is assured for at least 1,00,000 persons.

Indigenous cost-effective *vannamei* shrimp feed: Vanami^{Plus}

Indian shrimp feed market in 2019 was about million tons worth Rs 7,000 to 8,000 crores. Increasing shrimp feed price and escalating cost of production is a major challenge facing Indian shrimp farming. ICAR-CIBA took strategic effort and developed a cost-effective 'Desi feed,' Vanami^{Plus}, by identifying the untapped indigenous feed resources.

Vanami^{plus}

- Scientifically formulated with locally available ingredients
- Cost-effective- Formula cost of Rs. 55-65
- FCR of 1.2 to 1.5
- Increase the profit margin for farmers by 15-20 per cent
- An eco-friendly feed with better soil and water quality
- Customisable technology for small, medium and large scale operations, on a
- Licenses given on a non-exclusive basis

Impact of the Vanami^{plus}

- Installed capacity 10,000 tons/ annum
- It covers a farming area of about 1500 ha
- Fed produced worth of Rs 65 crores/annum
- About 900 persons are directly employed, and 15000 labourers are indirectly employed
- Vanami^{Plus} - the benchmark for pricing and performance for other commercial feeds
- The trickle-down effect benefited the farmers around 1,500 Crore per annum by saving the cost of production @10 per cent, thereby increasing the profitability of the farmer

'CIBASTIM' – Shrimp growth promoter

Intensification of culture with high stocking density is the key to economic success. Overcrowding leads to stress and diseases. Immune stimulation is vital for disease prevention and growth promotion. Biotech products addressing this area is finding increasing acceptance in aquaculture, especially in shrimp farming.

Highlights of the expertise/technology

- Selected microbial-based product for application with feed
- Indigenous technology commercialised
- Safe for use and environment
- Cost-effective compared to imported products
- Easy to apply

Impact of the CIBASTIM

- An increased presence of indigenous technology and product
- Production from 2013 to 2015 - 89.51 lakh tons
- Total economic benefits due to CIBASTIM technology Rs. 1,290 Crore
- Area covered – 5000 ha

Nested PCR detection kit for White spot syndrome virus (WSSV) affecting shrimp

White spot disease is a devastating viral disease in shrimp and causes 100 per cent mortality in a short span. This disease caused enormous economic loss to the tune of USD 1.0 billion annually since 1994 across the shrimp farming nations of the world. CIBA developed and commercialised a sensitive, specific, cost-effective, and users friendly nested PCR detection kit.

Highlights of the expertise/technology

- Indigenously developed and commercialised in 2002
- Highly specific, cost-effective, sensitive and user-friendly
- Detects as low as ten virus numbers
- Results obtained in 5-6 hrs
- CIBA keeps improving the kit

Impact of the WSSV kit

- Savings by using the commercialized the kit from 2002 to 2008, more than Rs. 3,340 Crores
- Improved kit footprint from 2014 increasing and serves as an import substitute, and under commercialisation

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Water Quality Kits

Optimum water quality is critical in the success of aquaculture, and every species has its unique water quality requirements for the maximum performance. Water quality parameters can deteriorate overnight; therefore, it needs regular onsite monitoring. ICAR CIBA has developed cost-effective kits for the estimation of critical water parameters.

Significance of the water quality kits

- Estimation of dissolved oxygen (DO), pH, ammonia, calcium, magnesium, and hardness (CMH)
- User-friendly, higher accuracy and sensitivity
- Can be used onsite in field conditions
- Available in 3 combinations of DO, pH, Ammonia alone and CMH

Technology Benefits/impacts

- Reliability of water quality
- Resolution for the fears and loss of production due to water deteriorations
- Better utilisation of water resource and reduce the water footprint
- Business opportunities and employment generation
- M/s. Fisherman's, Madhya Pradesh and M/s. Shrimpex, Tamil Nadu, obtained the license

Open-water Integrated multi-trophic Aquaculture (IMTA) initiatives in Sindhudurg district of Maharashtra

An open water brackish water cage unit (BCU) was set in Gad river, Juva Pankhol, Malvan Cage stocked with 800 *Laters calcarifer* fry, along with fifty ropes of green mussel (*Perna virdis*). After nine month of rearing, seabass reached 990.10 g with a total production of 360 kg, with 63 per cent survival. The net income realised during the nine months was Rs. 1,67,000. The average monthly income was Rs. 18,555 for the group. The time invested for this was about two hours daily. Five successful breeding trials were conducted between June to July 2019.

