SEAWEED FARMING ENTREPRENEURSHIP

Recommendations Emerging From International Workshop On

Entrepreneurship Development Through Seaweed Business By Cooperatives

Jointly Organized by

Laxmanrao Inamdar National Academy for Cooperative Research and Development (LINAC), NCDC.

Network for Development of Agricultural Cooperatives in Asia and the Pacific (NEDAC), Bangkok.

Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India.

राष्ट्रीय सहकारी विकास निगम
NCDC
Assisting Cooperatives. Always!

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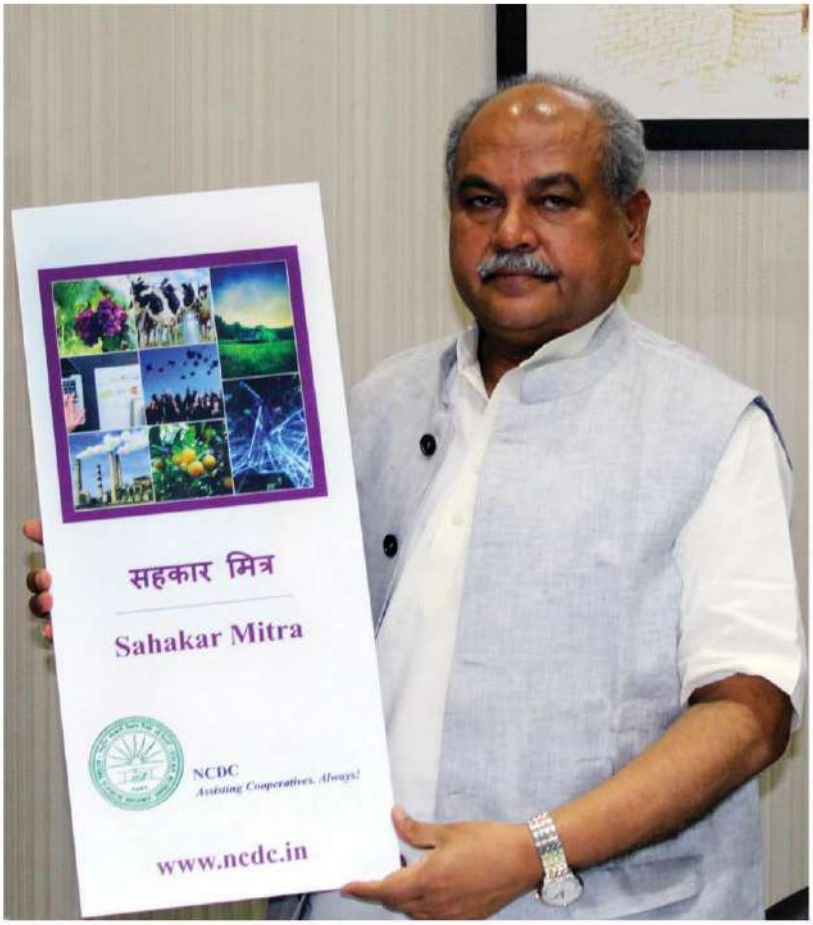
NCDC—SIX DECADES OF SERVICE TO THE NATION



- Since its inception in 1963, NCDC's cumulative release as on March 31, 2020 stood at Rs 1,52,590 crore. In 2019-2020 alone NCDC disbursed Rs 27,699 crore. About 70 percent of the total disbursements have taken place in the last 6 years.
- Sahakar-22, a mission mode activity of NCDC launched by the Hon'ble Union Minister of Agriculture & Farmers' Welfare on February 28, 2018, aims to achieve the Mission of New India by 2022 through Cooperatives for doubling the farmers' income.
- The Meghalaya Milk Mission was launched in June 2019 by Hon'ble Union Minister of Agriculture and Farmers Welfare, Hon'ble Governor Meghalaya, Hon'ble Chief Minister, Meghalaya and Hon'ble Deputy Chief Minister Meghalaya.
- Training and skill upgradation is a continuous process in NCDC. This has significantly enhanced and improved on-the-job performance in the Corporation. The business operations of NCDC have also evolved to adopt best practices in the area of operation.

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ACKNOWLEDGEMENTS

An International Webinar on "ENTREPRENEURSHIP DEVELOPMENT THROUGH SEA-WEED BUSINESS BY COOPERATIVES" was held on 28th January, 2021 with the aim to promote the Seaweed business and its value chain through cooperatives. It was jointly organized by the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, GoI, LINAC-NCDC, Department of Agriculture, Cooperatives and Farmers Welfare, GoI and Network for the Development of Agricultural Cooperatives in Asia and the Pacific (NEDAC), Bangkok, a regional forum established by the United Nations Food and Agricultural Organization (UN-FAO).

The recommendations suggested by experts during the webinar have been prepared by NCDC professionals, namely Dr. Raj Naresh Gopal, Ms. Minesh Tuteja, Mr. Patil Nilesh Suresh and Mrs. Prerna Gosain under the guidance of S. Bhupinder Singh, Chief Director, and Ms. Inderjeet Kaur, Director.

June 2021.

In the loving memory of

Dr Raj Naresh Gopal

Dr. Raj Naresh Gopal passed away unexpectedly on Friday, May 28, 2021 at the age of 44 due to COVID-19 complications.

He is survived by his wife and two daughters. He was brought up in the joint family at Bihar Shariff, Nalanda, Bihar and was immensely loved by one and all for his humble and supportive nature.

He was a graduate in Fisheries Science and then, pursued his post-graduation and Ph. D. in Fisheries Science from premier institutes of India. He started his professional career with the Indian Council of Agricultural Research (ICAR) then served with the Government of Uttar Pradesh and the National Fisheries Development Board (NFDB) before he joined National Cooperative Development Corporation (NCDC) as Deputy Director. He had been cleared for promotion as a Director in NCDC before he passed away.

With his dedication and commitment, he climbed the ladder of success and made an immense contribution to the fisheries cooperatives with his ever-learning attitude.

I know him from my earlier stint at the ICAR-Central Institute of Fisheries Aquaculture (CIFA), Bhubaneswar. I have also seen his dedication in his work as Regional Head of NCDC in Bhubaneswar. He was a known personality in the fisheries sector in India, always eager to discuss various aspects of the sector. A soft-spoken person with respect towards his seniors and colleague, he was liked by all wherever he served.

I learn that Dr Gopal was a major force in shaping the activities under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) in NCDC, combining his deep knowledge of the sector with practical insights in the field.

He possessed immense organizing skills, which I had witnessed during the organization of an International Seminar on Seaweeds by NCDC a few months back.

He truly lived through simple pleasures and nurtured a life-long relationship with his teachers, seniors, batch mates, colleagues and others. He was a great human being and always contributed to good deeds. His sudden demise has left a great vacuum in our lives. He will be deeply missed.

He has gone from our sight but he will be in our hearts forever.

J.K. Jena
DDG (Fisheries Sciences)
Indian Council of Agricultural Research
New Delhi
15 June 2021

FOREWORD

Shri Sundeep Kumar Nayak, IAS
Managing Director, NCDC, India

The international workshop on "ENTREPRENEURSHIP DEVELOPMENT THROUGH SEAWEED CULTIVATION" was organized jointly by NCDC- LINAC, the Department of Fisheries, Ministry of Fisheries, Animal Husbandry, and Dairying, Government of India and NEDAC, Bangkok on 28th January 2021.

NCDC as an apex level development finance institution set up by the Government of India under an Act of the Parliament has been working tirelessly as per its mandate to plan, promote and finance cooperative sector institutions in the country. NCDC is under the administrative control of the Ministry of Agriculture and Farmers Welfare, Government of India. NCDC has been partnering with the Governments and the Cooperative Institutions in various States and Union Territories to undertake developmental activities in diverse sectors, especially in agriculture and allied sectors.

Seaweeds are wonder plants of the sea, the new renewable source of food, energy, chemicals, and medicines with manifold nutritional, industrial, biomedical, agriculture, and personal care applications. Seaweeds are also termed as the 'Medical Food of the 21st Century' due to its usage as laxatives, for making pharmaceutical capsules, in treatment of goiter, cancer, bone-replacement therapy, and in cardiovascular surgeries.

For discussing the issues and challenges in entrepreneurship development in Seaweed cultivation, NCDC took a leadership role in conducting the international workshop for the stakeholders. The concept paper formed the basis for discussion in the workshop. The focus was on farmers attaining higher incomes through Seaweed farming. The workshop aimed to bring stakeholders on one platform and work towards forging alliances for the promotion of entrepreneurship in seaweed business through cooperatives. At the same time, the webinar identified bottlenecks at various levels and deliberated on finding lasting solutions to these bottlenecks.

"Entrepreneurship Development through Seaweed Business by Cooperatives"

On 28th January 2021, experts from Australia, Bangladesh, Cambodia, Canada, France, Iceland, India, Indonesia, Ireland, Italy, Myanmar, New Zealand, Philippines, Singapore, South Africa, Thailand, Trinidad and Tobago, the United Kingdom, the United States and Venezuela deliberated on the challenges in developing greater entrepreneurship among cooperatives dealing with Seaweed as a business, and possible solutions to those challenges.

This online workshop was organised jointly by LINAC - NCDC (Laxmanrao Inamdar National Academy for Cooperative Research and Development - National Cooperative Development Corporation), the Department of Fisheries - Government of India, and the Network for Development of Agricultural Cooperatives in Asia and the Pacific (NEDAC), a regional forum established by the United Nations Food and Agricultural Organization (UN-FAO) in Bangkok.

Inputs from the workshop are captured in this report, and shall contribute to the agenda of promoting entrepreneurship in Seaweed business, especially through cooperatives, and enhancing the socio-economic wellbeing of Seaweed farmers and other stakeholders. The workshop focused on the Asia-Pacific region and outlined the business opportunities in Seaweed farming and its ability to enhance incomes of Seaweed farmers, especially women.

Seaweed overview:

Seaweed farming is a resource neutral technology, not requiring land, fresh water, fertilizers or pesticides. It sequesters CO2 which results in mitigation of ill effects of climate change. It is a sunrise industry catering to commercial requirements of food, feed, pharma chemicals, cosmetics, biofuels, biofertilisers, bio-stimulants etc. Seaweed extracts are based on bio-stimulants which provide relief against a biotic stress and boost crop production. Animal and human nutrition products to boost immunity and productivity are next opportunity areas.

The workshop highlighted that the global market value of the Seaweed business is USD 12 billion; and in India this was estimated at Rs.300-500 crore. Globally, China, Indonesia and South Korea are the leading countries in Seaweed production. The demand for seaweed products is growing at a rapid pace, especially in the European market. In June' 2020, India launched a special initiative called the Pradhan Mantri Matsya Sampada Yojana (PMMSY), with total outlay of Rs. 20,050 crore towards promoting the fisheries sector in the country. Of this total outlay, Rs.640 crore has been specifically earmarked to promote and modernise various aspects in the Seaweed supply chain, such as inputs, cultivation, processing and

marketing. The support is directed to improve the practices, infrastructure and research in this sector and thereby help optimise the value chain of each player in the Seaweed trade.

Various similar initiatives have been taken by other countries, highlighting the growing attention being captured by the opportunity offered from Seaweed and Seaweed-based products.

Challenges:

It was highlighted that unlike terrain-based farms, clearly demarcated territory for Seaweed cultivation areas has not been undertaken. As such, very few coastal stretches are available for the purpose. Where some zones are demarcated, the area is not sufficient for apropos Seaweed cultivation at business scale. As such, Seaweed farmers are unable to develop permanence or scale in their activities. Lack of clarity on farming area, a basic facet, leads to disputes, low and infrequent productivity, inability to invest in better technologies and thereby, little improvement in related practices. This sector is therefore, challenged with shortage of capital for expansion, lack of crop insurance, and insufficient business and technical awareness at farming end.

A stark lack of business entrepreneurship in the first stages of the Seaweed supply chain, especially among the farmers was highlighted. While enormous leaps have been made in R&D, that has demonstrated use of Seaweed and its extracts, the farmers continue to suffer from poor industry linkages, disease, and infestation, poor bio-security measures, and more. There is a lack of targeted policies to support a more integrated and holistic direction for Seaweed businesses.

Opportunities:

The Asia-Pacific region is favoured with the climate, resources and traditional demand for Seaweed. Besides the domestic markets, there is now growing opportunity in non-traditional export markets too. Modern science has brought forth new products and prospects from Seaweed, not only as food, feed and fertiliser, but also in various other derivatives that can be extracted from Seaweed. Hence, it is imperative to create awareness of Seaweed farming and its uses, to create a good alliance between industry-R&D, institute collaboration, and linkages. Seaweeds are a key component of Integrated Multi-Trophic Aquaculture (IMTA) which provides important ecosystem services which is of great value.

The outcome of the webinar:

The webinar was a great example of Cooperative-Corporate Collaboration to enhance farmers' income through business development. The main outcomes of the webinar are as follows:

- Creation of "Business Incubation Centre" for promoting business in the fisheries sector. NCDC-LINAC will work on the concept with the support from Department of Fisheries, GoI.
- Need for Fish Farmer Producer Organizations (FFPOs) to promote Seaweed business activities in India.
- Network for Development of Agricultural Cooperatives in Asia and the Pacific (NEDAC) to support cooperatives working on Seaweed business in international trade and developing capacity.
- Organizations working on Seaweed businesses should promote Cooperatives/FFPOs to strengthen Seaweed value chain for ultimate benefit of producer farmers.

The workshop laid stress on maximizing available cultivable areas using fast-growing and climate-resilient strains, while augmenting awareness about Seaweed farming from business point of view and aiming at developing a model of commercial Seaweed farming through a network of cooperatives.

Inaugural Session.

Welcoming the participants in the inaugural, **Lt. Col. Bikramjit Singh, Chief Director, LINAC** and Coordinator of the webinar said that inputs from all distinguished speakers and deliberations thereon would go a long way in promoting entrepreneurship on seaweed business especially through cooperatives, and improving the socio-economic status of people from Asia Pacific region and particularly from India.

Dr. Krishna R Salin, Director, NEDAC, Bangkok, Coordinator of the webinar, said that this webinar is very important for the Asia Pacific region because Seaweed production has not expanded in this region as expected. Seaweed has a lot of potential both as a food and also in the industries as an input with several industrial applications from cosmetic to pharmaceutical industries, he added.

Welcome Address by Shri Sundeep Kumar Nayak, Managing Director, NCDC and Honorable Chairman, NEDAC

Shri Sundeep Kumar Nayak, Managing Director, NCDC and Honorable Chairman, NEDAC, while welcoming the dignitaries and participants, said that this is a great occasion for LINAC-NCDC, Department of Agriculture, Cooperatives and Farmers Welfare, GoI, Department of Fisheries, Ministry of Animal Husbandry, Dairy and Fisheries, GoI, and Network for the Development of Agricultural Cooperatives in Asia and the Pacific (NEDAC), Bangkok to jointly host this webinar on Seaweed. He further said that this webinar has been live screened on YouTube, Facebook and Twitter handle of NCDC and NEDAC, and on the zoom platform. He said that NEDAC takes pride in hosting this webinar for its member countries like Africa, Middle East, and Oceania Philippines. He appreciated the efforts of Dr. Krishna R. Salin, Honorable Director, NEDAC, and Bangkok for bringing together so many experts on Seaweed.

Opening Remarks

Address by Chief Guest: Dr Rajeev Ranjan, Secretary, Department of Fisheries, GoI

Dr. Rajiv Ranjan said that the Government of India is very keen on promoting the cultivation and entire value chain of Seaweed. Informing that the Department of Fisheries, GoI has prepared a detailed action plan and strategy to promote Seaweed business in India, he shared a brief presentation with participants. The brief points of the presentation are as follows:

- The global market value of Seaweed business is more than USD 12 billion.
- China, Indonesia and South Korea are leading countries in Seaweed production while India has a very insignificant presence at this point and that's why all stakeholders need to put efforts to change this scenario.
- India produced around 5000 tons of cultured Seaweed and collected 25000 tons of wild Seaweed. The total market value of the Seaweed business in India is approximately Rs.300-500 crore.
- Seaweed can be used as food for human beings, animal feed/supplements, biofuel, biofertilizer/growth stimulants, industrial uses like nutraceuticals, cosmetics, industrial chemicals, etc, and also useful as a nutrient scrubber, Carbon dioxide scrubber, oxy-genator & nursery ground for fishers.
- Seaweed food products for human consumption contribute about USD 5 billion and India has an opportunity to tap the business opportunity offered by this sector.
- Important Seaweed cultivable species in India are *Kappaphycus alvarezii, Gracillaria edulis, Turbinaria Spp., Surgassum wightii, Gelidiella acerosa, Gracillaria dura.*
- Seaweed cultivation can be done through raft or monoline or tube net method and DoF is looking forward to promoting all these methods including the Seaweed value chain. Self Help Groups (SHGs) are doing good work in Seaweed cultivation and will be promoted. This sector can provide huge employment opportunities in the coastal areas.
- Department of Fisheries along with the National Fisheries Development Board (NFDB), Central Salt & Marine Chemicals Research Institute (CSIR-CSMCRI), Central Marine Fisheries Research Institute (ICAR-CMFRI), National Institute of Ocean Technology (NIOT), and State Fisheries Department is promoting the Seaweed culture in India.
- GoI has launched Pradhan Mantri Matsya Sampada Yojana (PMMSY) in June' 2020 with a total outlay of Rs. 20,050 crore and out of this, Rs.640 crore has been earmarked to promote the Seaweed value chain in India and the main objective of this scheme is to increase the income of Seaweed farmers.
- India has a long coastline with available resources for Seaweed cultivation, low labour cost, and domestic market with the opportunity to tap the export market and develop-ing rural entrepreneurship. But we also need to create awareness on Seaweed farming and its uses, create a good alliance between industry-R&D, institute collaboration, and linkages.
- The broad strategy for Seaweed cultivation and value chain under PMMSY is to expand the area, enhancing research and development, ensuring quality seed supply, institu-tional development for market promotion, increasing capital investment in small scale Seaweed Processing, utilization of existing labour, integrated and cluster-based approach and up-gradation of technology.

- Intensive efforts will be made by the implementing agencies to prioritize the formation and promotion of FFPOs, support cooperatives and SHGs in the potential coastal areas of the country.
- Department of Fisheries, GoI is targeting to produce 11.2 Lakh tons seaweed by 2024-25, and has prepared an action plan with separate production target for States/ UTs. The total fund has been allocated in potential states for seaweed cultivation as well as additional investment for interventions like the establishment of seed banks, genetic improve-ment programs for high yielding cultivars, Seaweed parks, etc.
- Department of Fisheries is doing convergence with various ministries to synchronize the efforts to promote seaweed farming.
- GoI has taken major decisions like enhancing seed availability, promoting indigenous species, permission for the natural collection, support intensive convergence, enhanc-ing training and capacity building, popularizing seaweed based products, developing seaweed farming in Island territories, developing entrepreneurship in Seaweed farm-ing, and support to industries.

Shri Manoj Joshi, Additional Secretary, MoFPI, India

Shri Manoj Joshi laid emphasis on processing and marketing of Seaweed along with its cultivation. He enlightened the participants that MoFPI operates a scheme 'PM Formalization of Micro Food Enterprises' (PM-FME), which provides a 35% subsidy with bank loan linkage to individual entrepreneurs, self-help groups, cooperatives, farmer producer organizations to set up common processing facilities or incubation centers and marketing support. The scheme provides subsidy to those micro-enterprises whose turnover is less than USD 200,000 or investment is about 1 crore. It also provides bank loan linkages to Farmer Producer Organizations; grants working capital loan to self-help groups to set up Incubation center or common processing facilities in areas viable for seaweed cultivation and processing. As there is large market potential in production and marketing, it is required to set up common processing facilities to research institutions. Ministry of Fisheries, GoI can guide NCDC to focus on 5 to 10 areas, along with cultivation, processing, packaging, and marketing. Sh. Joshi suggested to focus on a few clusters to begin with, and ensured convergence of the schemes of MoFPI to scale up the production of Seaweed.

Dr. U.S. Awasthi, MD, IFFCO, India

Dr. Awasthi spoke on the importance of Seaweed and its use in agriculture, especially as an organic biostimulant. It is derived from red and brown seaweeds (Kappaphycus), which enhances crop productivity and provides resistance against stress, he said. He informed that Indian Farmers Fertilizer Cooperative Ltd. (IFFCO) is marketing the Seaweed biostimulant developed by Bhavnagar-based Central Salt and Marine Chemical Research Institute (CSMCRI), a national laboratory working under the Council of Scientific and Industrial Research (CSIR). CSIR-CSMCRI has already patented this product and it is being used as a biostimulant for the crops as it is increasing yield of several crops by 11% to 13%, and decreasing use of chemical fertilizers. IFFCO has joined hands with AquaAgri with a 50% partnership to boost its business. Farmers are now willing to buy Seaweed as both in the form of liquid biostimulant and granules. IFFCO has a wide pan India reach as it is owned by 40 million farmers, 37,000 Cooperatives as their members in the industry farmer's organization. AquaAgri has an advantage for Seaweed cultivation for additional research and providing adequate compensation to the farmers for Seaweed cultivation. Their sellable products have 20% Seaweed extracts which contain carbohydrates, organic salt, other inherent nutrients like vitamins, plant growth, regulators like auxin, cytokinin, gibberellin, etc. In agriculture, bio-stimulants are safe, eco-friendly with no phototoxic effect. It also provides higher crop yield by 8% to 15%, enhances psychological efficiency, and improves quality. Bio-stimulant is a kind of collaboration that starts from the producer to the consumer and goes through the industry to the cooperatives directly to the farmer's field.

Dr. Thierry Chopin, Professor of Marine Biology, University of New Brunswick, Canada

Dr. Thierry Chopin talked about seaweeds as a key component of Integrated Multi-Trophic Aquaculture (IMTA) that provides important ecosystem services which are of great value. He also said that there was presently a renewed interest in seaweed mariculture which had been triggered by:

- Their cultivation in integrated multi-trophic aquaculture (IMTA) systems,
- The emerging understanding of the ecosystem services they provide, and
- The development of novel uses/applications.

Integrated Multi-Trophic Aquaculture (IMTA) systems:

Dr. Thierry Chopin also explained the initial three components that constitute the IMTA system, which are:

- Fed Aquaculture whose component is finfish,
- The Organic Suspension Extractive Aquaculture component which is the shellfish; and
- The Inorganic Dissolved Extractive Aquaculture component which is the seaweeds.

He explained the way all the above said individual components work as a system. When the nutrients are added to the system which in turn creates a nutrient zone, it can be seen that the small particulate organic matter doesn't go very far and hence, the shellfish have to be put quite close. There are dissolved inorganic nutrients, like dissolved nitrogen, dissolved phosphorus, and dissolved carbon, which move further and so the seaweeds need not be put as close as the shellfish.

Also, it can be realized that there are two other types of nutrients:

The large particulate organic matter from finfish that goes faster to the bottom, and

The feces and pseudofeces from shellfish, which also go to the bottom.

Hence, the need for a fourth component, the Deposit Extractive Aquaculture component, made of invertebrates like sea urchins, sea cucumbers and lobsters.

The fifth component is the Mineralizing Aquaculture component, with microbes and bacteria.

Not all IMTA systems have the five components present.
Two or three components may be sufficient.

Seaweeds (and other extractive species) had been valued only for their biomass and food trading values. But the approach needs to be changed as they also needed to be valued for the ecosystem services they provide, along with the increase in consumer trust and societal/political license to operate that they give to the aquaculture industry (circular economy approach).

Ecosystem services provided by seaweeds: -

Seaweeds are excellent nutrient scrubbers (especially dissolved nitrogen, phosphorus, and carbon).

An important fact about IMTA is that there is no need to add fertilizers and agrochemicals as the fed component (the fish) are providing the fertilization.

To accomplish that, Dr. Thierry Chopin urged the participants to change the way of thinking because until now nutrients have been considered as wastes or by-products, but they needed to be considered as co-products from one species that can be used as recovered fertilizers on feed resources, and also energy, for other species which then become additional crops providing economic diversification while the bioremediation of coastal nutrification takes place.

"Seaweeds do not need to be irrigated as they are already in the water."
Dr. Thierry Chopin said that in different parts of the world where water is becoming an issue, this is a significant advantage.

Seaweed cultivation does not need more arable soil and land transformation (deforestation).

Seaweeds can also be used for habitat restoration.

Seaweeds are the aquaculture component providing O_2, while the other animal and microbial components consume O_2.

Seaweeds can "**sequester**" (transient sequestration, not permanent at geological time scales) carbon dioxide, thus participating in reducing global warming and coastal acidification.

Dr. Thierry Chopin further said that he would much prefer to talk about coastal acidification than ocean acidification as he thinks that we will never be able to cultivate enough seaweeds to change the pH of an entire ocean; whereas, at the coastal level, it is possible to have an impact. Dr. Thierry Chopin added that from an economic perspective, the IMTA multi-crop diversification approach (growing fish, seaweeds and invertebrates) could be an economic risk mitigation and management option to address pending climate change and coastal acidification impacts, thereby increasing the resilience of the aquaculture sector.

Benefits of seaweeds in terms of increase in societal/political license to operate:-

If seaweed cultivation (and other components of IMTA systems) is combined with wind farms, in integrated food and renewable energy parks (IFREP), the combination can reduce cumulative footprint which would be important to get more societal acceptance of both activities.

Giving an economic value to the ecosystem services provided by seaweeds

The value of these important services to the environment and, consequently, to society are, however, never accounted for in any budget sheet/business plan of seaweed farms and companies as seaweeds are presently being valued only for their biomass and food trading value. For Dr. Chopin, the value of the ecosystem services should be first recognized, then a monetary value be given to them, to then use this value as financial and regulatory incentive tools.

It is time to develop a system of nutrient trading credits, not only a system of carbon trading taxes.

To get the true value of seaweed aquaculture, it is important to give a value to these ecosystem services. They could be used as financial and regulatory incentive tools to encourage single-species aquaculturists to contemplate innovative practices, such as IMTA, as a viable alternative to their current practices.

Moving towards an Integrated Sequential Biorefinery (ISBR) approach:

It is necessary to move towards an Integrated Sequential Biorefinery (ISBR) approach which aims at One Species - Several Processes - Several Products. Dr. Chopin said that he prefers to talk about co-products than by-products or wastes, which help people think in terms of the circular economy approach. He also presented a demonstration of how the Integrated Sequential Biorefinery (ISBR) can work.

Towards The Turquoise Economy and The Turquoise Revolution:

The Blue Economy needs to become greener. If we combine blue with green, Dr. Chopin mentioned that it is time we talk about The Turquoise Economy and The Turquoise Revolution.

Dr. Blossom Kochhar,
Chair, Blossom Kochhar Group, India

Shri Sundeep Kumar Nayak, while introducing Dr. Blossom Kochhar, said that Dr. Kochhar, who manufactures a wide range of aromatherapy beauty products under the brand name 'Blossom Kochhar Aroma Magic', uses Seaweeds to great perfection in adding value. He informed that NCDC, in association with NEDAC, is planning to set up an incubation center with the support of the Government of India. NCDC would like to collaborate with the industries and entrepreneurs by connecting young graduates across India, said Nayak, while offering to collaborate with Dr. Kochhar too.

Congratulating NCDC Managing Director Shri Sundeep Kumar Nayak on organizing a workshop of this kind, Dr. Kochhar said that since she had been manufacturing and into cosmetics, beauty spa, and wellness field for a long time, she has gained some knowledge about a lot of natural, organic products and also Seaweeds to a certain extent. Narrating her personal experience about how she got into Seaweeds, Dr. Kochhar said that once during her visit to Chennai, she found the hands of the ladies who were working with Seaweeds, were flawless and had a wonderful color; and there was no aging effect. Hence, she started thinking of entering into the Seaweed business and after some research, she found that Seaweeds has lots of proteins, polyunsaturates, polysaccharides, fatty acids, amino acids, pigments, vitamins, sterols, and other biochemical agents. When they were combined along with essential oils it was seen that it had a wonderful effect. She added that she used it in sunscreen lotions because it has excellent photo-protection properties. She also found that the Seaweeds had tyrosine (an inhibitor) that stops melanin from forming. The best thing she found that Seaweeds have anti-aging properties as they had peptides that brighten up the skin. She informed that the firming gel makes the skin look 5-10 years younger within three minutes. She also mentioned that a lot of her packs have the whitening (lightening) agent, along with vitamin C. She said that these Seaweeds have Vitamin C, Vitamin-A, and Vitamin B-complex which are beneficial for the skin; and have excellent moisturizing effects. It also helps in reducing hall fall problems and keeps dry hair moist. Dr. Kochhar expressed her willingness to work with NCDC in future.

Sh. Abhiram Seth,
Managing Director, Aquaagri, India

Highlighting the benefits of Seaweed farming, Shri Abhiram Seth said that the Seaweed industry is an extremely viable model for all stakeholders, and can give sustainable livelihood opportunity for those who don't have land-holding and with a limited amount of investment, without relocating them from the local habitat. He shared that Seaweed cultivation is the best source for women entrepreneurs to earn a higher income and one does not require land, freshwater, fertilizers or pesticides to cultivate it. It is a sequester of CO2 which results in the mitigation of the ill-effects of climate change. It is a sunrise industry, catering to commercial requirements of food, feed, pharma, chemicals, cosmetics, bio-fuels, bio-fertilizers, bio-stimulants, etc. Seaweed extracts are based on bio-stimulants which provide relief against abiotic stress and boost crop production.

He stressed that animal and human nutritional products to boost immunity and productivity are the next opportunity areas for business. Moving from a low-value to a high-value range of products, one can produce hydrocolloids, go to bio-stimulants, look at animal nutrition, next branch out organic chemicals, nutraceuticals, and lastly develop edible packaging options. Shri Seth also talked about Aquaagri's journey and how the IFFCO farmers have accepted its agriculture products range. They partnered with a scientific system under the limited scheme and have validated the application of Seaweed formulation for both cattle

and poultry. Immune modulation response in cattle and poultry has significant improvement by a small number of Seaweed formulations.

He added that they are now developing a higher range of value-added food solutions made out of carrageenan. In this large sector, Aquaagri has an insignificant presence but there is a long way to go in the next five years to reach the goal set by the Fisheries Ministry. He said that this Rs.28 crore industry is likely to grow to Rs 8000 crore by 2030. However, 75% of Seaweed stimulants sold in India is imported from North America and Europe. Aquaagri aims to ensure continuous availability of high-quality planting material for the cultivators through cooperative mode; and Shri Seth suggested for setting up a Public-Private Partnership (PPP) company under section 25, leveraging the fisheries department, ICAR, and CSIR institutions particularly-CSMCRI/ CMFRI/ NCSCM. In India, the Environment has recently granted permission for Seaweed cultivation in gulf areas jointly being run by CSMR/ CMFRI and NCSCM which will lead to rapid expansion in the gulf areas. "They need to work with the scientific institution by leveraging the available technology to improve the viability of our cultivars going forward. Further, they need to have cultivation models for land-based cultivation, invest in research over human nutrition, Seaweed site mapping, and a pilot study is needed in this area to determine their viability, improve biomass availability, and to do deep-sea cultivation for which the Fisheries Department can fund under the scheme. There is a need to leverage the cooperative network and model for propelling the growth of seaweed cultivation, to encourage and support for the adoption of seaweed nutrients in dairy, poultry, and fish to improve their immunity reduce mortality and increase productivity," he suggested.

Ms. Kavita Nehemiah, Snap Natural & Alginate Products Pvt. Ltd., India

Established in 1979, Snap Natural & Alginate Products Pvt. Ltd. (India) is one of the largest processors of Natural Seaweed based products in India. They manufacture Alginates from Sargassum Wightii (brown algae), Carageenan from Euchema Cottonii (red algae) and their formulations.

Ms. Kavita in her address mentioned that Snap, started manufacturing textile grade Alginate. The main competitor was Chinese material and since Sargassum weeds are unable to match the viscosity of laminaria weeds they exited the textile industry. Sargassum weeds however gives excellent Gel strength making it ideal for use in food and pharmaceutical industry.

Ms. Kavita shared the use of Alginate in various industries like in pharmaceutical industry it is used in antacids as it creates a raft layer in the stomach so that acids don't reflux. It also has wound healing properties to heal stomach ulcers, and is used as dental impression material. In cosmetics it is used in face packs. Due to its gelling properties, Alginate is used heavily in the food industry for foods like ketchup/sauces, fruit juices (it aids separation of sugar and

pulp), ice cream (it prevents ice crystal formation). And finally industrial grade Alginate is used in welding electrodes and rubber latex.

She added that Carrageenan, which is manufactured from red algae, is primarily used in dairy industry for making khoya, ice-cream, milk-shake, cheese and products like jelly, processed meats, puddings, etc. Carageenan improves texture and taste, it imparts a uniform color and flavor, it also reduces the protein denature of milk while heating, and thus keeps a lot of nutrient property intact. It also improves the yield because it has a better binding capacity. Internationally, the food industry is the largest consumer of Alginate and Carrageenan. In India, however, lower quality ingredients are used and it requires a change in mindset to increase the consumption in the food industry.

She emphasized Seaweed farming and its impact on coastal communities. "Lower literate fisher-folk and women can take up Seaweed farming to diversify the livelihood and multiply their income," she said.

Ms Nehemiah further said that Seaweed farming refers to both harvestings from the natural beds based on the calendar (Sargassum and Turbeneria) and cultivation in the sea for Kappaphycus. Seaweed farming is a labor-intensive process that generates employment at every level, primarily for women. She stated that Rs. 500 to 700 per day can be earned by 6-8 people on each boat and during seasonal months SNAP employs around 2000 people.

Dr Nguyen Van Nguyen, Deputy Director, Research Institute for Marine Fisheries, Vietnam

Dr Nguyen Van Nguyen started his presentation by briefing over the aspects of fisheries and aquaculture business in Vietnam which includes fish stock assessment, fishing technology, post-harvest technology, biodiversity, marine environment, and aquaculture including Seaweed. He shared that Vietnam has more than 3000 km coastal line with island and river mouths. Seaweed flora has 800 species and biomass estimated to be around 86000 tons that to mainly from Sargassum species. 7 seaweed species are cultivated in Vietnam for seafood and gell production, including 3 species of *Gracilaria*, 2 species of *Kappaphycus, Eucheuma denticulatum* and *Caulerpa lentillifera*. Despite large total potential area of nearly 30000 hectares, less than 10000 hectares are cultivated.

For *Kappaphycus* and *Eucheuma*, as these species are imported from the Philippines and continueously cultivated for 30 years, the seed become degradated and growth rate declines. This leads to shortage of raw materials and unavailability of processing factories.

For *Gracilaria*, the main reason is due to the competition by shrimp. *Gracilaria* in Vietnam consists of 3 main species with natural harvested production around 800 hectares per year and

for the potential area around 20000 hectares. Gracilaria used contribute a large proportion in fisheries production in Vietnam before the year 2000. Thereafter, it shrunk down because the focus shifted to shrimp ponds.

Caulerpa species cover around 80 hectares in central Vietnam with the export of around 2400 tons per year to Japan. However, Vietnam also has a large potential domestic market due to its 100 million populations whose consumption habit is changing in favor seaweed diet due to cultural exchange.

There is a need to diversify Seaweed cultivation in aquaculture for a sustainable and balanced environment. Coastal eutrophication has increased during the period 2005 to 2018 as there is a continuous rise in Nitrogen levels. This leads to drastic degradation in water quality in coastal aquaculture area, which is shown by the increase in frequency of redtide and oxygen depletion in coastal quaculture area (aeration is required in fish cages). While shrimp-based approach leads to unsustainable aquaculture, seaweed secures sustainable aquaculture as it helps solve coastal eutrophication. It also appears to be potential subsitution for rice in salt invasion areas in the Mekong delta

Dr. Nguyen discussed the Government's vision on the Seaweed industry as Vietnam has great potential to develop Seaweed industry. The Government is supporting research to promote seaweed-based markets by collaborating with enterprises and policymakers through Research Institute for Marine Fisheries (RIMF).

Dr. Anicia Q Hurtado
University of the Philippines Visayas.
Mia-ao, Iloilo Philippines

Dr. Anicia Q. Hurtado enlightened everybody about some science-based innovations for the sustainability of red seaweed cultivation. To begin with, global Seaweed aquaculture production is led by China followed by Indonesia. She shared that *Eucheuma denticulatum*, the spiny *Eucheuma* produced in small volume ranging from 84000 to 274000 reached its peak in 2015. The *Eucheuma* spp. reached its highest volume in 2015 i.e., 10.18 million but declined in the following three years. *Eucheuma* was the first genus name of *Kappaphycus* until 1988 when it was identified as a distinct and separate genus from *Eucheuma*. Today, there are two major commercial species of *Kappaphycus*, i.e. *alvarezii* and *Eucheuma denticulatum*. *Kappaphycus alvarezii* reached its highest volume of 1.88 million in 2010, and declined in the following three years. An increasing volume of *Gracilaria* was recorded from 2000 to 2016 but decreased slightly in 2017-18. It is only the *Porphyra spp*. and *Porphyra tenera* which recorded increasing volume from 200 to 208. There are 3 major red seaweeds cultivated commercially in the Philippines i.e., these are *Kappaphycus (K. alvarezi, K. malesianus and K. striatus); Eucheuma (E. denticulatum), and Gracilaria (G. firma and G. heteroclada).*

She stated that the seaweed industry is faced with challenges just like any other industry. These are the major challenges: 1) low productivity and production due to poor farming practices; 2) insufficient financial and technical support from the government and academia i.e., shortage of capital for expansion, lack of crop insurance, weak industry-academia linkages; 3) disease and pest infestation brought by climate change; and 4) poor bio-security measures and farm management, i.e. lack of specific policies for seaweed.

She stressed that for the industry to remain robust and sustainable there must be the adoption of bio-security measures and good aquaculture practices for seaweeds which must be science-based knowledge and information for the framing of policies. Then, she emphasized on maximizing available cultivable areas using fast-growing and climate change resilient strains, cost-effective cultural techniques, diversification of crops and product applications. She made some suggestions for the seaweed industry to remain robust, and sustainable. "We have to make some strong and reliable innovations, sound farm management and adoption of biosecurity measures. All these are needed like proper zonation of farm structures, rigid screening of propagules, acclimation of seedlings, removal, and collection of macro-epiphytes, strengthening of main lines, culture lines, anchors, disinfection of cultivation ropes, etc.," she said.

She further said that another innovation is needed to shift from shallow water to deeper waters of farming during the lowest tide especially during this global climate change time though the latter cultural system entails higher investments than the former.

She underlined that the use of fast-growing cultivars like different strains and morphotypes of Kappaphycus is another innovation. The shift from traditional ways of tying seedlings using non-biodegradable soft plastic 'tie-tie' to a more eco-friendly and efficient techniques like the use of soft rope-like polypropylene as loops and tubular nets are highly advisable.

She drew attention to another innovation i.e. to use of micropropagated propagules developed from tissue culture techniques. These new and improved cultivars developed from tissue culture techniques are more fast-growing and resilient to abiotic stresses which make the seaweed more resistant to pests and diseases infestations.

She shared that another innovation is to shift from a monocrop culture system to integrated multi-trophic aquaculture which is more eco-friendly and economically profitable.

She said that IMTA is the aquaculture of fed organisms like finfish or shrimp which combines with the culture of organisms that extract either dissolved inorganic nutrients like the seaweeds or particular organic matter like the shellfish.

Summarizing her presentation, she said that a sustainable industry involves the interrelationship of social and economic aspects to be equitable. Social and environmental aspects have to be bearable and economic and environmental to be viable. A warm and strong harmonious relationship among all the stakeholders of the civic value chain is imperative as the farmer is the very heart of the industry. He/she needs financial support and training from the government, the Seaweed industry association, the academia and research centers for the latest technology developed from R&D and innovations.

Dr Yugraj Singh Yadava
Director, Bay of Bengal Programme Inter-Governmental Organisation

Dr Yugraj Singh Yadava, Director, Bay of Bengal Programme, Inter-Governmental Organisation (BOBP-IGO) made a presentation on "Seaweed Farming for Industrial Applications: A Value Chain Approach". In his presentation, he highlighted the global scenario on seaweed production. Dr Yadava said that the global seaweed production had reached 33 million tons in 2018, from about 21 million tons in 2010. About 97 percent of the production is farmed and only 3 percent is harvested from nature. The average annual growth of seaweed production is about 4 percent. Japanese kelp, Eucheuma, and Gracilaria are the top species and together, they constitute 70 percent of the seaweed production. The major producer countries are China, Indonesia and the Republic of Korea and their contribution amounts to about 87 percent of the global production. "Nowadays, the use of seaweed is booming. In 2017, globally, 0.48 million tons of seaweed valued at USD 880 million were exported. Indonesia led the global export with a 21 percent market share, followed by Chile (9%) and Ireland (7%). Most traded commodities are the lever, agar, red seaweeds, and *Undaria pinnatifida* (brown algae)," said Dr Yadava.

Describing the seaweed production scenario in India, Dr Yadava said that in 2018 the seaweed production was around 26,000 tons. In contrast to the global trend, only 15 percent of seaweed is farmed in India. Green seaweed makes 51 percent of the production and red seaweed is the major farmed species. The production remains more or less concentrated on the coasts of Tamil Nadu and Gujarat. He informed that the Department of Fisheries, Government of India is now promoting seaweed business through its flagship programme, The Pradhan Mantri Matsya Sampada Yojana (PMMSY).