National Surveillance Programme for Aquatic Animal Diseases

This programme is being conducted by ICAR-CIBA with a network of 24 institutions in 14 States. The objective of the project are:

- To carry out effective active and passive disease surveillance programme in six coastal districts of Tamil Nadu and Andhra Pradesh
- To develop a disease database
- To create awareness among farmers about the impact of the surveillance programme

Integrated freshwater/low saline shrimp and paddy farming Thanjavur and Kanchipuram Model, Tamil Nadu

- No salt addition unlike low saline farms in Andhra Pradesh
- Paddy crop irrigated with nutrients abundant shrimp farm discharge water
- Agricultural farmers saved approximately Rs. 5,000 by minimising the use of the fertilizers
- Additional paddy production of 8 to 9 bags/Ac (60 kg/bag)
- Aquaculture farmers are providing their farm discharge water free of cost. Shrimp farms discharge water irrigated paddy fields.

Soil and Water Health Cards

CIBA developed a working model for Soil and Water Health Cards distribution in Nellore District, Andhra Pradesh.

This was done in collaboration with three private aqua laboratories engaged in brackish water aquaculture, namely, The Waterbase Ltd of KCT Group Trust, Thapar; Alpha Biologicals Pvt. Ltd., and Blue Shell Aqua Analytical Lab and Fisheries College, Nellore.

Geospatial planning for aquaculture expansion

Geographic information system based multi-Criteria Decision Support System was developed to identify the suitable potential sites incorporating land, soil, and water resource characteristics with mandatory requirements specified under the Coastal Aquaculture Authority Act. This methodology was evaluated selected coastal districts such as Nellore, Nagapattinam and now expanded to the coastal regions in Maharashtra and Tamil Nadu.

AQUASTAT 2019- Brackish water

- Consists of information about various aspects of aquaculture, namely, global and Indian scenario of brackish water aquaculture, production and trade statistics, per capita availability of fish, utilization pattern of fish, and so on.
- It also includes milestones, success stories of CIBA technologies, impacts analysis, economic loss due to major diseases, doubling of farmers income and review for World, India, and States.
- Will be updated regularly.

Public-Private Partnership

A total number of one hundred and twenty-eight MoUs have been signed in the last two decades (1999-2019). As on date, ICAR-CIBA commercialised nineteen technologies. A total amount of around Rs.1.66 crores generated from one-time license fee, revenue share and royalty. On the Intellectual Property Rights side, eight patents obtained and five patents have been filed. About forty start-ups were graduated and trained by ICAR-CIBA.

Vanami Shrimp app

ICAR-CIBA has launched a mobile application – CIBA Shrimp app – to establish a linkage with farmers and extension workers for the dissemination of the technology information and understand the field requirements. The user can download the app for free and it can work in off-line mode too.

The application contains eight modules namely, on better management practices (BMP), estimation of biomass and inputs, on-farm disease diagnosis, on-farm risk assessment, update and advisories, government regulations, frequently asked questions (FAQs) and post a query to the scientist. The app has been widely used by the stakeholders in India and abroad with more than 18,800 downloads. Over 3,000 queries were received from the end-users so far and they were answered by the experts within two working days. The content, functionality, user friendliness, layout, design, reliability and interactivity of the modules of this app are ranked high. The end users perceived that the application as very useful to the farmers and that it helps them to take decisions at the farm level. Google Firebase application data showed that 98.4 per cent of users of Vanami Shrimp app are free from errors and crashes.

Way Forward

Technology support

- Selective Breeding Programme for Indian white shrimp *Penaeus indicus*.
- Scope for shrimp farming in inland saline regions of South-Western Punjab.
- Diversification of species, species of interest – mullet, selective breeding of Indian white shrimp *Penaeus indicus* need to be taken up as a flagship programme of CIBA at the earliest.
- Development of policy, regulations, Markets, WTO, Traceability and IPR.
- Comprehensive GIS-based mapping of brackish water areas. Research on sustainable use of saline water resources, carrying capacity, and climate change impacts.
- Cost-effective and quality feeds using indigenous materials, live feeds.
- Formulated feeds and functional feeds, fishmeal replacement with new protein sources from plants and insects.
- Tailor-made formulated feeds, e.g., Organic feed.
- Comprehensive disease control and health management programmes on existing and emerging diseases, surveillance, biosecurity and packages for fish health management.
- Genomics (full genome sequencing: nutrigenomics: pathogenomics: Bioinformatics)