Dr Yadava further explained the different industrial applications of seaweed. Focussing on the Hydrocolloids, which constitute agar, alginates and carrageenan, he said that two key grades of agar are produced from either gelidium or gracilaria seaweeds. The use of gelidium agar is focused on the pharma-bacteriological plates although there is some use also in food. Gracilaria agar is mainly used in food and is often sold as a single ingredient for home use in Asia. The second use of seaweed is alginate. sodium alginate and propylene glycol alginate (PGA)

are widely used in food and industrial applications. The calcium gelling reaction is used in many food applications, the classic of which is the red pimento strip in green olives. Sodium alginate is also used as a thickener in sauces, syrups and toppings for ice cream. Carrageenan, the third industrial application is extracted from the red edible seaweeds. It is widely used in the food industry for its gelling, thickening, and stabilizing properties. Its main application is in dairy and meat products, due to its strong binding to food proteins.

Projecting the demand for seaweed products in India, Dr Yadava said that the demand is growing both in domestic consumption and also in exports. India is a net importer of seaweed products and the unit value of seaweed products imported is usually higher than the exported products. To sum up, there is a scope in the domestic market both for increasing production and also in value addition.

Dr Yadava said that the growth in downstream sectors is one in the pharmaceuticals and the Indian pharmaceuticals sector supply over 50 percent of the global demand for various vaccines. He said that the 'Pharma Vision 2020' of the Department of Pharmaceuticals, Government of India aims to make India a major hub for end-to-end drug discovery. India also plans to set up an approximately Rs.1 lakh crore (US $ 1.3 billion) fund to provide a boost to companies to manufacture pharmaceutical ingredients domestically by 2023. Second, the Indian food processing industry, one of the largest industries in India, accounts for 32 percent of the country's total food market and is ranked fifth in terms of production, consumption, export and expected growth. The Ministry of Food Processing Industries is making all efforts to encourage investments in the business. Third, as cosmeceutical, the Indian cosmetics products market is projected to grow at a CAGR of 4.23 percent during the period 2020-2025. Globally, the cruelty-free (no animal testing), vegetarian, and vegan (no animal ingredients at all) beauty market has exploded in recent years and is finding its space in the Indian market too. Dr Yadava also presented the value chain of seaweed, from crop to solutions to end uses.

On the scope for cooperatives in seaweed entrepreneurship, Dr Yadava said that at the farming and harvesting level, seaweed is a labour-intensive activity, which though decreases but also remains substantial at the washing, grading, and drying stages. A low level of technology is required for the initial processing of seaweeds. Through community entrepreneurship, the above three stages can be brought under the production sphere of the cooperative.

Presenting the roadmap for the seaweed business, Dr Yadava said that presently the seaweed farming is receiving global attention with projected growth in the upstream industries and the domestic demand is likely to increase. "There is a scope of rural entrepreneurship in seaweed farming through cooperatives. However, a cooperative focusing only on production and drying is unlikely to make enough money to grow. Entrepreneurship will be on internalizing as much of the value chain as possible. At the same time, a clear Government policy will be required that inter alia covers identification of suitable areas, forward and backward link

ages, market intelligence, knowledge, and capacity building of stakeholders at different levels, and finally access to finance," said Dr Yadava.

Dr. Atul Patne, IAS
Commissioner Fisheries, Government of Maharashtra

Dr. Atul Patne spoke about Seaweed business prospects in Maharashtra with aims to create livelihood opportunities for coastal populations, to provide an alternate source of income for fishers, especially during the fishing ban period, to meet the industrial demand for manufacturing of Agar, Agarose, Carrageenan, and Alginates from Seaweeds. Advocating for mass production of seed material for commercialization of the Seaweed culture and conserving natural resources, Patne suggested that fisherwomen, who are primarily into fresh fish trading, can also explore Seaweed as a lucrative business prospect. In Maharashtra, fisher folks have not yet started Seaweed culture due to unavailability of seeds and unidentified potential sites.

He further said about the potential areas in Maharashtra for implementation of Seaweed farming.

Maharashtra has a 720-km coastline comprising 7 coastal districts. 2 Taluka's from 4 coastal districts are primarily selected for Seaweed cultivation in coordination with UNDP. Department of Fisheres, Maharashtra is planning to conduct awareness programs for an alternative source of income for livelihood & sustainable development. Surveys for the selection of suitable sites to cultivate Seaweed need to be carried out by Central Fisheries Organizations/ Institutes immediately on priority, informed Dr. Patne.

Sharing an action plan for the promotion of Seaweed business in Maharashtra, he said that through the PMMSY scheme 10-20% of fisherwomen of selected coastal villages need to be involved in Seaweed culture resulting in a fixed income source. He informed that for the financial year 2020-21, NFDB has approved 2000 rafts and 800 monolines for Seaweed cultivation, planning awareness & training programs.

Fisheries Department of Maharashtra will arrange for seed availability through research centers like CSMCRI, (Central Salt and Marine Chemical Research Institute), Bhavnagar. Department will arrange pre & post-harvest/ processing, channelize through the buyer-producer meet.

He also said that in India economically important Seaweed are mainly *Gracilaria edulis, G. dura, G. debilis Kappaphycus alvarezii Sargassum spp., Turbinaria spp*. etc. He also spoke about various industrial applications of seaweed such as Agar/Agarose in gel-forming agent, used to make clear noodles in Japan, binder for medical tablets and capsules, molecular and microbiological application. Carrageenan is used in creaminess to dessert, thickening agent in dairy products, salad dressings, emulsifier in the pharmaceuticals, pet food. Alginates are applied in animal food, textile printing, dental impressions, emulsifier in the pharmaceuticals, etc.

He concluded his presentation by suggesting a plan to promote Seaweed business in Maharashtra by surveying suitable sites to cultivate seaweed by Central Fisheries Organisation/Institutes immediately to fulfill seed requirements of the seed bank. He also suggested that facilitation centers should be run by expert institutes like CSIR-CSMCRI (Central Salt and Marine Chemical Research Institute), Bhavnagar and Central Marine Fisheries Research Institute (CMFRI) and also through Fish Farmers Producer Organization (FFPOs). The Central Government needs to channelize the buy-back intervention policy to encourage Seaweed culture, he added.

Mr. R. Govindrajan,
Head R&D, Zydus Wellness Ltd, India,

Mr. R. Govindrajan talked about the application of Seaweeds in the pharmaceuticals industries. He spoke from a user's perceptive. Most of the users of pharmaceutical products don't know that it contains Seaweed carrageenan agar. For example, he said, a microbiology lab cannot run without the agar medium today. Most of the tablets in the market today have alginates, carrageenan, and a thickener or starch derived from the Seaweed. Majorly, Seaweeds are used for manufacturing colloids like agar, algin, and carrageenan which are used in food, chemical, and pharmaceutical industries. Recently, a lot of pharmacological activity is seen as Seaweeds have medicinal properties qualifying for the nutritional industry. Seaweeds are rich in protein, vitamins, and minerals.

In India, there are 720 species of which 60 are commercially important Seaweeds. They occur abundantly along the coasts of Tamil Nadu, Gujarat, Lakshadweep, and Andaman-Nicobar Islands. Speaking about Seaweed's use in food technology, he said agar is used as a gelling and thickening agent for confectionery and bakery industries, as a stabilizer for the preparation of cheese, and salad dressings. It is also used as a clarifying agent for liquors. In the pharmaceutical industry, it is used as a laxative for constipation. It is also used in cosmetic industries and textile industries.

Alginate is used as emulsifiers in the pharmaceutical industry. It is a blood-clotting agent and also used as jellies for saturation in the stomach, also used as sodium alginate as emulsions in the toothpaste industry and shaving creams etc. Alginates are also used as denture moldings. Carrageenan is majorly used as pharmaceutical aids. It is used as an anti-inflammatory agent. In terms of pharmaceutical use, they have used pigments, like carotenoids, as a source of Polyunsaturated Fatty Acids (PUFA) especially, as DHA. PUFA is a vegetarian source of Fatty Acids. It is also used as Vitamins, antioxidants, and toxic products proteins, etc. In terms of Biotechnological applications, algae species like Spirulina platensis, Chlorella Vulgaris, Haematococcus pluvialis, odontella aurita, among others are widely available.

Apart from nutritional support, Seaweed is also used against various biological diseases like antimicrobial, antiviral, antifungal, antiallergic, etc. Given the Covid-19 pandemic, sulfated polysaccharides from red algae show antiviral activities towards viruses responsible for human infectious diseases. Fucoidan has potent antiviral properties towards viruses like RSV, HIV, and human cytomegalovirus. Other pharmacology property report includes antioxidant activities, it controls heart diseases, anti-inflammatory, anti-cancer, anti-diabetic, anti-viral, anti-ulcer and goiter treatment.

He summed up by saying that in food and medical applications and bioactive properties Seaweeds are found to be having some immunomodulation and antibiotic activities as well. Among the marketed products includes Life Extension Optimized Fucoidan, Organic Chlorella the daily detox, Seaweed Freeze-dried supplements, etc.

Dr. Suseela Mathew,
Principal Scientist, Head of Division, Biochemistry & Nutrition,
ICAR-Central Institute of Fisheries Technology (CIFT), Cochin, India

Dr. Suseela Mathew explained about Seaweed-based functional foods business models from ICAR-CIFT.

Among the marine organisms, seaweeds represent one of the richest sources of bioactive molecules with a reported lot of health benefits. Under its bioactivities, it finds immense applications in the field of biomedical, nutraceutical, aquaculture, cosmetics, etc. It has fostered the cultivation of seaweeds by manyfold, she said.
She also highlighted the global seaweed scenario. Currently, Seaweed production is 30 million tons with 95% of production from culture while the remaining 5% coming from natural beds. The top seven countries that account for the global production of seaweeds are China, Japan, Korea, Indonesia, Philippines, Malaysia, and Vietnam. In India, we are not using

seaweeds for food because we don't relish their taste; hence seaweeds are utilized mostly for hydrocolloid production mainly for Agar, Agarose, Carrageenan, and Alginates, etc. The potential of seaweeds as a source of nutraceuticals remains greatly underexplored - especially on a commercial basis. Culture is being done in Gujarat and Tamil Nadu. A total of 366 seaweed species are used, the important ones being *Gracilaria edulis*, *G. dura*, *G. debilis* *Kappaphycus alvarezii*, *Sargassum spp.*, *Turbinaria spp*. etc. Every year there is an increase in global seaweed production through culture but the wild collection is almost stagnant over the years. Among the different continents, Asia ranks first and among countries, China tops in production. Among active compounds from seaweeds, many compounds are very important like Sulphated polysaccharides gain importance because of their antioxidant, anti-tumor, and other properties. Seaweeds are generally good for health as they contain proteins having essential amino acids. Seaweed contains polyunsaturated fatty acids including omega-3 and omega-6 fatty acids in good amount. It also contains a good amount of polyphenols, sterols, and pigments especially fucoxanthin which are good anti-oxidants, good anti-fungal, anti-microbial, reduces cholesterol, etc.

She also highlighted about biochemical composition of Seaweeds. To create a database on the biochemical composition of Seaweeds lot of research work has to be done. The most important molecule is Fucoidan which gained much attention these days. It is a natural sulfated polysaccharide extracted from the extracellular matrix of brown seaweed and it is reported to have anti-viral, anti-tumor, anti-inflammatory, anti-oxidant, and anti-bacterial properties. Another important compound is Fucoxanthin - its main carotenoid in marine brown algae, with properties like anti-cancer, anti-diabetic, anti-obesity, anti-tumor, anti-inflammatory, anti-oxidant and hepatoprotective activities as well as cardiovascular and cerebrovascular protective effects which further increased its demand.

India is producing 5.3% of global production i.e., 25000 tons, and a lot has to be done to increase the production of Seaweed.

Presenting a brief overview of the industrial utilization of Seaweed, she said that alginate, agar, and carrageenan are being used as thickening agents and hydrocolloids. Globally, 10 metric tons of Seaweed are harvested for hydrocolloid production. In India, its production is not that much. Recently, ICAR-Central Institute of Fisheries Technology, Cochin has undertaken intensive research on seaweed and focus is on nutrient profiling of Seaweeds, extraction, and characterization of bioactive compounds from Seaweeds, the establishment of their bioactivities using animal model studies, development of seaweed-based nutraceuticals, and other products.

She also briefed about the Agri-business incubation (ABI) center located at ICAR-CIFT, Cochin. CIFT transfers the technology through the agribusiness incubation center. Any entrepreneur can come and incubate here. During the first or second year, they will incubate in an incubation center and along with the scientists, the entrepreneur will also work to bring out the technology, and finally, when the technology is matured enough, they will start their enterprises. In the past few years, nearly 50 technologies have been transferred by CIFT.

She informed that recently, ICAR-CIFT has transferred technology for 7 Seaweed-based nutraceuticals (functional foods) developed by ICAR-CIFT like CIFTEQ Fucoidan: It is a freeze-dried dietary supplement from brown seaweed enriched in Fucoidan and micronutrients. A process using green chemistry principles has been developed for the extraction of bioactive polysaccharide Fucoidan from brown Seaweed with high yield. This product has been completely characterized using advanced chromatographic and mass spectrometric techniques in terms of its content of fucoidan, essential microelements such as Zinc, Iron, and Calcium, water-soluble vitamins, amino acids, brown pigment fucoxanthin, and taurine. This product has been licensed to M/s. Amalgam Foods Pvt. Ltd. The nutraceuticals like FucoidanExt, FucoTeaExt, Seaweed NutriDrink, Seaweed Cookies, Seaweed Yoghurt, Seaweed Sanitizer are some of the promising seaweed-based products developed by ICAR-CIFT which have created tremendous impact in the sector; and the institute is still striving hard in its research endeavor to realize the immense nutritional potential of Seaweeds in the right direction to translate the vision of Hon'ble Prime Minister of India in the context of ushering in fruitful Blue Revolution.

She also informed about other products developed by ICAR-CIFT - ZAFORA Seaweed Hand Sanitizer, ZAFORA-360 Enriched Fucoidan Capsules, and ZAFORA Gargle which have an antiviral, nutritional, immune-modulatory effect. The ZAFORA Seaweed Hand Sanitizer containing the major ingredients like Isopropyl alcohol, Seaweed extracts Carrageenan, and Aloe vera extract can be a suitable alternative in the market as an immediate hygienic control to contain the spread of corona infection. Similarly, ZAFORA-360 enriched Fucoidan Capsules contains Fucoidan, a high-value sulfated polysaccharide having wide health benefits which include anti-inflammatory, anti-viral, and anti-cancer properties and can be used as an immune booster. Zafora Gargle is a homogenous blend of spices extracts, ayurvedic herbal extractives, and Fucoidan from Seaweeds, flavored with mint also proved to be very effective against Covid as it possesses antiviral and antibacterial properties.

She also informed that M/s Bodina Naturals Private Limited (BNPL) is now entering into the manufacturing and trade of Seaweed derivatives as one of its main activities in the future, so that the health benefits from Seaweed can be reaped by millions of people. She informed that Seaweed-based products developed by CIFT are also available online through www.ayurgifts.com. Recently, World Health Organization (WHO) has recognized the Seaweed publication of ICAR-CIFT to promote Seaweed as an immune remedy against COVID-19.

Dr. Raj Naresh Gopal and Mr. Patil Nilesh Suresh, Dy. Director and Assistant Director, NCDC, New Delhi, India

From NCDC, Dr. Raj Naresh Gopal and Mr. Patil Nilesh Suresh gave the closing presentation on "Scenario of Seaweed Business in India".

Dr. Gopal informed that India has now foused on Seaweed culture and its value chain. He highlighted the global scenario in the Seaweed business and said that even at the production level, Sseaweed production has effectively grown, more than 100% in the last 10 years, from 14.70 million tons to 30.40 million tons, during 2005-2015. As assessed by FAO, the Sea-weed business industry is worth more than USD 6 billion in revenue per year. There is a rising demand for the Seaweed business. The key players are various Fast Moving Consumer Good companies, different Research Organizations bringing in new technologies, various medicinal and cosmetics manufacturers, fertilizers companies, and many more. In the global scenario, it is obvious that the consumers are getting more aware of the benefits and use of Seaweed.
Hence, there is growing demand in the Seaweed business. The Seaweed business extract side is dominated by Europe and more than 80% of Seaweed production comes from China and Indonesia. The same region is Leading Exporters including Korea and the Philippines. The Main Importers are Japan and the United States of America. Within India, the main production areas are Tamil Nadu, Gujarat coasts, and its islands. Out of 844 species, only 221 are commercially important in this region. However, in 2020, the Seaweed production was not much, it was only 25,000 tons. Nevertheless, the opportunity indicated enhancing the income and large employment generating potential in India. The Opportunities come from a very large coastline of more than 8000 kilometers, with traditional marine fishing folk. There-fore, it will enhance the livelihood of fisher-folk communities, and also strengthen the contin-uous supply for Seaweed-based products & applications. It is, equally, important for environ-mental issues also as it is a major tool to treat coastal pollution and to capture Co2. The grow-ing consumer demand across domestic & international market is the main driving factor for the growth of Seaweed business. Therefore, the Government of India has now taken special focus as a catalyst, to promote Seaweed based business.

Shri Patil Nilesh Suresh shared the initiative taken by the Government of India to promote Seaweed cultivation in India. He mentioned that Pradhan Mantri Matsya Sampada Yojana (PMMSY) has emphasized the promotion of Seaweed cultivation. He elaborated on the challenges and opportunities in Seaweed businesses. He shared the "Seaweed Business Entrepreneurship Development Model" with participants. The model will dovetail the subsidy component from the Department of Fisheries, GoI while NCDC will give credit assistance by its capability of funding. This business model targets fisheries cooperative societies, FFPOs, and federated SHGs through State Government/UTs.

QUESTION & ANSWER SESSION

Prof. Krishna R. Salin, coordinator of this international webinar moderated the Question & Answer session.

Q1. Is it feasible to do Seaweed production in inland areas or indoor conditions?

Dr. Thierry Chopin: Yes. The practice is close to integrated multi-trophic aquaculture, i.e., aquaponics in the marine environment. Aquaponics follows the same principle as IMTA. Regarding the backwaters in Kerala and the coastal areas of other provinces in India, the influx of freshwater much more, and maybe instead of Seaweed, there is room to grow aquatic plants that we can grow in lower salinities or aquaponics systems.

Q2. How does the licensing system for Seaweed farming work in the public open water bodies in the coastal area of Canada?

Dr. Thierry Chopin: As we are trying to develop Seaweed aquaculture in Canada through integrated multi-trophic aquaculture, the main challenge is regulations. In Canada, most of the regulations in aquaculture are addressing salmon because 85-95% of aquaculture in Canada is salmon. India and other countries in the region should develop their licensing framework based on local priorities.

Q3. How do the production issues on leasing water bodies work in the Philippines?

Dr. Anicia Q Hurtado: In the Philippines, a permit from the local government is given only by hectares, and normally, one single Seaweed farmer can only farm one hectare.

Q4. How is the system in Vietnam?

Dr. Nguyen: It's quite similar to the Philippines. So, the land and the water services belong to the local government, and they can lend it to the farmer and use this data to decide how much they can hire. But the large companies can request a large area, and the local government may offer them a large area for specific production and terms of operation.

Q5. Is license given to individual farmers or even to cooperatives?

Dr. Nguyen: Both

Dr. Yadava: In India, the area between 0 to 12 nautical miles in the sea is within the jurisdiction of the coastal states and the Union Territories. Any approval or permission within this area has to come from the respective states and the UTs; but so far there is no clearcut policy on the allocation of the leasing. Ministry of Fisheries may consider bringing out a model policy that can be shared with the states and the UTs, and then the policy can be placed and put in operation.

Q6. How is the procurement strategy? Do you get enough material from the Indian coast that you procure for your products and how does it benefit the farmers? How do you motivate farmers to supply the raw material that you want?

Dr. Blossom: We get enough products from there, but we don't get it directly from the farmers but through an intermediary. I would try to get it directly from the farmers.

Ms Kavita: We procure directly from the farmers. Sargassum is widely available in the sea, so that is collected and easily available. There are a lot of challenges when it comes to cultivated seaweed, but sargassum which is just harvested from the sea, are widely available. We procure bamboo for the raft, we keep for the Sargassum, fisherfolk go out, we invest in their boats we do a lot of investment in the Mandapam area to help them and to make it a profitable venture. But Kappaphycus is affected by cyclones wherein the rafts get destroyed. Change in sea temperature, sea salinity which dipped to 15% this yeat, also affects the farming.

VOTE OF THANKS

Ms. INDERJEET KAUR,
Director, NCDC, New Delhi, India

In the end, Ms. Inderjeet Kaur from NCDC proposed the vote of thanks on behalf of the NCDC and expressed deep gratitude and thanks to Dr. Rajeev Ranjan, Secretary, Department of Fisheries, Government of India;, Mr. Manoj Joshi, Additional Secretary, Ministry of Food Processing Industries (MoFPI); Prof. Krishna R Salin, Hon. Director, NEDAC Bangkok, Thailand; Dr. Thierry Chopin, Prof. of Marine Biology, University of New Brunswick, Canada; Dr. US Awasthi, MD, IFFCO, India; Dr. Nguyen Van Nguyen, Deputy Director, Research Institute for Marine Fish, Vietnam; Dr. Anicia Q Hurtado, Senior Scientist, SEAFDEC, Aquaculture Department, Philippine; Dr. Yugraj Yadava, Director, Bay of Bengal Programme IGO, India; Dr. Atul Patne, Commissioner Fisheries, Government of Maharashtra, India; Dr. Suseela Mathew, Principal Scientist, ICAR-CIFT, India; Dr. Blossom Kochhar, Chair, Blossom Kochhar Group, India; Mr. Abhiram Seth, Aquaagri, India; Ms. Kavita Nehemiah, Snap Natural & Alginate, India.

She extended deep gratitude to Shri Sundeep Kumar Nayak, IAS, Managing Director; Col. Bikramjit Singh, Chief Director (LINAC); Dr. Raj Naresh Gopal, Deputy Director; and Shri Patil Nilesh Suresh, Assistant Director from NCDC for their unflinching support and encouragement to organize this international workshop. She also thanked Ms. Vanitha, CD MIS and MIS support team for providing technical assistance. She further congratulated all team members of the organizing committee for successfully organizing this international webinar. In the end, she thanked all the participants, who joined the webinar on 'Entrepreneurship Development through Seaweed Business by Cooperatives' on 28th January 2021.

ACTION PLAN

Action item and broad stratergy emerged from the workshop

Seaweed Farming	
Suggestion/ Recommendation	**Comments**
Seaweed sites	Identify ideal sites exclusively for Seaweed farming for each State/ UTs for socio-economic upliftment of the coastal community.
Seaweed farming method	Improve Seaweed farming methods: reduce recurring expenditure, develop off-shore farming methods.
Promote horizontal expansion of Seaweed farming	Pilot studies to be conducted and development to be made only in areas where the coastal villagers are interested to take up farming.
Sustainable Production of Seaweed	Seaweed mariculture is the only alternative towards steady supply of raw material and for sustainability, while the natural beds will be conserved. This has to be addressed through the Integrated Multitrophic Aquaculture (IMTA) programme along the Indian coast.
Climate Change and its resultant sea level rise	In the context of Climate Change and its resultant sea level rise, estuaries are expected to be inundated with seawater and more and more protected bays and estuaries can be brought under Seaweed cultivation. Brackishwater species of Seaweeds if any, can be considered for large scale cultivation.
Large scale cultivation of Seaweeds for industrial requirements	It can be encouraged for mitigating ocean acidification and can offer livelihood support to many coastal fisherfolks. Creating awareness through socio-economic interventions can bring in more benefits.
Availability of seed stock	It is the major deciding factor for making commercial cultivation more viable. Hence, the stock improvement and seed production technology can be attempted through biotechnological interventions. Natural seed banks can also be created either in ponds or in suitable sub-tidal regions.
Introduction of new strains	Kappaphycus and other commercially important Seaweeds such as Gracilaria NBr-10, fast growing red Seaweed from subtropical climatic zones.
Explore planting material	Explore import/introduction of planting material both to reinvigorate and diversify the cultivars following all legal formalities.
Commercial farming	Commercial farming of unconventional agarophytes such as Gracilaria dura and G. debilis (Gracilariaceae, Rhodophyta) and their value addition through linkage with industrial partners.
Steady supply of raw material	To ensure steady supply of raw materials, high priority to be accorded for large scale mariculture.

Seaweed Resources and Exploitation

SL No.	Suggestion/ Recommendation	Comments
1.	Study to revise Seaweed biomass	Undertake study to revise Seaweed biomass estimates for commercially important Seaweed resources.
2.	GIS mapping	A GIS map indicating the biomass for harvest along the Indian coast is very much essential.
3.	Scientific and improved Seaweed collection methods	Encourage proper scientific and improved Seaweed collection methods for profitability and sustainability, while avoiding overharvest, destruction of habitat and harvest of immature Seaweeds.
4.	Seaweed harvest calendar	Develop Seaweed harvest calendar for each region.
5.	Seaweed database	Annual data on Seaweed resources exploited, edible products and other products to be maintained and documented.
6.	Study	Identify reasons for decline and methods for repopulation.
7.	Stress resistant strain	Identify stress resistant strains from natural environment and also develop stress resistant strains of cultivable species.

Utilization

SL No.	Suggestion/ Recommendation	Comments
1.	Value addition and post-harvest technology	Utilization of Seaweed and Seaweed products, their value addition and post-harvest technology are to be addressed with major thrust.
2.	Utilization of spent biomass	Programmes on utilization of spent biomass of Seaweed industries for manure, biodiesel production etc. should be strengthened.
3.	Biomass sources for biofuel production	Seaweeds are regarded as highly potential biomass sources for quality biofuel production due to their rapid multiplication and growth rate (8-10 times faster) compared to terrestrial and aquatic higher plants. Farming of marine algae is a green technology without the involvement of energy, fertilizers and chemical inputs; and is not a labour intensive avocation.
4.	Ocean acidification	Large scale mariculture of marine algae can definitely check ocean acidification considerably. It is estimated that 3% of world's coastal waters with Seaweeds grown, would produce 230 billion litres of ethanol.

5.	Bioethanol production	As majority of Seaweeds lack lignin and pectin on their cell walls, their breakdown and fermentation can be hastened and enhanced by the involvement of suitable microbes (Bacillus spp; Vibrio splendidusetc). The bioethanol thus produced from seaweeds can be blended with petrol. The energy content of algal biomass is roughly 4700 kcal/kg compared to the energy value of coal (3600-4200 kcal/kg).
6.	New Seaweed species	For functional foods and bioactive secondary metabolites, search for new seaweed species are to be strengthened.

Policy		
SL No.	**Suggestion/ Recommendation**	**Comments**
1.	Seaweed based Bio-stimulant	Seaweed based bio-stimulants for use in agriculture should be duly notified as agricultural inputs by the Ministry of Agriculture and Farmers' Welfare.
2.	Standards for use of Carrageenan	Food Safety and Standards Authority of India (FSSAI) may be requested to harmonize Indian Standards for use of carrageenan as a food additive in line with the CODEX standards.
3.	Single window system	Adopt single window system in the form of a Nodal Cell for Seaweed cultivation, processing and marketing to be set up under the Department of Fisheries, GoI similar to the Bureau of Aquatic Products as in China, Philippines and Indonesia.
4.	Export of red seaweed	Explore the possibilities of lifting restriction on export of farmed red Seaweeds. Anomaly in classification of agar, algin and carageenan under the Central Excise and Customs tariff requires to be rectified.
5.	Clearance for use of coastal waters	Clearance for use of specific coastal waters should be obtained for Seaweed farming from Coastal Zone Management Authorities.
6.	Agricultural produce	Cultivation of Seaweeds and the harvested (wet/dry) Seaweeds shall be treated respectively as agricultural cultivation and agricultural produces for the purpose of fiscal levies.
7.	Encourage the Seaweed cultivation	Seaweed cultivation should be encouraged and undertaken all over the Indian coasts as seaweed cultivation is ecologically safe and green technology helps sequester CO2 levels and thus check ocean acidification.
8.	Mariculture in phased manner	For the production and marketing of value added products raw material exploitation from the natural beds should not be encouraged and the raw material requirement should be met from mariculture at least in a phased manner or limited the cast ashore materials.

9.	Harvesting from natural bed should be restrictive	Harvesting of Seaweeds from natural beds to be regulated by fixing quota system and restricted during post-reproductive stage (after completing the spore liberation) to ensure and enhance natural stock.
10.	Regulation for natural beds	Harvesting Seaweeds from the natural beds should be regulated in such a way that this process should not spoil the habitat.

Policy		
SL No.	**Suggestion/ Recommendation**	**Comments**
1.	Integrated Multi Trophic Aquaculture (IMTA)	Integrated Multi Trophic Aquaculture (IMTA) – further refining for areas with high tidal amplitudes and horizontal expansion.
2.	Documentation of Seaweed Resources	Integrated taxonomic approaches for documenting the Seaweed resources of India.
3.	High yielding strains of Seaweed	Development of stress resistant and genetically improved high yielding strains of commercially important seaweeds for improving livelihood options of coastal communities.
4.	Molecules from marine algae	Bio prospecting of novel molecules from marine algae of native origin for industrial and health applications.
5.	All India Coordinated Research Project	For more livelihood opportunities, better utilization of Seaweeds and to increase national production, linkages between researchers, farmers and industries must be strengthened through an All India Coordinated Research Project on Seaweeds.

WORKSHOP ON -

"ENTREPRENEURSHIP DEVELOPMENT THROUGH SEAWEED CULTIVATION"

CONCEPT PAPER

INTRODUCTION

India has a coastal line of around 7,500 km which can be potential seaweed farming zones. The required manpower for the seaweed farming and processing can be met considerably from the fishermen communities, which are vulnerable to climate changes, thereby can enhance their livelihoods. Seaweed farming and its associated preliminary processing can be taken in village or community levels as a strategy of adaptability and resilience in the context of climate change. India has 14500 km of navigable waterways. Utilizing these natural advantages for Seaweed cultivation could have several advantages for India.

Seaweed does not require any fresh water, arable land and nutritional inputs. As water scarcity is emerging as an important challenge in the country, this has relevance for the country. World Bank predicts that achieving a global production of 500 million tons of Seaweed by 2050 would absorb 10 million tons of nitrogen, which is 30% of the nitrogen estimated to enter in the ocean. Seaweed can also absorb 15 million tons of phosphorous, which is 33% of the total phosphorous reached to the ocean by runoff.

The Seaweeds are macroscopic/macrophytic algae, a primitive type of plants lacking true roots, stems and leaves. Seaweeds grow in the marine and shallow coastal and brackish waters, and lack root system and conducting tissues like land plants. Four groups of seaweeds are recognized according to their pigments that absorb light of particular wave lengths and give them their colours of green algae (900 species), blue algae, brown algae(1500 species) and red algae (4000 species). The greatest variety of red seaweeds is found in subtropical and tropical waters, while brown seaweeds are more common in cooler and temperate waters.

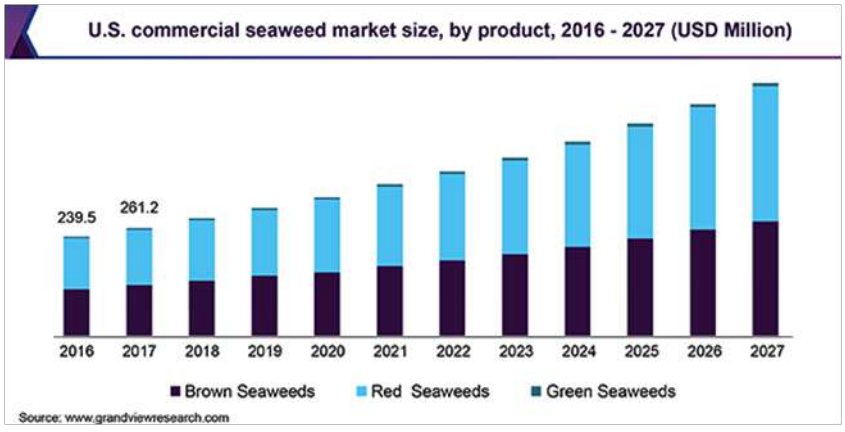
Seaweeds (macro algae) are wonder plants of the sea, the new renewable source of food, energy, chemicals and medicines with manifold nutritional, industrial, biomedical, agriculture and personal care applications. Seaweeds are also termed as the 'Medical Food of the 21st Century' due to its use as laxatives, for making pharmaceutical capsules, in treatment of goiter, cancer, bone-replacement therapy and in cardiovascular surgeries.

The major industrial applications of seaweeds in India are as a source of agar, agarose and carrageenan used in laboratories, pharmaceuticals, cosmetics, cardboard, paper, paint and processed foods. There are 46 seaweed-based industries, 21 for Agar and 25 for Alginate production, but they are not functioning upto their rated capacity, due to short-supply of raw materials.

GLOBAL SCENARIO OF SEAWEED PRODUCTION

Seaweed resources available around the world include more than 1000 species, from which only hundred species are being commercially used. Apart from the natural sea weed beds, they are extensively farmed and traded mainly in several South East Asian countries. In 2012, only 33 countries and territories worldwide cultivated seaweed; but in 2015, as many as 50 countries reported the practice of seaweed aquaculture (FAO, 2016). Seaweed production has grown in output volume from 13.5 million tons in 1995 to just over 30 million tons in 2016. World Seaweed production showed *Kappaphycusalvarezii* and *Eucheumadenticulatum* together contribute 41% of total seaweed production, while *Saccharina japonica* contributes 29%, *Gracilaria spp*. 14%, *Porphyra spp*., 7% and *Undariapinnatifida* 9% of the total production.

The global commercial Seaweeds market size was calculated to be at USD 5.9 billion in 2019, and is anticipated to witness a CAGR (Compound Annual Growth Rate) of 9.1% over the forecast period. Technological developments in cultivating cultured Seaweed coupled with rising investments in application segments, including animal feed and agriculture, are likely to propel market growth in the coming years.



Increasing awareness pertaining to the health benefits of the product coupled with increasing demand for foods and snacks derived from commercial Seaweed is estimated to boost the human consumption application segment. The swelling demand for marine plant extracts, used as thickening and gelling agents in the cosmetic and food industries, is also likely to boost growth, primarily in North America and Europe.

The industry in the USA was valued at USD 311.4 million in 2019. It was the fastest-growing region in North America owing to the strong presence of application industries. The industry in the USA is anticipated to expand further due to increasing awareness regarding the application of the product in the pharmaceutical industry.

China and Indonesia are the largest Seaweed producers with over more than 80% of the world production in 2016. China produces mostly Saccharina japonica and Undariapinnatifida and to the lesser extent Gracilaria and Pyropia (FAO 2016). On the other hand, Indonesia produces mainly the carrageenophytes Kappaphycus and Eucheuma (FAO 2016). Philippines and Republic of Korea produce over 1 MT while the Democratic Republic of Korea, Japan, Malay-sia and Zanzibar produced over 1 lakh tons each.

Trade in aquatic plants increased from USD 60 million in 1976 to more than USD 1 billion in 2016. Indonesia, Chile and the Republic of Korea are the leading exporters. China, Japan and the United States of America are the lLeading importers in the Seaweed trade (FAO, 2018).

The key players in the global commercial seaweed market include CP Kelco, SeasolInternational, Chase Organics GB Ltd., Indigrow Ltd., Acadian Seaplants Ltd., Yan Cheng Hairui Food Food Co., Ltd., Algea, Pacific Harvest, Mara Seaweed, and Aquatic Chemicals. Global concern has been rising regarding the impact of climate change on seaweeoabunciance, distribution and quality. It is therefore, relevant and time to develop alternative production strategies.

GLOBAL SCENARIO OF SEAWEED PRODUCTION

- Remedy for non-availability of required quantity of Seaweeds for various uses.
- Provide occupation for the coastal people.
- Provide continuous supply of raw material for Seaweed based industry.
- Provide Seaweeds of uniform quality for use in industry.
- Conserve natural populations of concerned Seaweeds.
- Seaweed farming is an eco-friendly activity.
- Major tool to treat coastal pollution in the sea and reduce CO2 in global warming.

India has the potential and long coastline to become one among the players in Seaweed market that's projected to hit $26 billion globally by 2025. In India, Seaweed becomes strategic commodity in fisheries revitalization plan other than shrimp and tuna in the recent years though natural Seaweed collection has been the livelihood for the coastal fisherwomen for several decades especially in Gujarat and Tamil Nadu where the natural Seaweed resources are found. G. acerosa and G. edulis are being commercially harvested for agar production and Sargassum, and Turbinaria are harvested for alginate production since the early 1950s in India (Krishnamurthy, 1971). These algae are harvested from 20 islands and the mainland coast of Gulf of Mannar and Palk Bay, Southeast coast of India.

Some 844 species of Seaweeds have been reported from Indian seas, their standing stock is estimated to be about 58,715 tons (wet weight). Among them, 221 species are commercial-ly important and abundant along the Tamil Nadu and Gujarat coasts and around Lakshadweep and Andaman & Nicobar Islands. Rich Seaweed beds occur around Mumbai, Ratnagiri, Goa, Karwar, Varkala, Vizhinjam and Pulicat in Tamil Nadu & Andhra Pradesh and Chilka in Odisha.

NUTRITIONAL COMPOSITION OF SEAWEED

Most people unknowingly utilize Seaweed products daily in the form of processed food items like processed dairy, meat and fruit products and domestic commodities like paint, toothpaste, solid air refreshers, cosmetics etc. Seaweeds are excellent source of Vitamins A, B1, B12, C, D & E, riboflavin, niacin, pantothenic acid, folic acid as well as minerals such as Ca, P, Na, K. Their amino acid content is well balanced and contains all or most of the essential amino acids needed for life and health. They have more than 54 trace elements required for human body's physiological functions in quantities greatly exceeding vegetables and other land plants. These essential elements are chelated, colloidal, optimally balanced form hence they are bio-available.

WHY SEAWEED CULTIVATION ?

1. Seaweed farming creates promising business opportunities in developing countries by promoting rural communities, small family farms and women through cooperative model, while at the same time combating the environmental problems we face, such as overfishing and climate change. Ensuring that this green business stays afloat will have positive ripple effects for years to come.

2. Seaweed farming does not require buying land, fertilizer, pesticides, seeds, fresh water, or a multitude of expensive tools and equipment. The necessities for this business are sunlight, sea water, carbon dioxide, seaweed (which multiplies on its own and is 50 times more productive than corn), and sometimes a boat.

3. Seaweed farming is one of the few ways of life in developing countries that allows a certain level of flexibility. As a result, women can work in this business and gain an independent income without neglecting their traditional household work. In particular, Tanzania has seen women emerge as leaders in the Seaweed world, and they have even moved onto producing Seaweed flour in addition to farming.

4. Over the years, global fishing practices have become less and less sustainable, resulting in the decline of the global fish stock. Overfishing has become such a problem in our oceans that it is leading to the loss of species and entire ecosystems, which in turn will deprive the world of a rich food source that we depend on for economic, social and dietary reasons. In the coastal areas of this world where fishing is a main industry, the growing field of seaweed farming can offer a lucrative alternative. The fewer people are out for fishing, the less risk for overfishing.

5. Considered to be the trees of the sea, Seaweed can help negate the effects of climate change in our oceans, which has caused rising temperatures and increased levels of carbon dioxide in our waters. Seaweed does this by absorbing carbon dioxide in the water, and it can even absorb five times more CO2 than plants found on land.

6. In addition, unlike industries such as shrimp production, Seaweed growing has little negative effect on coasts and leaves shoreline ecosystems intact. In fact, seaweed can actually leave the coast cleaner than it was before, because it captures toxic chemicals, such as nitrogen from sewage and agricultural runoff.

ENTREPRENEURSHIP POTENTIAL FOR SEAWEED FARMING IN INDIA

- Seaweeds grow abundantly along the Tamil Nadu and Gujarat coasts and around Lakshadweep and Andaman and Nicobar islands. There are also rich Seaweed beds around Mumbai, Ratnagiri, Goa, Karwar, Varkala, Vizhinjam, Pulicat and Chilka (Odisha).

- Out of approximately 700 species of marine algae found in both inter-tidal and deep water regions of the Indian coast, nearly 60 species are commercially important.

- The surveys carried out by CSMCRI, CMFRI and other research organizations have revealed vast seaweed resources along the coastal belts of South India. On the West Coast, especially in the state of Gujarat, abundant seaweed resources are present on the intertidal and sub tidal regions.

- The Seaweed industry in India is mainly a cottage industry and is based only on the natural stock of agar-yielding red Seaweeds, such as Gelidiellaacerosa and Gracilaria edulis, and algin yielding brown Seaweeds species such as Sargassum and Tubineria.

  India produces 110-132 tons of dry agar annually utilizing about 880-1100 tons of dry agarophytes. Annual algin production is 360 to 540 tons from 3,600 to 5,400 tons dry alginophytes.

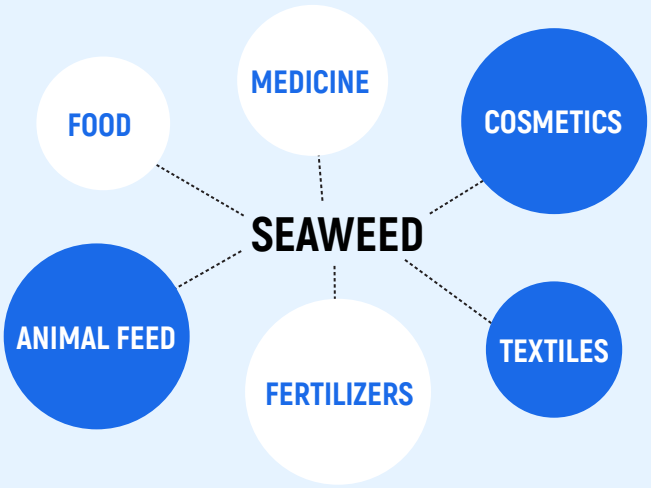
Seaweed farming has evolved into a successful commercial endeavour in a number of tropical countries endowed with clear, unpolluted intertidal environments and protected beach locations. In contrast to other forms of aquaculture, Seaweed farming has minimum capital and technological requirements and provides important economic opportunities to marginal coastal communities with limited livelihood options. India, with a lengthy coastline and a major coastal fisher population, is more suitable for Seaweed farming.