Policy and Infrastructure support

- Establishment of new hatcheries, nurseries, grow-out farms and feed mills for commercialising new species
- Training and capacity building for nursery and grow-out farmers, hatchery operators, and feed mill owners
- Regular impact assessment studies and corrective actions
- Land lease policies- unfinished agenda for many States
- Water lease policies- Not in place
- Electricity tariffs – Very high compared to Thailand and Vietnam and even among States, the electricity charges vary very widely.
- Diesel prices – one of the highest in the region

Seafood exports – Recent trends and its implications on marine fisheries

A. Gopalakrishnan

Indian seafood export is at crossroads, mainly due to the fluctuating marine landings of the country. Some trends indicated by the sea food export sector of the country appear unhealthy from the ecosystem point of view. Trade in seafood export is influenced by International regulations and trade laws enforced by different importing countries within the purview of International trade guidelines of with World Trade Organization (WTO) and others.

Recently, many seafood importing countries have imposed strict regulations with respect to conservation measures followed in the exporting countries. Mainly, they are looking into fishery improvement programmes, which address the sustainability concerns of the importing countries.

The major resources contributing to sea food export from India include the shrimps, frozen fishes (ribbonfish and sciaenids), octopus, squids and other related resources. Even though shrimp is caught from the wild, majority of shrimp exports are constituted by farmed shrimps with the non-native shrimp species Litopenaeus *vannamei* contributing the most. With non-native shrimps making a major foray into the aquaculture scenario, India has almost surpassed all other shrimp farming countries to produce the maximum. But this trend is not sustainable in the long-term as massive production of non-native shrimps in the coastal belt would lead to issues related to carrying capacity. With the strict implementation of import ban on shrimp and shrimp products by the United States for countries that did not comply with harvesting methods safe to sea turtles, India faces a major problem

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director.cmfri@icar.gov.in

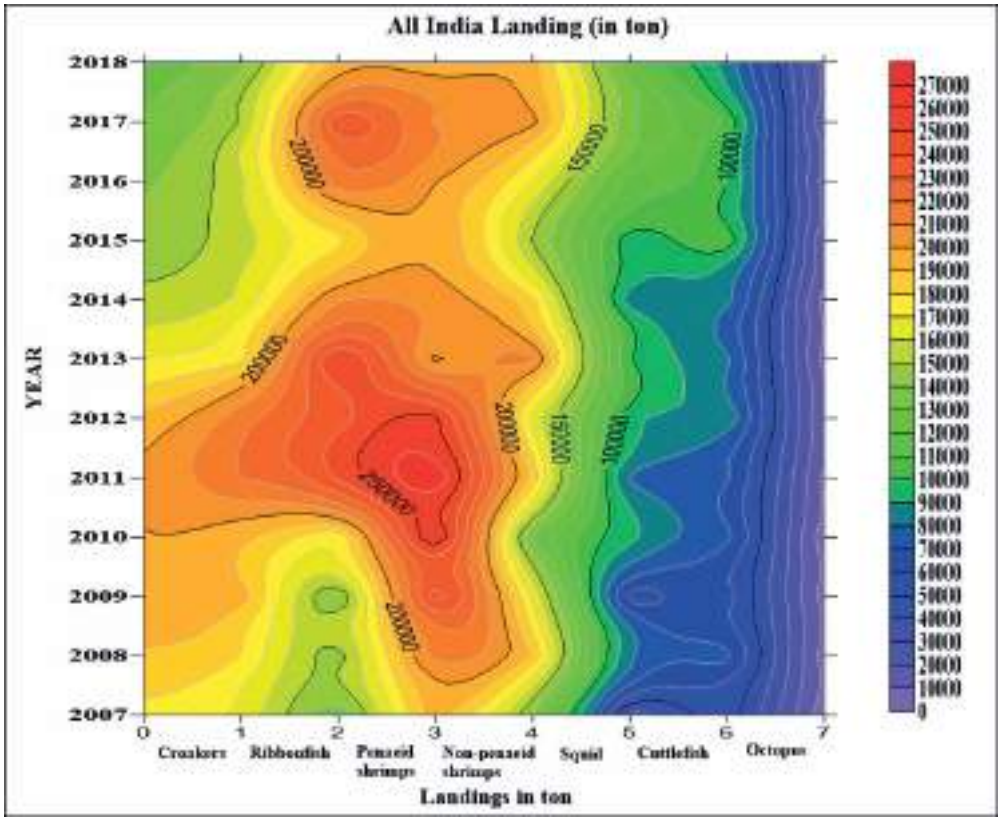
with respect to the marketability of wild Indian shrimps. The fact is that India has been taking keen interest in conserving the areas generally inhabited by turtles.