In India, 434 species of red Seaweeds, 194 species of brown Seaweeds and 216 species of green seaweeds are found in both inter-tidal and deep water regions (CMFRI, 1987). Out of these, nearly 60 species are commercially important. Agar yielding red seaweeds such as Gelidiellaacerosa and Gracilaia sp. are collected throughout the year while algin yielding brown algae such as Sargassum and Turbinaia are collected seasonally from August to January.

The Seaweed production potential in lndia is estimated at 1,005,000 ton distributed in six states of lndia (Modayil, 2004) comprising 250,000 tons in Gujarat; 250,000 tons in Tamil Nadu; 100,000 tons in Kerala; 100,000 tons in Andhra Pradesh, 5,000 tons in Maha-rashtra and 300,000 tons in Andaman and Nicobar Islands. However, a significant progress in organised Seaweed farming was not made till the beginning of the 21st century due to various reasons.

Besides, Seaweed industry has a potential export market mainly due to its diverse uses. It has been estimated that India can produce one million tons of dry sea weed providing employment to nearly 2 lakh fishers with an annual income of Rs 1 lakh per individual. The annual turnover of Kappaphycus alone is estimated as Rs 2 billion. Cooperatives backed by institutional and financial support led to the expansion of seaweed (Cooperatives/ Self Help Groups (SHG) model (mostly women). It is a potential employment generating and income earning activity to the coastal fisher women.

BUSINESS OPPORTUNITY FOR COOPERATIVES IN SEAWEED CULTIVATION



Applications of seaweed in various sectors/industries

- As a staple food in Japan and China. Seaweed is super-food full of protein, omega-3s, vitamins, minerals, fiber, calcium, iron and bioactive substances, and are called medical food of the 21st century.

- Provides valuable source of raw material for industries like health food, medicines, pharmaceuticals, textiles, fertilizers and animal feed.

- Used for production of Agar, Alginates and Carrageenan. Chemicals from brown seaweeds such as alginic acid, mannitol, laminarin, fucoidin and iodine are extracted on a commercial basis.

- Seaweeds are exported either in **raw form** (fresh or dried Seaweeds) or **processed form.**

- A soluble fiber from red Seaweed, **carrageenan** is used as a food stabilizer in organic foods, and it is a natural healthy food additive, replacing sugar or salt. It can even be used to produce vegan and kosher dietary supplements, such as fish oil, which we take for plenty of health benefits like supporting a healthy heart and brain.

- **Agar** (Agar can be a vegetarian substitute for gelatin, a thickener for soups, in fruit preserves, ice cream and other desserts, as a clarifying agent in brewing and for sizing paper and fabrics), **Algin** (Algin is used to make medicines), **Sodium Alginate** (It is used in many industries including food, animal food, fertilizers, textile printing and pharmaceuticals) can be produced from seaweed.

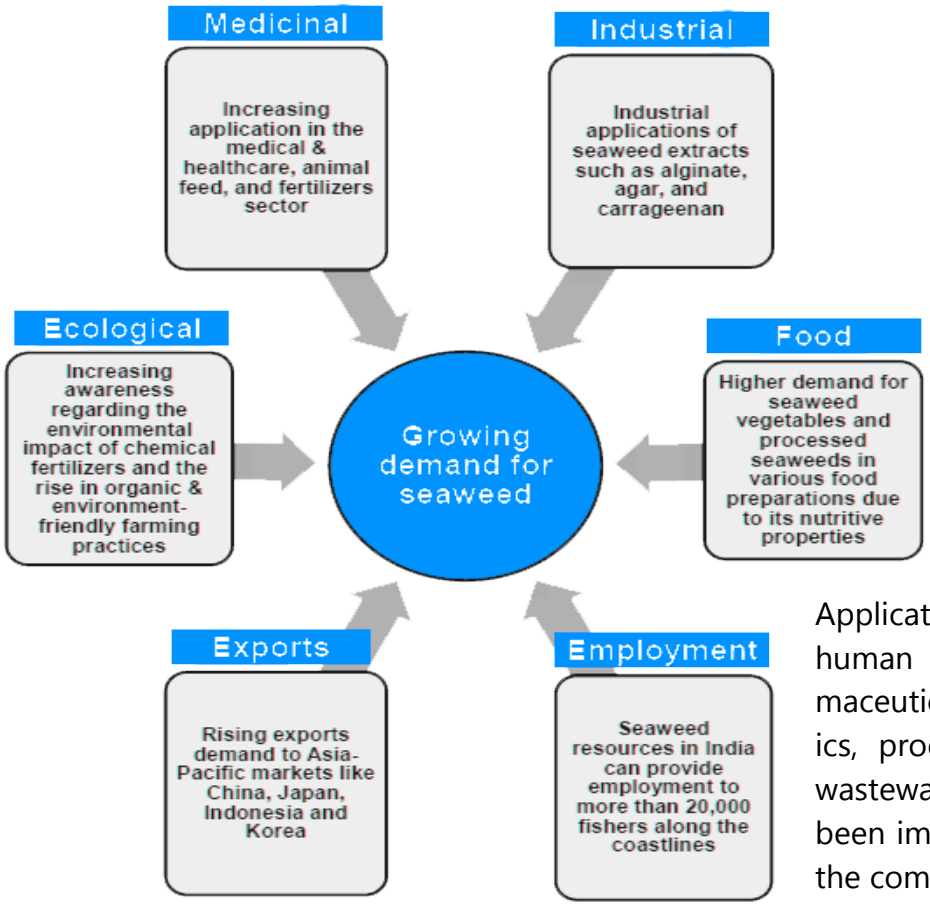
- Seaweed also can produce **Biostimulants** and benefits of Biostimulants are as follows.
- They can help farmers reduce the use of chemical fertilizers by **25-30 per cent**.
- When paired with organic farming, they can improve the yield by **15-20 per cent**.
- In the advent of a crop undergoing stress, through a delayed monsoon, for instance, the chances of survival or revival using biostimulants are **much higher**.
- Production of **hydrocolloid** – The main uses are thickening and gelling agent. As thickening agent, they find uses in soups, gravies, salad dressing, sauces and toppings; while as gelling agents, they are extensively used in products like jam, jelly, marmalade, restructured foods, and low sugar/calories gels.

SEAWEED PRODUCTION AND AREAS IN INDIA

Station No.	Area	Annual yield in tons (Fresh wt.)
I	Tamil Nadu	22,044
II	Gujarat	20,000
III	Maharashtra	20,000
IV	Lakshadweep Is.	8,000
V	Goa	2,000
VI	Kerala	1,000
VII	Unexplored areas	27,000
	Total	**100,044**

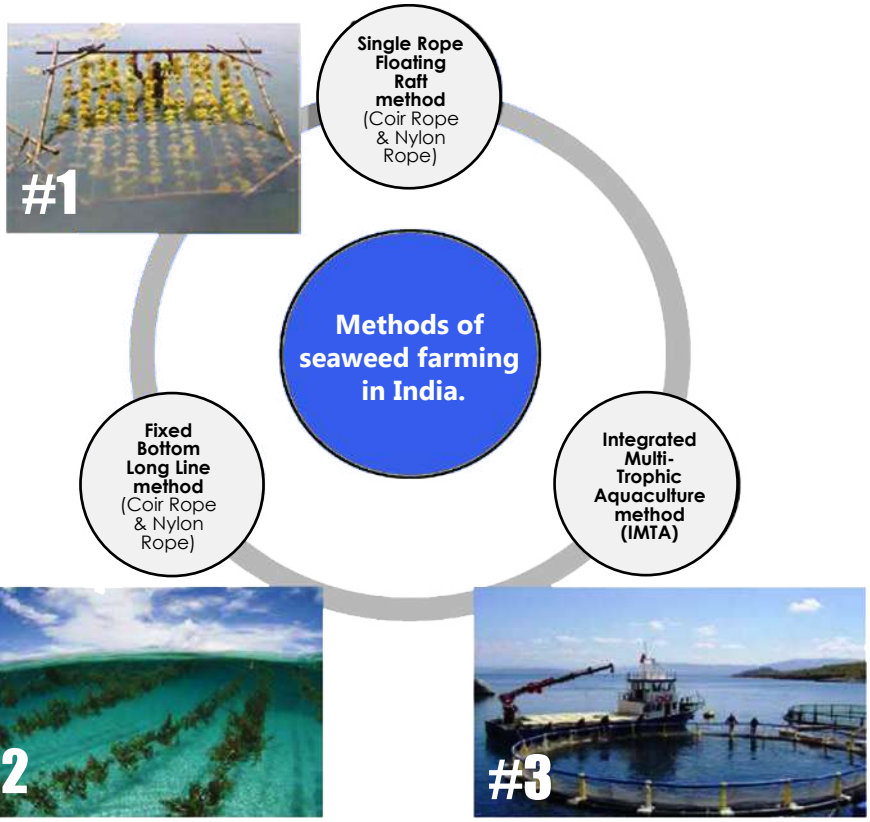
NEED FOR EXPANSION OF SEAWEED FARMING

- Seaweed farming provides alternative occupation with revenue generation for the coastal people.
- Culture of Seaweed helps prevent natural collection and conservation/sustenance of natural resources.
- Seaweed farming involves minimum technological and capital requirements.
- Grow out periods are short, normally lasting less than two months.
- Given these unique characteristics, Seaweed farming has generated substantial socio-economic benefits to marginalized coastal communities.
- Supplies raw material for Seaweed-based industry and has the potential to generate further socio-economic benefits to coastal communities in tropical regions.



Application of Seaweeds in human food, animal feed, pharmaceuticals, agriculture, cosmetics, production of bio-fuel, and wastewater management has been important for the growth of the commercial Seaweeds market.

METHODS OF SEAWEED FARMING IN INDIA



PROCESS OF CULTIVATION

Single Rope Floating Raft (SRFR) method developed by CSMCRI

1. Single Rope Floating Raft (SRFR) method developed by CSMCRI is suitable for culturing Seaweeds in wide area and greater depth.
2. A long polypropylene rope of 10 mm diameter is attached to 2 wooden stakes with 2 synthetic fiber anchor cables and kept afloat with synthetic floats. The length of the cable is twice the depth of the sea (3 to 4 m).
3. Each raft is kept afloat by means of 25-30 floats.
4. The cultivation rope (1 m long x 6 m diameter polypropylene) is hung with the floating rope. A stone is attached to the lower end of the cultivation rope to keep it in a vertical position.
5. Generally 10 fragments of Gracilaria edulis are inserted on each rope. The distance between two rafts is kept at 2 m.
6. Floating raft technology has been recommended to be used in certain areas in the Gulf of Kutch for deep-water Seaweed cultivation

PROCESS OF CULTIVATION

#1

Raft Preparation

#2

Tying Graft Seaweeds

#3

Moving The Raft To Sea

#4

Securing The Rafts

#5

Culture In Progress

#6

Sampling For Growth

#7

Harvested Raft

#8

Wet Seaweed

#9

Sun Drying Of Seaweed

CULTURE ECONOMICS OF SEAWEED FARMING (RAFT CULTURE - Kappaphycusspp)

The Kudumbam (family) model of cultivation (KMC) is a farming system initially introduced by PepsiCo and then widely adopted for Kappaphycus culture in Tamil Nadu. Cultivation is organized by members of a SHG (Self Help Group) who normally belong to the same family but may include other members from the same community. Collectively, the group prepares the rafts, seeds the lines, provides maintenance and harvests on the due date. Basic infrastructure is facilitated by the company, the harvest is purchased on a buyback basis and payments are effected by the company through the bank accounts of the SHG.

Total cost for seaweed culture for 5 members

Sl. No.	Description	Amount
1.	No. of Cooperative member / SHG-SIZE	5
2.	Cost of one Raft (Rs.)	1500
3.	No. of Raft per member	45
4.	Total No of raft for 5 members (5x45)	225
5.	Total cost for 225 rafts (225xRs1500)	337500
	Total	**337,500**

Total cost for seaweed culture for 5 members

Sl. No.	Description	Amount
1.	Total no. of rafts	225
2.	Harvesting period (Days)	45
3.	No. of rafts handling per day	5
4.	Total seaweed after harvest from 5 rafts (Kg) @ 260kg/raft	1300
5.	Total seed required for re-plantation of 5 rafts @ 60 kg/raft (in kg)	300
6.	Net produce from 5 raft deducting seed / day (in kg)	1000
7.	Dry weed obtained from 1000 kg of fresh weed (10:1 Dry ratio) (in kg)	100
6.	Dry weed produce in a month (100 X 25 days operation) (in kg)	2500
	Total	**337,500**

Monthly income of a 5-member group

Sl. No.	Description	Amount
1.	Cost of one kg dry weed (Rs)	38
2.	Gross monthly income / group (2500 kg XRs. 27.5/-)	95000
3.	Loan repayment-monthly EMI/GROUP (Rs 1900x5 members) inRs	9500
4.	Net monthly income / group (Rs 95000-Rs 9500)	85500
	Net monthly income / member (Rs.85,500/5)	**17100**

Earlier, the fisher women were getting Rs.5000 per month as income thorugh natural seaweed collection. After seaweed cultivation each fisher woman is getting Rs.17,100 per month on an average.

STATUTORY REQUIREMENTS FOR CULTIVATION AND COMMERCIAL UTILIZATION

Biological Diversity Act, 2002 regulates the access to biological resources which includes Seaweed for purpose of research/commercial utilization and thus, users need to seek prior approval of National Biodiversity Authority (NBA)/State Biodiversity Board (SBB) as per section 3/section 7 of the Biodiversity (BD) Act, as the case may be. Cultivation of Seaweeds does not fall within the ambit of Biological Diversity Act, 2002.

CHALLENGES IN SEAWEED CULTIVATION IN INDIA

- In India, Seaweeds are mainly used for extracting phycocolloids and the high cost of pond-produced seaweeds may not be profitable unless the harvested seaweeds are processed for multiple products e.g. biofuel, bio-stimulants, food, cosmetics and pharmaceuticals. Seaweed growers are receiving minimal prices for their harvested Seaweeds due to their sale to cottage-level industries for indigenous phycocolloid extraction.

- Seasonal dependency of Indian Seaweed culture represents a crucial challenge, which needs to be overcome. Monsoon (Southwest and Northeast monsoon) periods in India are associated with occasional occurrence of cyclones and typhoons and create high seawater turbulence and high tidal fluctuations.

- A major portion of the Indian coastline is exposed to the open sea and has high tidal amplitudes. Hence, R & D efforts need to develop culture systems which can withstand high water dynamics in open water areas.

- Seaweed farming in India revolves around only Kappaphycus sp. And there is scarcity of quality seed material for Kappaphycus cultivation in coastal areas and scarcity of quality seed materials of native species such as Gracilariadura, Gracilariadebilisespecially after monsoon rains.

- Limited extension services: Training and workshops and extension material for Seaweed Cultivation is not readily available, making it hard to train personnel in this field.

- Marketing constraint: Lack of awareness and information makes the Seaweed cultivators/ farmers depend on middlemen for the marketing of raw material.

- Financial constraint: Institutional Financial support is hard to avail in Seaweed Cultivation.

- Other challenges in Seaweed farming affecting crop productivity and quality are crop health issues such as high temperature impacts, diseases, epibionts and grazing pressures which rely on R&D efforts to reduce or eliminate.

KEY MANUFACTURER/EXPORTERS/WHOLESALE SUPPLIERS IN INDIA

- Sri LingeshwarAndavar (SHG).
- Aquaagri Processing (P) Ltd.
- Pssgt Export (P) Ltd.
- Parshv Chem. Industries.
- Mars Petcare Company (p) Ltd.
- Suboneyo Chemicals Pharmaceuticals (P) Ltd.
- Redox Industries Limited Darshan Bio Tech (P) Ltd.
- Aushadh Agri Science (P) Ltd.
- Sikko Industries Ltd.
- MigrowAgro Products (P) Ltd.
- Blue Clouds International Ltd.
- United Agro Chemicals (P) Ltd.
- Pruthvidhara Crop Care (P) Ltd.
- Gujarat Livelihood Promotion Company (GLPC)

POTENTIAL COLLABORATION OPPORTUNITIES

The potential collaboration would be between the investor and a research institute supported by various Cooperatives/Federations/self help groups and fishing communities present in the coastal region of India as important human resources. The potential collaborators may be:

- Marine Algal Research Center, CSMCRI
- ICAR-Central Marine Fisheries Research Institute (CMFRI),
- CSIR-Central Salt and Marine Chemicals Research Institute (CSMCRI)
- Aquaculture Foundation of India
- National Fisheries Development Board (NFDB)
- Department of Fisheries, Government of India

APPROVALS/INCENTIVES BY GOVERNMENT OF INDIA

Foreseeing the immense potential of Seaweed and byproduct Industry in India, the Pradhan Matri Matsya Sampada Yojana (PMMSY) has put forth a number of components under its various schemes for the development of Seaweed farming in the country with a total investment of **Rs 640 crore** mainly as subsidy support in the initial stage which is expected to deliver direct and indirect employment to about 10 lakh people in the next five years (2020-1 to 2024-25).

Under PMMSY, Seaweed farming will be promoted in a mission mode and supported through financial, marketing and logistical support to ensure income and welfare gains to small fisher population, especially women and fisherwomen headed households. Seaweed seed banks, nurseries, tissue culture units, processing and marketing units, etc. would be supported. The mission Seaweed culture integrates the following major components under PMMSY:

i. Genetic improvement programmes and Nucleus Breeding Centers (NBCs)

Under the central sector scheme sub-components of 'Genetic improvement programmes and Nucleus Breeding Centers (NBCs) of the PMMSY', genetic improvement programmes for Seaweeds will also be supported with 100% central funding.

ii. Fish data collection, fishers' survey and strengthening of fisheries database

The PMMSY envisages strengthening of fisheries database which includes survey and regular census of inland and marine fishermen, resource/fish stock assessment (including seaweeds), with 100% central assistance.

iii. Development of Seaweed cultivation

Under the centrally sponsored beneficiary oriented sub-component of the (PMMSY), 'Development of Marine Fisheries including Mari-culture and Seaweed cultivation', the following activities will be supported:

a) Establishment of Seaweed culture rafts including inputs (per raft).

b) Establishment of Seaweed culture with Monoline/tube net Method including inputs (one unit is approximately equal to 15 ropes of 25 m length)

For establishment of Seaweed culture (including inputs) for raft method, financial assistance of Rs.15,000 per raft with central share/subsidy of 40% i.e. Rs.6,000 for General category and 60% i.e. Rs.9,000 for ST/ST/Women beneficiary would be provided; and for monocline/tube net method, financial assistance of Rs. 8,000 per raft with central share/subsidy of 40% i.e. Rs.3,200 for General category and 60% i.e. Rs.4,800 for ST/ST/Women beneficiary would be provided under this scheme.

iv. Establishment of Brood Banks/ seed banks for seaweeds)

Under the centrally sponsored non-beneficiary oriented sub-component of (PMMSY), 'Enhancement of Fish Production and Productivity', Establishment of Brood Banks/seed banks for Seaweeds will be supported.

Source:https://www.thehindubusinessline.com/economy/agri-business/637-crore-for-a-new-beginning-for-seaweed-farming/article32124532.ece

INCENTIVES by NATIONAL FISHERIES DEVELPMENT BOARD (NFDB)

Analyzing the importance of Seaweed prospects, a meeting of the Parliamentary Consultative Committee of the Ministry of Agriculture & Farmers Welfare on **"Marine Fisheries-Mari Culture in India"** was held on 2nd July 2018 at Rameshwaram which was convened by the Government of India in coordination with the Tamil Nadu State Fisheries Department.

Consequent to this meet, an exclusive project proposal on **"Large scale cultivation of Seaweeds in coastal areas of Ramanathapuram District in Tamil Nadu"** requesting for a total project cost of Rs 200 lakh and Rs.25.50 lakh towards training of 1500 fisher women was sent to National Fisheries Development Board (NFDB). So far, NFDB has released Rs.36 lakh as first instalment out of 60% share and the state Government has sanctioned Rs.18 lakh out of 30% share. Till date, 750 fisherwomen have been provided hands on training on Seaweed culture (Kappaphycus 550 and Gracilaria 200) with the coordination of Central Salt Marine Chemical Research Institute (CSMCRI). The trained beneficiaries were formed into 170 clusters and cultures are in progress. Currently, 6800 rafts (2400 rafts for Gracillaria edulis and 4400 rafts for Kappaphycussp) have been provided to the fisherwomen. Production of 18 tons of Gracillariaedullis and 268 tons of Kappaphycussp have been achieved.

OBJECTIVES OF THE WORKSHOP

The overarching goal of the workshop on 'ENTREPRENEURSHIP DEVELOPMENT THROUGH SEAWEED CULTIVATION" was to bring various stakeholders on one stage and brainstorm the various possibilities for promotion of entrepreneurship in this sector through cooperatives.

At the same time, the workshop helped identify the bottlenecks at various levels and solutions thereof. The key beneficiaries of this workshop were the Seaweed farmers, budding entrepreneurs, youth, women and vulnerable communities. The workshop aimed at augmenting the awareness about Seaweed farming from a business point of view and also came up with an actionable, time bound plan which would contribute towards attaining the vision of 'Atmanirbhar Bharat'. Specifically, the workshop aimed at developing a model of commercial Seaweed Farming through a network of cooperatives.

The outline of the 120-minute long workshop in virtual mode:

A. Technical Sessions

i. Seaweed Farming: Scenario Analysis
ii. Production Systems and Best Management Practices
iii. Value additions
iv. Supply Chains
v. Role of Collectives (Cooperatives, SHGs and others)

B. Experience sharing

C. Way Forward

PARTICIPATION

Seaweed cultivators, Cooperative Societies/Federation entrepreneurs, youth, fisherwomen, vulnerable communities, scientists, technocrats, policy makers, processors, sellers, subject matter experts, academicians, supply chain players, development finance institutions, quality control institutions and the media, and other stakeholders.

International Webinar Entrepreneurship Development

Through

SEAWEED BUSINESS BY COOPERATIVES

28 January, 2021 Thursday at 10:30 AM (IST)

About Speakers

Sl. No.	Name	Brief Profile
1.	Lt Col Bikramjit Singh, Chief Director, LINAC-NCDC, India 	An army professional from Electronics and Mechanical Engineering with 24 years of experience in Defence Procurements, Project Management, Equipment Management, Client Management and Operations. He has worked in Ministry of Defence (Army HQs) with special focus an "Indigenous Development of Equipment of Import Origin based on Strategic Planning". He worked as an administrator in manpower planning, training and development, identifying training needs, conducting programmes and measuring its effectiveness in Army Training Institutes. Presently heading LINAC and is instrumental in conceptualizing, designing, developing, organizing and evaluating all types of training programmes for the training year 2020-21, he was at the forefront of organizing various training programmes for national as well as international participants. He has many awards and accolades to his name including the Chief of Army Staff Commendation card and General Officer Commanding in Chief Commendation card

2	Prof. Krishna R Salin, Hon. Director, NEDAC Bangkok, Thailand 	Dr. K. R. Salin is currently coordinating the Aquaculture and Aquatic Resources Management (AARM) Program of the Asian Institute of Technology (AIT), Thailand, as its Chair. He has been active in the aquaculture and seafood industry as an entrepreneur, researcher, and academic for over 24 years, working with various national and international organizations in Australia, Bangladesh, Cambodia, China, East Africa, India, Myanmar, Thailand, and Vietnam. He is an elected Director of the World Aquaculture Society (WAS) Asia Pacific Chapter and a Visiting Professor at the Shanghai Ocean University, China. The primary focus of the Sustainable Asian Aquaculture Platform he set up at AIT is to enhance farm productivity, quality, and safety by innovating smarter systems along the entire value chain. He also offers customized training programs to government, researchers, and the industry.
3	Mr. Sundeep Kumar Nayak, Managing Director, NCDC & Chairman, NEDAC, India 	Born to Mrs. Phullara Nayak and Mr. Srihari Nayak, Jammu & Kashmir cadre IAS officer Shri Sundeep Nayak grew up in Balasore, Odisha. His father was an Odisha cadre IAS officer; and mother was a Reader of Philosophy in Govt colleges of Odisha. Sundeep was educated at Ravenshaw College Cuttack, IIT Kharagpur, London School of Economics & Political Science, and Monterey Institute of International Studies California dabbling alongside with photography. He has also done short-term academic programs in national and international institutes of eminence that include the IIM Ahmedabad and the Goldman School of Public Policy, University of California, Berkeley. He has over 34 years of professional experience in private sector (Tata Steel), public sector (ONGC) and the State and the Central Governments. He is the Chairman of Indian Potash Limited, a major private sector player in the fertilizer space. His major assignments as a civil servant included Managing Director of the premier cooperative sector financing behemoth NCDC in the Government of India; Managing Director of the largest PSU in J&K, the State Power Generation Utility, Principal Secretary of Energy, Agriculture, Tourism Departments in J&K and as District Magistrate of two key Districts in Central Kashmir Valley, namely Srinagar and Budgam in the Nineties. He was also the Director of major companies like the NALCO, the MECL and the Hindustan Zinc Ltd. Under his leadership, the NCDC Team has scaled new heights in financing the cooperative sector enterprises of various sizes across the country. NCDC achieved phenomenal growth in turnover in FY 2017-18 clocking more than USD 4 billion. He has been the prime mover in formulating several new initiatives in the financing arena, the latest being Yuva Sahakar, the Entrepreneurship and Innovation Scheme of Financial Assistance for the Youth on a Start Up mode.
4	Dr. Rajeev Ranjan, Secretary, Department of Fisheries, India	Dr. Rajeev Ranjan, IAS is presently posted as Secretary (Fisheries), Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, a newly formed Department for ensuring focused sustainable and responsible holistic development of the Fisheries sector in India. He has a

		vast experience of working in various capacities in the field and policy making levels during the last 35 years in the Government. He has held many challenging and important assignments, particularly in the areas of developmental finance, commerce and industry, both in the Government of Tamil Nadu and Government of India. Previously he was holding the post of Special Secretary, Goods and Service Tax (GST) Council in the Department of Revenue, Ministry of Finance, and Government of India. Dr. Ranjan has also served as the Director in the Department of Industrial Policy and Promotion in the Ministry of Commerce and Industry, Government of India from 2000 to 2005. His significant contribution was in the modernization of Intellectual Property (IP) offices in the country as the Project In-charge and the various amendments to the Patent Act and revamping of the IP administration. He also worked as Chief (Joint Secretary Level) (from 2005-07) in the National Manufacturing Competitiveness Council (NMCC) and prepared the 'National Strategy for Manufacturing.' He is passionate about reforms and bringing about systematic changes in the organizations and improving Governance.
5	Mr. Manoj Joshi, Federal Additional Secreatry, MoFPI India 	Shri Manoj Joshi is a 1989 batch Kerala cadre IAS Officer. Presently, he is working in the M/o. Food Processing Industries, Govt. of India as Additional Secretary. He has earlier worked as Additional Chief Secretary (Finance), Kerala Government. He has done Bachelor's Degree in Mechanical Engineering from NIT, Jaipur and also done CFA and M.A. in Economics. He has worked as Joint Secretary at various Central Govt. Ministries like MSME, Finance, Commerce, Personnel, Public Grievances & Pensions, and also worked as Counsellor at Embassy of India, Washington DC. He has vast experience in various subjects during his tenure at various Ministries of Govt. of India and Kerala Government. Presently he is looking after the Mega Food Park Scheme and newly introduced Scheme called "Prime Minister Scheme for Formalization of Micro food processing Enterprises (PMFME)" as part of ***Aatmanirbhar Bharat Abhiyan,*** announced by Hon'ble Prime Minister for **Rs.10,000 crore** in five years as a Centrally sponsored Scheme in all the States and Union Territories. Another Scheme called "**Production-Linked Incentive Scheme (PLIS**) for Food Processing Industry with an outlay of **Rs.10,900 crore** is also going to be implemented under the supervision of Shri Manoj Joshi.

6	Dr. Thierry Chopin, Prof of Marine Biology, University of New Brunswick, Canada 	Dr. Thierry Chopin was born and educated in France. He obtained his Doctorate from the University of Western Brittany, Brest, France. He moved to Canada in 1989 and is presently Professor of Marine Biology at the University of New Brunswick in Saint John. Dr. Chopin's research focuses on the ecophysiology, biochemistry and cultivation of seaweeds of commercial value and the development of Integrated Multi-Trophic Aquaculture (IMTA) systems for environmental sustainability (nutrient biomitigation and other ecosystem services, and green technologies for improved ecosystem health), economic stability (improved output, product diversification, risk reduction and job creation in coastal communities) and societal acceptability (better management practices, improved regulatory governance and appreciation of differentiated and safe products). Dr.Chopin has published 151 refereed papers, 24 book chapters, 47 non-refereed publications, 428 abstracts (presented at 259 scientific meetings in 41 countries on 6 continents), 1 English/French DVD, 4 YouTube videos and has frequent contacts with the media (magazine articles, newspapers/radio/TV interviews and documentaries in 256 media in 42 countries). He has given 97 invited seminars in 14 countries. Dr. Chopin was, from 2010 to 2017, the Scientific Director of the Canadian Integrated Multi-Trophic Aquaculture Network (CIMTAN), an interdisciplinary strategic network of the Natural Sciences and Engineering Research Council of Canada (NSERC). He is the President of Chopin Coastal Health Solutions Inc. since 2016. Dr. Chopin is Past President of the Aquaculture Association of Canada, the Phycological Society of America and the International Seaweed Association. He is an advisor to the International Foundation for Science and a member of the Editorial Boards of the journals *Aquaculture International, Perspectives in Phycology, European Journal of Phycology,Journal of Applied Phycology, Aquatic Living Resources and Aquaculture Reports, and of the professional magazine Fish Farming International.* Dr. Chopin is the recipient of the NSERC Synergy Award for Innovation, the Aquaculture Association of Canada Research Award of Excellence, the New Brunswick BioSciences Achievement Award, the R3 (Research, Results, Recognition) Award of the New Brunswick Innovation Foundation and the Simply the Best Award of the UNB Associated Alumni.

7	Dr. US Awasthi, MD IFFCO, India 	Dr.Udai Shanker Awasthi (born on 12th July, 1945) is an Indian Technocrat, missionary of co-operative movement, environmentalist, Philanthropist and Managing Director of Indian Farmers Fertiliser Cooperative Ltd. (IFFCO) since February 1993. Born in Lal Ganj, District Rae Bareilly and brought up at Village Sathni, Unnao District of Uttar Pradesh, he graduated in Chemical Engineering from Banaras Hindu University in 1967. A true envoy of farmers & cooperative masses, he commands a leadership not merely in Indian Fertilizer Industry but is a respected name in Global fertilizer world. IFFCO, under his dynamic leadership, has achieved laurels, where 55 million farmer families are reaping the benefits of toil of Dr.Awasthi year after year for last two and half decades. He is the tallest corporate head and no less a cooperative leader, a rural economist, an accomplished technocrat and above all a leader for rural farmers. Under his visionary leadership, IFFCO ranks at 1st position in the list of Fortune India 500 companies (Fertilizer & Agrochem Category) in the country. IFFCO is at 8th position in the list of Business Standard (BS) 1000 companies. He is also on board of several other National and Global firms. Dr. U S Awasthi pursued a degree in Chemical Engineering during 1963-1967, from Banaras Hindu University, Varanasi.
8	Dr. Blossom Kochhar, Chair, Blossom Kochhar Group, India 	A clear visionary, way ahead of her time, Dr. Blossom Kochhar is the pioneer of aromatherapy in India and is globally recognised for her work. She is the Chairperson of Blossom Kochhar Group of Companies and her name is synonymous with successful brands – Blossom Kochhar Aroma Magic and Blossom Kochhar College of Creative Arts & Design (BKCCAD). With over 35 years of experience and a double doctorate in aromatherapy, she manufactures her own range of aromatherapy-based beauty products under the brand name 'Blossom Kochhar Aroma Magic' with her husband Colonel Kochhar. It is the first aromatherapy product line of the country and stands as an unparalleled leader in this segment for 25 years now. With over 200 products including skin care, hair care, body care, singular essential oils and exclusive blends, Blossom Kochhar Aroma Magic cosmetics include both the retail range and salon range. Her loyal customers include celebrities and Bollywood stars. Leading salons across the country use her salon range of aromatherapy treatments. She is a name to reckon with when it comes to beauty education and she heads the country's premier hair, beauty, make-up and spa school chain called Blossom Kochhar College of Creative Arts & Design (BKCCAD). Dr. Blossom Kochhar introduced a structured and systematic approach to hair, beauty and spa education almost 30 years ago in order to bring the Indian beauty industry to the international standards. BKCCAD, a world-class training institute, offers prestigious international certifications including Pivot Point, CIDESCO, ITEC, IHB, MUD (make-up designory) and more. Dr. Kochhar and her

		team of educators have created winners in the industry. She is an icon to thousands of beauty professionals in India. She has many awards and accolades to her name, including the Best Women Entrepreneur of the Year Award. The International Women's Day award, the Gates and Custodian Person of the Year Award as well as the Universal Humanity Award, The Lifetime Achievement Award for her contribution to the Indian hair, beauty and spa industry as a pioneer of aromatherapy in India.
9	Mr. Abhiram Seth, Aquaagri, India 	Abhiram Seth is the Managing Director of Aquaagri since 2008. Aquaagri is an enterprise focused on promoting Aqua Agriculture through self-help groups, amongst the coastal communities. He is carrying forward the work originally initiated by Pepsico for manufacturing bio-stimulants for Agricultural application and Carrageenan an ingredient used by the food processing industry from the sea plants grown locally. Till March 2008 he was the Executive Director – Exports and External Affairs for PepsiCo India. Starting in 1993 he led Pepsico's exports and agricultural development efforts in India. In this role he worked on creating backward linkages with the farmers for sourcing raw material by leveraging a unique Public-Private partnership built with the Punjab Government and Punjab Agricultural University. Pepsi's Contract Farming model is now acknowledged as a major private sector initiative in the field of agriculture. He initiated Pepsi's foray into Citrus cultivation and Seaweed Farming, which are unique models of backward integration. In 2001, at Pepsico he took on additional responsibility of driving the sustainability agenda and external affairs. In this period, Pepsi made great strides in the area of Water Management and Waste Disposal. The positive water balance initiative launched in year 2002 is now being emulated by many industries and the Zero Waste Centre initiative is widely being acknowledged as a best practice. Abhiram graduated in Economics from Delhi University, and then went on to do his Masters in Management Studies from Jamnalal Bajaj Institute, Bombay University with specialization in marketing.

10	Ms. Kavita Nehemiah, Snap Natural & Alginate, India 	Ms. Kavita Nehemiah holds an undergraduate degree in Economics (Hons) from St. Stephens College, Delhi and an MBA from Cornell University, USA. She has previously worked in the Financial Services Industry for 10+ years. First with a Microfinance company where her role included designing financial products for the urban poor and later co-founding a Financial Technology company where as co-founder her role spanned multiple functions. At SNAP she oversees Marketing of Agricultural and Formulated products.
11	Dr. Nguyen Van Nguyen, Dy Director, Res Inst for Marine Fish, Vietnam 	Involve with seaweed research since 1997. Goodlink with researchers and producers society in Vietnam. Responsible for seaweed research program at Research Institute for Marine Fisheries – amajor scientific consulter for Ministry of Agriculture and Rural Development in terms of seaweed development in Vietnam.
12	Dr. Anicia Q Hurtado, University of the Phillippines Visayas 	**Anicia Q. Hurtado** was a Senior Scientist at the Aquaculture Department, Southeast Asian Fisheries Development Center (SEAFDEC-AQD), Tigbauan, Iloilo, Philippines for more than 20 years. She spearheaded the Seaweed Program of AQD during her entire career at the Center. She is at present the Chair of the Integrated Services for the Development of Aquaculture and Fisheries (ISDA Inc.), an organization of past and present scientists of SEAFDEC-AQD. She finished her Doctor of Agriculture (Phycology) at Kyoto University, Kyoto, Japan in 1988 as a Monbusho scholar. She worked closely with seaweed farmers as consultant of international funding agencies like WB-IFC, ADB, USAID, AusAID, GTZ, Cargill, ZSL, local agencies like PDAP, and government agency DA-BFAR in the pursuit of sustainable seaweed farming from lab-sea-based nurseries to field cultivation. She is the lead Editor of the Book - Tropical Seaweed Farming Trends, Problems and Opportunities: Focus on Spinosum and Cottonii of Commerce published by Springer Nature in November 2017. She is currently involved as the Developing Country Partner (Phil.) of the GCRF-UKRI GlobalSeaweed* Project, a 4 –year project (Oct 2017- Dec 2021) on the ***'Sustainability of Seaweed Aquaculture in the Developing Countries'*** at the University of the Philippines Visayas, Miag-ao Iloilo. She is a member of the UK International Peer Review College since February 2018 as a reviewer of proposals submitted for possible funding by UKRI-GCRF. She is one of the members of the European Algae Biomass Association (since Oct 2020) with a VIP status for her significant contributions to the algae sector, a clear recognition of work in promoting the sector. She has written several scientific papers published in peer-

		reviewed journals from micropropagation, farm management, disease mitigation to colloid characterization of *Gracilaria* and *Kappaphycus*. Likewise, she is book chapter contributor to some Algal Books. She is also a regular reviewer of manuscripts submitted to peer-reviewed journals like Algal Research, Journal of Applied Phycology, Aquaculture, Aquaculture Research, Journal Marine Policy and Botanica Marina, to name a few.
13	Dr. Yugraj Yadava, Director, Bay of Bengal Programme IGO, India 	***Dr Yugraj Singh Yadava*** heads the Bay of Bengal Programme Inter-Governmental Organisation. With a career spanning 44 years, Dr Yadava in his initial career worked as a Fisheries Scientist with the Indian Council of Agricultural Research. In 1994 he took over as Fisheries Development Commissioner to the Government of India and in August 2000 moved to the Bay of Bengal Programme,a field project of the UN Food and Agriculture Organization, which later became an Inter-Governmental Organisation. Dr Yadava'sresearch and developmental works*inter alia*include pioneering studies on large river systems and their floodplains, promoting small-scale aquaculture, developing capacities of stakeholders in implementation of the Code of Conduct for Responsible Fisheries; promoting development of fisheries cooperatives; and building resilience of small-scale fisher communities to face the vagaries of the sea and climate-induced changes. Having worked in 10 countries in South and South-east Asia, his contributions to the global agenda on fisheries and aquacultureare equally impressive. Aprolific writer and a photographer, Dr Yadava has about 150 published works and 50,000 quality pictures on fisheries from different parts of the world in his photo archives.
14	Dr. Atul Patane, Commissioner Fisheries, Govt of Maharashtra, India 	**Work Experience** – • Collector, Gadchiroli • CEO, Zilla Parishad, Nagpur & Chandrapur • CEO, Maharashtra Maritime Board • MD, Maharashtra State Mining Corporation • Secretary, Textile, Government of Maharashtra • Director, Petroleum & Natural Gas, GoI • Director, Social Justice & Empowerment, GoI • Director, Agriculture, Cooperation and Farmers Welfare, GoI
15	Mr. R. Govindrajan, Head R&D, Zydus Wellness Ltd, India 	**Education**: M.Pharm., Ph.D. Post doctoral fellowship from King's College London. **Experience**: More than 18 years in Research and development • Senior scientist, National Botanical research institute • Head Product technology, Dabur international, Dubai

		• Head, Himalaya Global Research Centre, Dubai • Visiting researcher, Kings College London • Visiting professor, NIPER Ahmedabad • Adjunct Professor, RAK medical college and university, UAE **Publications**: More than 65 publications in peer reviewed journals, including editorials, review papers and around 10 chapters in books More than 10 patents with 4 technologies transferred for commercialization **Awards & Honours**: BOYSCAST Fellow, DST, Government of India Fellow Indian Ethnopharmacology society Fast track young scientist: DST Government of India
16	Dr. Suseela Mathew, Pr Scientist, India 	**Education –** • Ph.D. Post Harvest Technology • M.F.Sc. Industrial Fishery Technology • B.F.Sc **Current Projects –** • Marine Biomolecules - Characterization and Utilization for Nutraceutical, Biomedical and Industrial Applications (Institute Project) • Assessment of Demersal Fishery Resources along the Continental Slope (200-1200m) of Indian EEZ and Central Indian Ocean (CMLRE Project) • Nutrient Profiling and Evaluation of Fish as a Dietary Component (ICAR Outreach Activity Project) **Awards & Recognition-** • Biochemistry and Nutrition related to Fish and Fishery Products
17	Dr. Raj Naresh Gopal, NCDC, India 	**Education –** • Ph.D. Fish Endocrinology • M.F.Sc. Fish Nutrition & Bio-technology • B.F.Sc **Work Experience-** • Presently, serving as a Dy. Director (Fisheries) at National Cooperative Development Corporation (NCDC), New Delhi (Since July, 2020 to till date). • Served as Senior Executive (Tech.), at National Fisheries Development Board (NFDB), Ministry of Agriculture, Dept. of AHDF, GoI), Hyderabad from Apri 2013 to April 2016. • Served as Assistant Director Fisheries cum Chief Executive Officer, FFDA (Jaunpur & Ambedkarnagar District), Department of Fisheries, Government of Uttar Pradesh from July 2007 to April 2013 (Got selected through UP Public Service Commission Exam). • Served as Technical Assistant, Fisheries at ICAR Research Complex for Eastern Region
18	Mr. Nilesh Patil, NCDC, India	**Education –**