The government is implementing several programs related to sea turtle conservation and its documentation. There are published and unpublished reports from Lakshadweep and other regions of the country, indicating that turtle population has enhanced due to conservation programs. Unfortunately, because of lack of proper documentation of these conservation measures with respect to fishing and related activities (implementation of Turtle Excluder Device), we are facing stiff penalties from importing countries, particularly the United States.

Indian shrimps are exported at a very competitive price and do not fetch a premium price in international markets. The traceability mechanisms in Indian shrimp production scenario are improving with several fishery improvement programmes associated with shrimps. An example of this is the green tiger prawn improvement programme initiated by ICAR-CMFRI. This shrimp is dominant in the Pamban coast, particularly in the Gulf of Mannar and Palk Bay region. ICAR-CMFRI envisages that an improvement in the stock health of *P. semisulcatus* and proper documentation of the recovery process can fetch a premium price for the species in international markets while satisfying concerns regarding its sustainability.

The production trends of shrimps, fish and other related resources such as squids and cuttlefishes, indicate inter-annual fluctuations with a peak in production in the recent past (Figure 1).

Hence the chances of increasing their production further are limited; however, they can be enhanced with focused improvement programmes of the various resources. ICAR-CMFRI has taken steps such as eco-labelling involving Marine Stewardship Council (MSC) to certify the Ashtamudi short neck clam, *Paphia malabarica*. This could potentially fetch a premium price for the resource while addressing any concerns regarding the sustainability of the resource. There are several such programmes mooted in the interest of conservation of marine resources in the country.



Our primary concern is to maintain marine harvests at sustainable levels, while ensuring livelihood security of the people directly dependent on these resources. So, we have to re-orient out thinking on means to increase the value of trade rather than volume. A good example is the case of tuna fishery of the country. Tuna in the domestic market fetches a much lower price and the quality of tuna which enters our domestic markets is not comparable with those exported to international markets. Tuna export from the country is yet to reach its potential due to lack of infrastructure facilities so as to ensure its quality after harvest. Hence our primary concern should be to enhance trade by value than volume.

In general, the challenges facing Indian seafood export sector needs to be addressed with concern. We have hopes that the fishery relying on India's rich marine biodiversity can overcome these challenges. Also, it is equally important that fishery improvement programmes move along with other developments in the sector so that sustainability is guaranteed.

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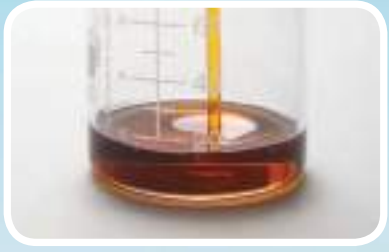
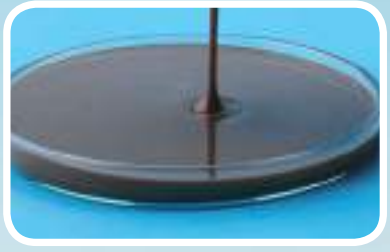

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NETFISH-MPEDA observes Swachhta Pakhwada 2019

In connection to the he 'Swachhta Pakhwada 2019' observance, the NETFISH-MPEDA conducted 18 harbour and coastal clean-up programmes across the 7 coastal States of between November 1 and 15, 2019. This was done with the aim to sensitise the fishers and general public about the impact of single use plastics on marine eco-system and about sanitation and hygiene required in fishing boats and landing centers.

West Bengal

Swachhta Pakhwada campaign was conducted at Digha, Purba Medinipur in collaboration with Ramnagar Biodiversity Management Committee, Purba Medinipur on November 7, 2019. The event consisted of an awareness programme for the school students and followed by a coastal clean-up covering about 3.5 kms from New Digha to Old Digha. Around 43 participants, including students and teachers of Hirapur Dashagran High School, NETFISH & MPEDA officials, NGO members, HDC and representative of Digha Sankarpur Development Authority (DSDA), actively collected plastic bags, PET bottles, plastic cups, thermocol pieces, broken nets etc. from the coastal areas.

The marine drive in Digha was also cleaned up. Finally, a road rally to create awareness on abuse of plastic and to make environment clean was carried out by the school students.