		• MBA (Agri-Business Management) from Vaikunth Mehta National Institute of Co-operative Management (VAMNICOM), Pune • B.F.Sc (Fisheries) from College of Fisheries, Ratnagiri under Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli **Work Experience-** 10 years of experience in Business Development of Agriculture and allied fields- • Assistant Director, National Cooperative Development Corporation (NCDC)-Involved in Financial Assistance and Development of Cooperatives. • Assistant Project Manager, TechnoServe (Management Consultancy Firm)- Involved in World Bank Assisted Project to Maharashtra Government and Development of Milk Value Chain in Ahmednagar, Maharashtra • Chief Executive Officer, Khargone Farmer Producer Company Ltd (Action for Social Advancement) – Involved in Incorporation and Business Development of Farmer Producer Company in Khargone District of Madhya Pradesh. • Sr. Lead (Project Department), Future Agrovet Ltd (A subsidiary of Future Group)- Development of Forward and Backward Linkages for Agricultural Products.
19	Ms. Inderjeet Kaur, NCDC, India 	**Education-** • Master in Commerce **Work Experience-** • Joined National Cooperative Development Corporation (NCDC) in 2008 as an Assistant Director • Finance Division, NCDC (2008-2019) • Regional Diretor, Pune, NCDC (July, 2019 to July, 2020)

List of Registered Participants					
Sl No.	**Name**	**Designation**	**Organization**	**Country**	**State**
1	Dr. K. T. Channeshappa	Executive Director	NCDC	India	DELHI
2	Atul Kumar	Director	NCDC	India	DELHI
3	Bikramjit Singh	Chief Director	NCDC	India	DELHI
4	V K Dubasi	Regional Director	NCDC	India	CHATTISGARH
5	Lt. Col. (Dr) Baljit Singh	Chief Director	NCDC	India	ASSAM
6	PRABU PAULRAJ	DIRECTOR	NCDC	India	DELHI
7	Smt Monalisa Das	Secretary	OMM Sai Primary Fishermen Cooperative Society	India	ODISHA

8	Shri Bijay Ketan Behera	Member	Jaydurga Primary Fishermen Cooperative Society	India	ODISHA
9	Smt. Jayashree Garnaik	Member	OMM Sai Primary Fishermen Cooperative Society	India	ODISHA
10	Sebastian Joseph	Director	NCDC	India	ASSAM
11	Anant Kumar Bhandari	Executive Director	Sikkim Consumer Cooperative Society Ltd.	India	SIKKIM
12	TipparatPongthanapanich	Aquaculture Officer	FAO	Thailand	NULL
13	Arup Bhattacharyya	Assistant manager	Nischintapur S.K.U.S Ltd	India	WEST BENGAL
14	Dr. Nityananda Das	Associate Professor	College of Fisheries (OUAT),Rangailunda,Odisha,India	India	ODISHA
15	Smt Satyabhama Behera	Secretary	Dulladei PFCS	India	ODISHA
16	Kyawt Yin Min Thein	Program Coordinator	NEDAC , Bangkok Office	Thailand	NULL
17	Manas Kumar Khatua	Secretary	SamudrikaMachhyaUtpadakaBanijya Bikash PrathamikaSamabaya samiti	India	ODISHA
18	OmprakasMaiti	Chief Exquitive Officer	Bandhan Multistate Co-operative credit Society Ltd	India	WEST BENGAL
19	n.chandra	Executive director	National Fisheries Development Board	India	TELANGANA
20	PRASHANTA BAIDYA	MANAGER	BAIDYAPUR SKUS LTD	India	WEST BENGAL
21	SATHEESAN	REGIONAL DIRECTOR	NCDC	India	KERALA
22	PRADIP MANDAL	Clerk	BAIDYAPUR SKUS LTD	India	WEST BENGAL
23	Surendra Kumar Barik	Member	Utkal Marine PFCS	India	ODISHA
24	Shri SahadebTarai	Secretary	Maa PFCS	India	ODISHA
25	Prasan Behera	Secretary	MahabirMadhurodiyaMastyajibiSamabaya Samiti	India	ODISHA
26	SmtBasantiMoharana	Member	Dulladei PFCS	India	ODISHA
27	Dasarathi Majhi	Secretary	Dhenkanal Central Fishery Cooperative Society Ltd	India	ODISHA
28	Prof. Mohanraju	Professor & Head	Dept Ocean Studies & Marine Biology Pondicherry University	India	A & N ISLANDS
29	RasitaSrikerdkruen	Program Coordinator	NEDAC (Head office)	Thailand	NULL
30	Dr. Vibha K.	Consultant (Fisheries)	NDFD, Department of Fisheries, Governemt of India	India	DELHI
31	Venu S	Assistant Professor	Pondicherry University	India	KERALA
32	V M	CHIEF DIRECTOR	NCDC	India	TAMIL NADU

	CHANDIRASEKARAN				
33	Ganesh Gudia	Secretary	Maa Thanapati PFCS	India	ODISHA
34	NirodBhusan Das	Assistant Manager	Bahabalpur PFCS	India	ODISHA
35	Kiran Kumar Behera	Secretary	Panchubisha PMFCS	India	ODISHA
36	Falguni Jally	Secretary	Satapada PFCS	India	ODISHA
37	Satish Tucker	Adviser	NCDC	India	DELHI
38	Dharani Mallick	Secretary	Sabuliya PFCS	India	ODISHA
39	Nirmala Achary	Secretary	Balugaon Gopalpur PFCS	India	ODISHA
40	Prof R S Chauhan	Dean, fisheries	G B Pant Univ. of Agri. & Tech.	India	UTTARAKHAND
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42	K. Ramesh Kumar	Assistant Professor	Department of Economics and Rural Development, Alagappa University	India	TAMIL NADU
43	Shri Pravat Das	Chief General Manager	FISHFED	India	ODISHA
44	R. SATHISHKUMAR	Research Scholar	Alagappa University	India	TAMIL NADU
45	V.Sandhiya	Research Student	CIFE	India	TAMIL NADU
46	Suguna P	Pg scholar	ICAR – CIFE	India	TAMIL NADU
47	Aswathy Ashokan	PhD scholar	ICAR-CIFE	India	MAHARASHTRA
48	Durgesh Verma	Student	Narendra Deva university of agriculture and technology	India	UTTAR PRADESH
49	G Deepak Reddy	Student	Central agricultural university	India	TRIPURA
50	Nikhil Sawant	SRF	College of fisheries	India	MAHARASHTRA
51	Shivam K Rathod	Fish Farmer & Trader	DL Fish Traders	India	GUJARAT
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53	Krishna Dayasagar Patil	Student	College Of Fishery Science Udgir	India	MAHARASHTRA
54	Ashish Melwani	PROPRIETOR	Digitech Aqua Impex	India	MAHARASHTRA
55	Mahendra Kumar Yadav	PhD Scholar at gbpuat	GBPUAT PantnagarUk	India	RAJASTHAN
56	PranaysreePravat Kumar	Assistant Fisheries Officer	Directate of Fisheries, Odisha	India	ODISHA
57	Chinta Aravind Kumar	Student	Government degree pg college Siddipet,Telangana	India	TELANGANA
58	K. Venkateswara Rao	Technical Manager	Deepak Negen	India	ANDHRA PRADESH

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62	MadhusmitaSethi	Assistant Fisheries Officer	Directate of Fisheries, Odisha	India	ODISHA
63	Varttikapriya	BFSc student	College of fisheries	India	BIHAR
64	Patel UrvibenMahendrabhai	Student	Agricultural University	India	GUJARAT
65	Dr. Dibakar Bhakta	Scientist	ICAR-CIFRI, BARRACKPORE	India	WEST BENGAL
66	Khushbu kumari	Bfsc	Cofkishanganj, basu	India	BIHAR
67	Priyaranjan Sahoo	Young professional	Odisha livelihoods mission	India	ODISHA
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69	Prasad PurushottamGheware	Student	College Of Fishery Science Udgir	India	MAHARASHTRA
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73	S. Sridhar	Secretary	Maa Gangadevi Primary Marine Fisherwomen Fish Marketing Cooperative Society	India	ODISHA
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75	Ms. Nileshwari Madhukar Warhekar	Assistant Fisheries Development Officer	Regional Deputy Commissioner of Fisheries Amravati	India	MAHARASHTRA
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77	Srujan Kumar	Principal	Apex	India	TELANGANA
78	Vijay kumar	Student	College Of Fisheries, kishanganj	India	BIHAR
79	Saiprasad S. Sawant	Assistant Professor	College of Fisheries	India	MAHARASHTRA
80	Kumar Gautam	Student	College of fisheries kishanganj BASU, Patna	India	BIHAR
81	MurariSatyavijayBhalekar	Assistant fisheries Development officer	Govt of Maharashtra Malvan	India	MAHARASHTRA

82	TANDALE AJAY TRIMBAKRAO	Assistant professor	MAFSU-NAGPUR/ COLLEGE OF FISHERY SCIENCE UDGIR DIST LATUR 413517 MAHARASHTRA	India	MAHARASHTRA
83	AmodSalgaonkar	International Board Member	World Sustainability Organization	India	MAHARASHTRA
84	HanjabamMandakini Devi	Scientist	ICAR-CIFT	India	KERALA
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86	V K	Project Manager	ICDP Palakkad PhaseII, Kerala	India	KERALA
87	Nagesh Barik	Senior scientist	CIFA	India	ODISHA
88	Yash Sunil Pawar	M. F. Sc. Student	Kerala University of Fisheries and Ocean Studies, Kochi.	India	MAHARASHTRA
89	Pradeep Ghose	AFO	Department of Fisheries Odisha	India	ODISHA
90	Sanjay Singh Rathore	Entrepreneur	Anuharam Aquatica Fish Farm	India	CHATTISGARH
91	Bijaypakhira	Secretary	MudialyFishermens co-Opp Society Ltd	India	WEST BENGAL
92	Dr BiswaranjanSamanta Ray	Senior Scientist Fisheries	KVK Mayurbhanj	India	ODISHA
93	Soumen Dutta	Accountant	Jiabandi SKUS Ltd.	India	WEST BENGAL
94	Dr Sunil Mohapatra	Head Scientist	KVK Balasore	India	ODISHA
95	PRAMOD KUMAR ROUT	DISTRICT FISHERIES OFFICER,GANJAM,ODISHA	FISHERIES DEPTT. GOVT. OF ODISHA	India	ODISHA
96	Sachitra Kumar Ratha	Research Fellow	Institute for Water and Wastewater Technology Durban University of Technology	South Africa	NULL
97	Anjana Prasad	College of fisheries kishaganj	Webinar	India	BIHAR
98	Subrata Dutta	Manager	Mangalpurskus ltd	India	WEST BENGAL
99	GawalePradnyaHaribhau	Student	Maharashtra Animal And Fishery Sciences University Nagpur	India	MAHARASHTRA
100	MinhazuddinHazari	Manager	ChiChingaFatikaSKus ltd	India	WEST BENGAL
101	Mahadev Das	Secretary	Janata skus Ltd	India	WEST BENGAL
102	Narayan Chandra Dey	Cashier cum Computer Operator	KaliaraSamabay Krishi Unnayan Samity Limited	India	WEST BENGAL
103	Dr. G. Padmavati	Assistant Professor	Pondicherry University	India	A & N ISLANDS
104	Biplab Ghosh	Manager	Nagarukhra FSCS Ltd	India	WEST

					BENGAL
105	श्रीनेपालसिंह	सचिव	मत्स्यजीवीसहकारीसमिति, थीथकीक्रादपुर, वि. ख.- नारसन, हरिद्वार	India	UTTARAKHAND
106	Santanu Adak	Manager	PACS	India	WEST BENGAL
107	Shri Govinda Sardar	Secretary	BaroChhaynaviMatsyajibiSamabay Samity Ltd	India	WEST BENGAL
108	Kamal Bera	Manager	PACS	India	WEST BENGAL
109	Dr.Shashikant J. Meshram	Associate professor	College of Fisheries	India	MAHARASHTRA
110	श्रीबालेन्द्रकुमार	अध्यक्ष	नगलाऐमादसहकारीमत्स्यजीवी समितिवि. ख. नारसन (हरिद्वार)	India	UTTARAKHAND
111	श्रीसागरकश्यप	सदस्य	थीथकीक्रादपुरसहकारीमत्स्यजीवीसमितिनारसनहरिद्वार	India	UTTARAKHAND
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113	Shrutika	Afdo	Fisheries office	India	MAHARASHTRA
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117	कपिलकुमार	अध्यक्ष	सहकारीमत्स्यजीवीसमितिलि. बहादराबाद	India	UTTARAKHAND
118	Smt. Subhashri Mondal	Secretary	Dakshin PurushottampurMatangini Mahila Marine FCS Ltd.	India	WEST BENGAL
119	अमरनाथ	अध्यक्ष	सहकारीमत्स्यजीवीसमितिलि. बहादराबाद, हरिद्वार, वि. ख. बहादराबाद	India	UTTARAKHAND
120	बिरसिंह	अध्यक्ष	खानपुरसहकारीमत्स्यजीवीसमितिलि. न्यायपंचायत- खानपुर	India	UTTARAKHAND
121	Tanmoy Kumar Ghosh	Manager	Alipurskus ltd	India	WEST BENGAL
122	Ashwani Kumar	Consultant	NCDC-LINAC	India	HARYANA
123	Tariq Hussain Bhat	Associate professor	Faculty of fisheries, SKUAST-K	India	JAMMU & KASHMIR
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125	SUVENDU DAS	SECRETARY	MAHANAD MATSYA UTPADAK SANSTHA SAMABAY SAMITI LTD	India	WEST BENGAL
126	S.GOVINDARAO	AD FISHERIES/ASST.GENERAL MANAGER	ANDHRA PRADESH STATE FISHERMEN COOP-SOCIETIES FEDARATION LTD	India	ANDHRA PRADESH
127	Achinta Kumar Mondal	Manager	Kalaikundu SKUS Ltd	India	WEST BENGAL

128	TANMOY GHOSH	Highest Designated Employee	PRATAPPUR S. K. U. S LTD	India	WEST BENGAL
129	SREEDHARAN K N	REGIONAL DIRECTOR	NCDC	India	KARNATAKA
130	Debabrata Biswas	Manager	Chandannagar LS Paccs Ltd.	India	WEST BENGAL
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132	SHYAMAL KUMAR BALA	CASHIER	CHANDANNAGAR LS PACCS LTD.	India	WEST BENGAL
133	Rutuja Rajendra Bhalke	Student	Maharashtra Animal and Fishery Science University Nagpur	India	MAHARASHTRA
134	LerishToliya	Student	Asian Institute of Technology	Thailand	NULL
135	Ashish Kumar Jha	Scientist	ICAR-CIFT	India	GUJARAT
136	TANMAY MANDAL	Maneger	SAMAJ KALYAN S.K.U.S LTD.	India	WEST BENGAL
137	Shri Srinath Mondal	Chairman	4 No. Bherry Fishery Cooperative Society Ltd	India	WEST BENGAL
138	Nimish Dhuri	Student	Asian Institute of Technology	Thailand	NULL
139	PONNERU JAYASREE	Student (M.Sc.Zoology)	No	India	ANDHRA PRADESH
140	Harsh	Student	College of fisheries	India	GUJARAT
141	Ruchira Sandeep Sawant	Masters student	Asian Institute of Technology, Thailand	Thailand	NULL
142	abhaykumar	Scientist	MRC of ICAR CIFT	India	MAHARASHTRA
143	Roshan Ramakant Akhade	Manager Aquaculture Projects	Texel Industries Limited	India	MAHARASHTRA
144	M A Khan	Project Manager	National Federation of Fishers Coops Ltd	India	DELHI
145	Moti Lal Sarkar	Fisherman	Fish farming Jharkhand	India	JHARKHAND
146	Rasika Rajesh Salgaonkar	Housewife	-	India	MAHARASHTRA
147	Haridarshan thakur	Student	College of fisheries,Kishanganj	India	BIHAR
148	Shubham Kumar Yadav	Student	College of fisheries science and research center etawah	India	UTTAR PRADESH
149	Nowshad	EA to MD and DGM Aqua	Matsyafed	India	KERALA
150	Smruti Ranjan Dash	Director	Genotech	India	MAHARASHTRA
151	JACINTO TILBE	GENERAL MANAGER	NORTHERN SAMAR MULTIPURPOSE COOPERATIVE	Philippines	NULL
152	GuruaribamAruna Devi	Senior Technical Assistant	ICAR-Central Institute of Fisheries Education	India	WEST BENGAL

153	Deepesh Khatkekar	Training Manager	Hotel	India	MAHARASHTRA
154	Amit Sanjay Patil	Master of Fisheries Science Student	College of Fisheries,Ratnagiri (India)	India	MAHARASHTRA
155	Anil Kumar P K	Scientist	Technology Information, Forecasting and Assessment Council (TIFAC)	India	DELHI
156	Rehana Raj	Scientist	ICAR- Central Institute of Fisheries Technology	India	KERALA
157	Mrs. Pathan TaufinTausif	Assistant Professor	Ratnagiri Sub-Campus, University of Mumbai, Ratnagiri	India	MAHARASHTRA
158	JatindraGangai	Secretary	Talaseri PFCS	India	ODISHA
159	Manjusha	Motivator	Matsyafed	India	KERALA
160	AbhaykumarBirnale	Manager	S S Services	India	MAHARASHTRA
161	JUMAH	Farmer	Coral Circle	India	LAKSHADWEEP
162	Mangesh Shirdhankar	Principal	Diploma in Fisheries Engineerig	India	MAHARASHTRA
163	Dr Puja Kumari	Research fellow	University of Aberdeen	United Kingdom	NULL
164	Dr Tapan Kumar Chourasia	Visiting Scientist	University Of Aberdeen	United Kingdom	NULL
165	Sushil C. Kamble	Gear Technician	Diploma in Fisheries Engineering	India	MAHARASHTRA
166	Sebastian Joseph	Director	NCDC	India	ASSAM
167	Nilesh Mirajkar	Assistant professor	DFE Ratnagiri,DBSKKV, Dapoli, Maharashtra	India	MAHARASHTRA
168	ASHWINBHAI NARANBHAI GOHIL	Primary school teacher	Primary education board gujarait	India	GUJARAT
169	Harish Kumar	Managing director	South canara and Udupi co operative fish marketing federation Mangalore	India	KARNATAKA
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171	Patil Nilesh Suresh	Assistant Director	NCDC	India	DELHI
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175	Dr. Raj Naresh Gopal	Deputy Director	NCDC	India	DELHI
176	R. Vanitha	Chief Director	NCDC	India	DELHI

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178	NARESH KUMAR SAHANI	Chairman	MUSAHARI PRAKHAND MATSYAJIVI SAHAKARI SAMITI LTD	India	BIHAR
179	INDRAJEET Kumar Sahani	Chairman	MAHUA PRAKHAND MATSYAJIVI SAHAKARI SAMITI LTD	India	BIHAR
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182	PRADEEP KUMAR SAHANI	Chairman	SONPUR PRAKHAND MATSYAJIVI SAHAKARI SAMITI LTD	India	BIHAR
183	CHATURBHUWAN	Chairman	VAISHALI FISH FARMERS PRODUCER COMPANY PRIVATE LTD	India	BIHAR
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185	Shri Narad Yadav	Chairman	Jay Bharat KrishakSewaSwavlambhi CS Ltd., Motihari	India	BIHAR
186	Shri ShatrughanSahani	Chairman	Kevati Primary Development Block FCS, Darbhanga	India	BIHAR
187	Shri Devraj Chaudhary	Chairman	Madanpur FCS Ltd., Aurangabad	India	BIHAR
188	Shri Rajiv Nayan Singh	Chairman	Mahua Cooperative Cold Storage Ltd., Vaishali	India	BIHAR
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192	Arjun Bhai	Secretary	Shree MaroliMatsodyogSahkariMandli	India	GUJARAT
193	Pratap Kumar Bind	Chairman	Chganan Block fcs ltd.	India	BIHAR
194	Shiva Mahaldar	Secretary	Pirpainti Block FCS ltd.	India	BIHAR
195	Jitenderbhai	Manager	The Umbergaon Fishermen Cooperative Society	India	GUJARAT
196	Laddu Sahani	Chairman	Kanti Block FCS ltd.	India	BIHAR
197	Shaileshbhai	Manager	Shree KrishanpurVibhagMatsodyogSahkariMandli	India	GUJARAT
198	PandubhaiTandel	Chairman	OnjalMachhiwadSahkariMandli	India	GUJARAT
199	P. Muthu Meena	Dir/ARCS	Deppt. of Fisheries and fisherman welfare	India	PONDICHERRY
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201	Sakrabhai	Manager	Vandhol Fisheries Cooperative Society	India	GUJARAT