In Kakdwip fishing harbour, a class on plastic waste management was held, followed by collection of wastes and sanitising of harbour on November 13, 2019, with the participation of students and teachers of Vocational Fisheries of Namkhana Narayan Vidyamandir, Namkhana, member of Kakdwip Harbour Committee and Sunderban Matsyajibi Sramik Union, Assistant Secretary of Akshay Nagar Fisherman Association, harbour cleaning staff, HDCs, NGO members and NETFISH State Coordinator.

A road rally from Kakdwip Bazar to Kakdwip Fishing Harbour was also conducted. The participants interacted with the shopkeepers, net menders and fishermen and spread awareness on dumping their wastes only in designated places to keep the harbour clean.

Odisha

NETFISH organised a harbour clean-up programme at Hatabaradi fish landing jetty, Hatabaradi, Chilka on November 6, 2019. The programme started with delivery of awareness messages to the Chilka fishers by the officers from State Fisheries Department, NETFISH and NGO-Palishree. It was followed by a mass clean-up effort involving around 50 participants, including fishers and officials. A large quantity of plastic wastes like damaged nets, pet bottles, polyethylene bags, broken plastic baskets, etc. were collected and disposed of.

A harbour clean-up programme was conducted on November 13, 2019 at Bahabalapur fish landing centre, Balasore. A large quantity of plastic

Swachhta Pakhwada campaigns conducted at Digha & Kakdwip

wastes such as damaged nets, pet bottles, polyethylene bags, broken plastic baskets, etc. were collected and disposed of. The fishers were told to avoid throwing damaged nets, plastic water bottles, polythene bags, broken plastic basket, engine oil cans, etc. in to the water bodies and to dump such wastes only in the waste bins kept at landing centre, while returning from fishing. Around 50 people including officials from State fisheries department, NETFISH and FISHFED, NGO members, stakeholders, trawler association members etc. participated in the event.

View of clean-up events at Hatabaradi and Bahabalapur fish landing centres

Andhra Pradesh

A fish landing centre clean-up programme was organised on November 14, 2019 at Pudimadaka, with the involvement of fishery stakeholder groups and fishermen societies and the NGO DFYWA. The event was started with a mass awareness meeting, in which the FDO Department of fisheries explained on requirement of hygiene in landing centers and the NETFISH State Coordinator gave messages related to fishery conservation and fish quality management. The clean-up programme was done with the involvement of 100 fishermen and officials. An excavator and a tractor were also arranged to clean and clear the mass dumping. The fishers were demonstrated how the premises can be cleaned up and NETFISH asked them to maintain it by doing regular cleaning.

A fishing harbour clean-up programme was conducted at Visakhapatnam harbour on November 15, 2019, with the involvement of Visakhapatnam Port Trust, fishery stakeholder groups, fishermen associations and the member NGO. All the participants collected plastic wastes from the harbour premises in offal bags. An excavator and a lorry were arranged by the Visakhapatnam Port Trust to clean and clear the wastes. An oath was also administered to the gathering to keep the harbour always clean.

Tamil Nadu

The Swachhta Pakhwada event was organised in Pondicherry on November 8, 2019 along with the Fisheries Department. The programme consisted of clean-up drives at Pondicherry Fishing harbour and the nearby Pudhukuppam fishing village. A total of 30 volunteers from fishermen community actively participated in the programmes.

Swachhta Pakhwada events at Pudimadaka and Vizag

A harbour clean-up programme was organized on November 9, 2019 at

Cuddalore Fishing harbour with the support of fisherfolk in and around Cuddalore Fishing harbour and the member NGO SOHES. Around 80 people participated in the clean-up programme. The net mending shed, wharf area, auction hall and the harbour premises were cleaned. Awareness notices were also distributed as part of the programme, by which around 200 fishers were made aware of the importance of cleanliness and personal hygiene at work place and the impact of plastic to the marine ecosystem as well.

A harbour clean-up programme was conducted in association with the Tamil Nadu Fisheries Department at Tuticorin Fishing Harbour on November 14, 2019. The programme was inaugurated by Mrs. N. Chandra, Joint Director of Fisheries, Tuticorin. Around 20 school students from Thasnevis Madha Higher Secondary School, Tuticorin led and about 50 fishermen from various fishermen unions took part in the clean-up event. Tuticorin Harbour Co-Management Committee members and HDCs of NETFISH also participated in the event. The participants cleaned the landing hall and other areas of the harbour and collected plastic wastes in garbage disposal bins.

The rubbles, bushes and garbage mounds were cleaned with the help of an excavator and finally the harbour premises were disinfected with bleaching powder.

A fish landing centre (FLC) and beach clean-up programme was conducted at Inigo Nagar, a fishing Village in Tuticorin on November 15, 2019. About 25 women of Inigo Nagar Fisherwomen cooperative society and few other volunteers and fishermen participated in the cleaning event. The participants were divided into groups cleaned the landing hall and the beach.

The FLC was washed with clean potable water and bleaching powder was applied. The fishermen and locals participated and were made aware about the importance of cleanliness of FLC.

View of clean-up events held at Pondicherry & Cuddalore

Swachhta Pakhwada clean-up events held at Tuticorin harbour & Inigo Nagar

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Kerala

A clean-up drive was conducted at Sakthikulangara harbour, Kollam on November 6, 2019 in association with Coastal Police, Marine Enforcement, NCC cadets of St. Joseph's School Neendakara and stakeholder's association members.

On November 7, 2019, NETFISH conducted a harbour clean-up at Munakakadavu in association with the Harbour Labour Union Co-ordination Committee. About 40 harbour workers from different worker's unions participated in the cleaning activity. They cleared the overgrown grass in the harbour premises and removed all solid litter from the harbour. Later on, auction hall and the compound were cleaned using water.

As part of Swachhta Pakhwada, NETFISH-MPEDA, EIA Kochi and SEAI Kerala region jointly conducted a harbour clean-up drive at Munambam Fishing Harbour on November 9, 2019.

Around sixty members from the above three organisations actively cleaned the fishing harbour. Two excavators were hired for the clearing of bushes in the unused parts of the harbour compound.

A clean-up programme was arranged at Azheekkal harbour, Kayamkulam on November 13, 2019, jointly with Coastal Police Station Neendakara and NSS volunteers from Government VHSS Kuzhithara. An awareness class and rally were also conducted as part of the event.

The plastic wastes collected were shifted to Sakthikulangara to be shredded under the Suchitwa Saagaram project.

View of Swacchta Pakhwada programmes at Sakthikulangara & Munakkakadavu

Swacchta Pakhwada programmes at Munambam and Azheekkal harbours

Karnataka

A plastic waste clean-up programme was held at Honnavar fishing harbour on November 11, 2019, with the involvement of fishers and member NGO SCODWES. More than 55 fishers attended the event. Lectures on 'Waste menace and its management measures' and 'Harbour clean-up programme' were delivered during the programme. After the lectures, the fishers were given a demonstration on how to clean the fishing harbour and auction hall. Afterwards, the auction hall, wharf and harbor premises were cleaned by the fishers.

At Amdalli harbour a clean-up was conducted on November 12, 2019 with the participation of around 65 people including fish workers and fishers. Lecture on 'Waste menace and its management measures was given to the fishers.

Then the representative of member NGO SCODWES and the SCO demonstrated how to clean the fishing harbour and auction hall.

Then the auction hall, wharf and the harbour premises were cleaned by the fishers.

Swacchta Pakhwada programmes at Honnavar and Amdalli harbours

Maharashtra

In Arnala, a beach clean-up activity was organised on November 10, 2019, in which 50 participants including fishermen, fisherwomen and members of Fishermen Co-operative Societies from Arnala participated. During the beach cleaning activity, about 02 tons of debris which included plastic sheets, mineral water bottles, chappals and shoes, thermacol, broken nets, tyres, medicine bottles, cement bags, tin cans, plastic glass, pieces of puff, plastic cans, pieces of cartons, wrappers of snacks, etc. were removed. Another beach clean-up activity was arranged at Harne landing centre on November 15, 2019 as part of the 'Swachhta Pakhwada 2019'. A total of 50 participants including fishermen and fish workers from Harne landing centres and workers from Gram Panchayat, Harne attended the programme.

View of beach clean-up events held at Harne

About one ton of debris including plastic sheets, mineral water bottles, broken bamboo baskets, fish wastes, pieces of fishing nets, broken fibre material, broken ropes, cement bags, pieces of cartons, wrappers of snacks, etc. were collected and disposed of safely.

All the clean-up events organised by NETFISH-MPEDA succeeded in carrying out sanitation initiatives effectively, in mobilizing people and in reinforcing the mass movement for cleanliness, thereby fulfilling the objectives of the celebration of 'Swachhta Pakhwada' fortnight, as part of the 'Swachh Bharat Mission' to contribute to Mahatma Gandhi's dream of a Clean India.

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