202	Naresh	Manager	Rupen Fisheries Cooperative Society	India	GUJARAT
203	M.V. Gayathri	Director	Priyadarshini Fisherman Welfare Cooperative Society	India	PONDICHERRY
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207	Rajani S	Project Officer	Matsyafed	India	KERALA
208	P. Vasugi	Director	Karaikal Women Cooperative Printing Society	India	PONDICHERRY
209	Poonguzhali	President	Karaikal Women Cooperative Printing Society	India	PONDICHERRY
210	R. Arulselvi	Secretary	Neithal Fisherman Welfare Cooperative Society	India	PONDICHERRY
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213	M. Rajeshwari	Secretary	Venmathi Fisherman welfare Cooperative Society	India	PONDICHERRY
214	Romila Devadas	Director	Mahe Vanitha Cooperative Society Ltd	India	PONDICHERRY
215	K.E. Sulochana	Director	Asraya Women Welfare Cooperative Society	India	PONDICHERRY
216	Ranjina	Director	Mahila Empowerment Service Cooperative Society	India	PONDICHERRY
217	manimallika.T	Director	Mahe Public Servants Cooperative Credit Society	India	PONDICHERRY
218	Shyni Rajeev	Director	Mahe Educational Cooperative Society	India	PONDICHERRY
219	Swapna	Director	Mahe Industrial Cooperative Printing Press	India	PONDICHERRY
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223	Pankaj Kumar Sahani	Secretary	Bachhawara Block FCS ltd.	India	BIHAR
224	Ram Kumar	Chairman	Navinagar Black FCS	India	BIHAR
225	Akhil Bhardwaj	Associate	Technoserve	India	UTTAR PRADESH
226	Debmuni Chaudhary	Chairman	Khodawanpur Block FCS	India	BIHAR

227	Abhinav Chandel	Junior Assistant	NCDC	India	TAMIL NADU
228	Mangan Mukhiya	Member	Flalka Block FCS lt.	India	BIHAR
229	Rajesh Kapoor	Deputy Director	NCDC	India	TAMIL NADU
230	Maria Ruban	Chairman	Colachel Fisherman Cooperative Society	India	TAMIL NADU
231	Helen Baby Chandra	Chairman	Azhikal Fisher Women Cooperative Society	India	TAMIL NADU
232	Anthoniyammal	Chairman	Kottilpadu Fisher Women Cooperative Society	India	TAMIL NADU
233	Sindhu	Community motivator	Matsyafed	India	KERALA
234	Pradip Das	Chairman	Matsyajibi Kalyan S.S. Ltd.	India	TRIPURA
235	Amal Sarkar	Chairman	Uttar Maharani M.S.S. Ltd.	India	TRIPURA
236	Deepa Srivastava	Chief Director	NCDC	India	UTTARAKHAND
237	Babulal mashram	President	Co-operative society	India	MADHYA PRADESH
238	Susy	Society secrtary	Matsyafed	India	KERALA
239	Kamal Debbarma	Chairman	Larima Multipurpose C.S. Ltd.	India	TRIPURA
240	Maria john	Chairman	Melakurumpanai Fisheries Cooperative society	India	TAMIL NADU
241	S. Saha	Chairman	Atal Bihari Multipurpose C.S. Ltd.	India	TRIPURA
242	Neethu. V. S	Project Officer	Matsyafed	India	KERALA
243	Kalliappan	President	killai Fisherman cooperative Society	India	TAMIL NADU
244	Mariamuthu	Clerk	Thoothukudi Muthu &Sangukuliyatkal Fisherman Cooperative Society	India	TAMIL NADU
245	P. Datta	Chairman	Gramonnayan Multipurpose C.S. Ltd.	India	TRIPURA
246	Jimson John	President	Manakkudi Fisherman cooperative Society	India	TAMIL NADU
247	J. Poomozhi	Stenographer	NCDC	India	TAMIL NADU
248	A. Prasanna Kumari	MTS	NCDC	India	TAMIL NADU
249	Anil kashyap	President	Machuasahkari samiti seoni	India	MADHYA PRADESH
250	Bhupinder singh	Chief Director	NCDC	India	DELHI
251	Uttam Das	Chairman	Relation Multipurpose C.S. Ltd.	India	TRIPURA
252	KrishnadhanDebbarma	Chairman	Netaji Subhas Multipurpose C.S. Ltd.	India	TRIPURA
253	Jagat Narayan Saha	PO	NCDC	India	MADHYA PRADESH
254	Sudhir Kumar Sharma	Financial Adviser	NCDC	India	DELHI

255	SushantaBanik	Chairman	Netaji Subhas Multipurpose C.S. Ltd.	India	TRIPURA
256	Nirmal Ch. Nath	SECRETARY	Sonaharibasa Multipurpose C.S. Ltd.	India	TRIPURA
257	Subir Das	SECRETARY	SabujAlo Multipurpose C.S. Ltd	India	TRIPURA
258	TuhinDebbarma	SECRETARY	Bakhiri Multipurpose C.S. Ltd.	India	TRIPURA
259	Buddha Chandra Debbarma	SECRETARY	LamsognaiBodolPoshupalan C.S. Ltd.	India	TRIPURA
260	NikunjaDebbarma	Chairman	ShariamukhiPoshuPalan C.S. Ltd.	India	TRIPURA
261	BilashKalai	SECRETARY	HambaiPoshupalan S.S. Ltd.	India	TRIPURA
262	Sunil Debbarma	Chairman	Kha ThansaPoshupalan S.S. Ltd.	India	TRIPURA
263	Satyajit Debbarma	Chairman	Dewan Poshupalan S.S. Ltd.	India	TRIPURA
264	Smt. Chabi Rani Tripura	SECRETARY	Hamcra Para Poshupalan S.S. Ltd.	India	TRIPURA
265	Amit Debbarma	Chairman	MadhuraiaPoshupalan S.S. Ltd.	India	TRIPURA
266	Ranjit Debbarma	Chairman	SindaiPashupalan S.S. Ltd.	India	TRIPURA
267	Ratnakar Panigrahi	CEO	Livelihood Alternatives Private Limited	India	ODISHA
268	AshiDebbarma	Chairman	SankumabariPashupalan C.S. Ltd.	India	TRIPURA
269	Sushil Majumder	SECRETARY	Janasakti Multipurpose S.S. Ltd.	India	TRIPURA
270	Chhabindra Dalai	Chief Operating Officer	Livelihood Alternatives Private Limited	India	ODISHA
271	Suman Saha	SECRETARY	Shantikali Multipurpose C.S. Ltd.	India	TRIPURA
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273	Sevak Batham	Co president	MachuaShkari Samiti Kisanpur Morena	India	MADHYA PRADESH
274	RICHAN BORO	PRESIDENT	SarenBeel Min Palan Cooperative Society Ltd.	India	ASSAM
275	UMESH CHANDRA BORO	CHAIRMAN	Dawgaphu Pisciculture Cooperative Society Ltd.	India	ASSAM
276	Jagat Ch. Boro	SECRETARY	GalaidingiKachariparaCoop .Piciculture Society Ltd.	India	ASSAM
277	Sh. Hariprasad Das		SECRETARY	India	ASSAM
278	Sh. Chandan Das		SECRETARY	India	ASSAM
279	Shri Santanu Sharma	SECRETARY	Netaipukhuri SS Ltd	India	ASSAM
280	Sri SuklalBasumatary	Secretary	Yamao Cooperative Fish Farm Society Ltd.	India	ASSAM
281	MILAN CHANDRA BHUYAN	SECRETARY	TARAJA COOP FISHERY COOP SOCIETY LTD.	India	ASSAM
282	Ashok B. Pillai	Chief Director, NCDC	NCDC	India	RAJASTHAN

283	Sunil Kumar Chhapola	Deputy Director	NCDC	India	RAJASTHAN
284	Dr Pawan Kumar Mahajan	Director Extension Education	Directorate of Extension Education Dr YSPUHF Nauni Solan	India	HIMACHAL PRADESH
285	NenPhanna	Researcher	Fisheries Administration	Cambodia	NULL
286	Deepak	Aquaculture Technician	Paspaley	Australia	NULL
287	Moe. ThandarOo	Myanmar	University	Myanmar	NULL
288	Dr. Dhruv Kumar	Teaching Associat	College of Fisheries Science and Research Center	India	UTTAR PRADESH
289	Yan Naung Tun	Demonstrator	Fisheries and Aquaculture, University of Yangon	Myanmar	NULL
290	PL Loo	Researcher	NUS	Singapore	NULL
291	Nishanth Reddy	Director	Sri Lakshmi Prasanna Aquaculture Private Limited	India	ANDHRA PRADESH
292	Swan Pyae	Student	University of Yangon	Myanmar	NULL
293	SivaramanIyempe rumal	Scientist	ICAR-Central Institute of Freshwater Aquaculture	India	ODISHA
294	Atul Raosaheb Sathe	Field Supervisor	Marine Products Export Development Authority	India	MAHARASHTRA
295	Dr. Harshavardhan Joshi	Senior Scientific Assistant	Fishery Survey of India	India	MAHARASHTRA
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297	Tejaswinikarale	PG research scholar	Central institute of fisheries education, Mumbai	India	MAHARASHTRA
298	SACHIN SATAM	PhD Scholar	College of Fisheries, Shirgaon	India	MAHARASHTRA
299	Shyam	Proprietor	Shravani fish farm	India	MAHARASHTRA
300	Kong vannakvannak	University of kratie	Faculty of agriculture	Cambodia	NULL
301	Dr. Satendra Kumar	Scientist (Fisheries)	Krishi Vigyan Kendra (JNKVV), Dindori (M.P.)	India	MADHYA PRADESH
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303	Jeetendra hemdev	Partner	Amar Ghanasingh	India	MAHARASHTRA
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305	YatiPhooPwint Aung -	Student	University of Yangon	Myanmar	NULL
306	RajendrakumarShi ngala	Superintendent of Fisheries	Dept of Fisheries, Govt. of Gujarat	India	GUJARAT
307	Rinkesh N. Wanjari	Student	Cife	India	MAHARASHTRA

308	Meenatchi S	Student	CIFE-MUMBAI	India	TAMIL NADU
309	Dr.Paul Pandian	Dy. Commissioner (Fy)	DoF	India	DELHI
310	Reddy CRK	CEO	ICCSIR	India	GUJARAT
311	Rakesh Rahul Jadhav	Assistant Professor	Dr.B.S.K.V. Dapoli	India	MAHARASHTRA
312	UdayKiranAkkapalli	Secratary	FCS	India	ANDHRA PRADESH
313	Mohan C O	Senior Scientist	ICAR CIFT	India	KERALA
314	Ramachandran	Lead Partner	BGreen Technologies	India	TELANGANA
315	SumitGarole	Entrepreneur	Student	India	MAHARASHTRA
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317	Dr. Rajesh, D.P.	Assistance Professor	College of Fisheries Managluru	India	KARNATAKA
318	KyalSinThway	to be a professor	Student	Myanmar	NULL
319	M Aktaruzzaman Hasan	Senior Assistant Engineer	LGED	Bangladesh	NULL
320	M.A.Yakub Basha	Additional Director/Managing Director, AFCOF,AP De	ANDHRA PRADESH STATE FISHERMEN COOP-SOCIETIES FEDARATION LTD	India	ANDHRA PRADESH
321	Arup	Ghosh	CSIR-CSMCRI	India	GUJARAT
322	Krupesh	Student	CIFE, -ICAR	India	MAHARASHTRA
323	Ashutosh Prakash	DDM	Nabard	India	JHARKHAND
324	San Htet San	Student	Department of Zoology	Myanmar	NULL
325	Aye AyeKhine	Assistant lecturer	University of Yangon	Myanmar	NULL
326	Sachi Singh	Founder	SeaRasa	India	KARNATAKA
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328	Yu Yu Aye	Lecturer	UVS	Myanmar	NULL
329	Durgesh Chavande	Student	Diploma in fisheries engneering, Ratnagiri.	India	MAHARASHTRA
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334	Manasi Bhosale	Student	Diploma in fisheries engineering	India	MAHARASHTRA
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336	Marketing Executive	Marketing Executive	Aquagri Processing Private Limited	India	DELHI
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338	Neeraj Verma	Rural Sales Officer	Havells India Limited	India	MADHYA PRADESH
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340	Sunil Dutt Sharma	Development officer	ICDP	India	HIMACHAL PRADESH
341	Rajneesh Kumar	Deputy Registrar cooperative societies	Department of cooperation	India	HIMACHAL PRADESH
342	Cho Cho Thin	Lecturer	Fisheries and Aquaculture, University of Yangon	Myanmar	NULL
343	Dr.Nilesh Anil Pawar	ACTO	ICAR-CMFRI	India	MAHARASHTRA
344	Shailendra PratapraoIndulkar	Director	Fish farmers depot	India	MAHARASHTRA
345	chandra K Murthy	Vice president	Society for Indian fisheries and aquaculture	India	KARNATAKA
346	Dr.K.T.Selvavinayagam	Senior Research Consultant	Rajalakshmi Engineering College	India	TAMIL NADU
347	Dr.K.Dharmar	Associate Professor and Head Department of Botany	PasumponThiruMuthuramalingaThevar Memorial College	India	TAMIL NADU
348	Dr.G.Prabhakar	Fishery Scientist	Krishi Vigyan Kendra	India	TELANGANA
349	Thierry B.R. Chopin	Dr.	UNIVERSITY OF NEW BRUNSWICK	Canada	NULL
350	Dr. P. Anantharaman	Professor	Marine sciences Annamalai university	India	TAMIL NADU
351	Dr.M.Kishan Kumar	Associate Dean	PV Narsimha Rao Telangana Veterinary University	India	TELANGANA
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353	B.SAI THARUN GOUD	Student	Osmania University,Government Degree collage siddipet	India	TELANGANA
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356	Svenkateshwarlu	Lecturer	T S coop union	India	TELANGANA
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358	Shyamal kumar Mishra	Karmadhakya	Khejuri 2 PS	India	WEST BENGAL
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374	RAVINDER KUMAR MANGLA	REGIONAL DIRECTOR NCDC RO BHOPAL	NCDC	India	MADHYA PRADESH
375	RAJULAL DEBBARMA	EXECUTIVE OFFICER	TRIPURA APEX FISHERY CO-OPERATIVE SOCIETY LIMITED	India	TRIPURA
376	Shivkumar Marko	Manager	Adivasi MachhuaSahakari Samiti MaryaditJantipur RN. 683	India	MADHYA PRADESH
377	Sh. Devender Kumar	Manager	The Kutail PACS	India	HARYANA
378	KrunaliTandel	Assistant fisheries Development officer	State fisheries dept maharashtra	India	MAHARASHTRA
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380	Tharsanamurthi	President	ArkattuThurai Marine Fishermen Cooperative Society	India	TAMIL NADU
381	DHANIRAM PATEL	Chairman	Shraddha machuasahkari samiti maryaditAtarhai	India	MADHYA PRADESH
382	Lorecris	ADMIN AIDE I (FISH PROCESSING)	MINDANAO STATE UNIVERSITY AT NAAWAN	Philippines	NULL

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385	Julirusso	Dr	Self	Italy	NULL
386	Vivekananda Babu	Research Scholar	Annamalai University	India	TAMIL NADU
387	Dr(smt) Vimlesh Rathore	Assistant Director	National Cooperative Development Corporation	India	DELHI
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389	Priyank khare	Comuteroprater	Icdpchhararpur	India	MADHYA PRADESH
390	Mohd Afzal	Assistant Director	NCDC	India	HARYANA
391	Lt. Col. Baljit Singh	Chief Director	NCDC, RO Guwahati	India	ASSAM
392	Pradeep sarma	Account	Icdpchhatarpur	India	MADHYA PRADESH
393	Iris Ann Borlongan	Asst. Prof.	University of the Philippines Visayas	Philippines	NULL
394	Jashandeep Sachdeva	Accountant	CS for Doors	New Zealand	NULL
395	Vijay Deokar	Assistant Fisheries Development officer	Department of Fisheries, Govt. Of Maharashtra	India	MAHARASHT RA
396	Asa Verma	Retd Sr. Manager PSCB	Coop bank	Australia	NULL
397	Ashok kumar	Fish farmer	Fishing	India	MADHYA PRADESH
398	Marlon Alejandro	Station Chief	Bureau of Fisheries and Aquaftc Resources Regional Office III	Philippines	NULL
399	Sankaranarayanan	Programme Officer	NCDC	India	DELHI
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401	Sh. Kuldeep	Manager	The Kosli PACS Ltd.	India	HARYANA
402	PRAMOD MATHUR	Adviser (Finance)	NCDC	India	DELHI
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404	Pramod Patole	Jobless	No organisation	India	MAHARASHT RA
405	MineshTuteja	Deputy Director	NCDC	India	DELHI
406	Hanuman prasad agrawal	State president	Sahakarbharati	India	RAJASTHAN
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408	Nilesh Patil	PSM	Yes Bank Ltd	India	MAHARASHT RA

409	Vidya Patil	HF	Business	India	MAHARASHTRA
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411	Dr.A.Noorjahan	Research head	Biofocus scientific solutions Pvt ltd	India	TAMIL NADU
412	BINEETHA. R	Project Officer	Matsyafed	India	KERALA
413	Chow Amat	Secretary	Progressive Farmers MPCS Ltd	India	ARUNACHAL PRADESH
414	Aneesh A	Project Officer	Matsyafed	India	KERALA
415	Daduram Patel	Secretary	Society	India	MADHYA PRADESH
416	Felix Ayson	Scientist/Consultant	ISDA-Phil. Inc	Philippines	NULL
417	Sanjeev Bhatia	Sr.PS	NCDC	India	DELHI
418	Shri RinchinNorbu	Secretary	Shertukpen Fruits and Vegetable Farmers Coop Society Ltd	India	ARUNACHAL PRADESH
419	Akshat Sharma	Sr. Assistant	NCDC	India	DELHI
420	Bhakti Sunil Peje	Assistant Fisheries Development Officer	Assistant Commissioner of Fisheries, Ratnagiri	India	MAHARASHTRA
421	SK Jasmin	Assistant Director of Fisheries	Fisheries Department Andhra Pradesh	India	ANDHRA PRADESH
422	Shri HageKobing	Secretary	North East MPCS Ltd	India	ARUNACHAL PRADESH
423	B CHANDRA SEKHAR	MANAGER	KEI RSOS PETROLEUM & ENERGY PVT LTD	India	ANDHRA PRADESH
424	SakharinateMachhimarSahakari Society ltd.	Secretary	Business	India	MAHARASHTRA
425	Shri Mihin Tayu	Secretary	Kwui MPCS Ltd	India	ARUNACHAL PRADESH
426	Sachin Ganesh Gaur	Committee Chairman	Maa ambajimatsyodhogsahkari samiti maryaaditchotasirpur Indore MP	India	MADHYA PRADESH
427	Shri Tenzin ThakchuDirkhepa	Secretary	Thembang MPCSL	India	ARUNACHAL PRADESH
428	Shri MogeLollen	Secretary	NampongManmaw LAMPS Ltd	India	ARUNACHAL PRADESH
429	Kailash Daulatram	Committee Chairman	Maa bhagwatimachlipalansahkari samiti MP	India	MADHYA PRADESH
430	Shri MobomRiba	Secretary	Miao LAMPS Ltd	India	ARUNACHAL PRADESH
431	YOJANA PRAMOD TANDEL	Representative	Neelkranti fishery society	India	MAHARASHTRA

432	Shri Tana Kaya Tara	Secretary	Border Area MPCS Ltd	India	ARUNACHAL PRADESH
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434	Shri TakamNabum	Secretary	Amen MPCS Ltd	India	ARUNACHAL PRADESH
435	Luke Augustine Lusbo	Shrimp Farmer	Vasai agro farm	India	MAHARASHTRA
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437	Sourabh ravindramulye	Mearchant navy	Ratnagiri	India	MAHARASHTRA
438	LalthariRalte	Secretary	Zotlang Poultry Farming Coop. Society Ltd.	India	MIZORAM
439	Rosiamliana	Secretary	Zotlang Multipurpose Coop. Society Ltd.	India	MIZORAM
440	RS Verma	IAS	Registrar Cooperative Societies Haryana	India	HARYANA
441	Lhingkhochin	Chairman	Van Dhan Vikas Kendra	India	MANIPUR
442	Matt Craze	Analyst	Spheric Research	Chile	NULL
443	BaminOnya	Coordinator	SenyiApoo MPCS Ltd	India	ARUNACHAL PRADESH
444	Margret Touthang	Secretary	Van Dhan Vikas Kendra	India	MANIPUR
445	SudarsanBiswas	Deputy Director,	NCDC, Guwahati	India	ASSAM
446	Mukesh batham	Chairman	Kaharmachaliudyogsahakari samiti fajalpura	India	MADHYA PRADESH
447	BijayKalita	Chairman	Kumatia Fishery Coop Society Ltd	India	ASSAM
448	K. Ramthansanga	Chairman	Civil Pensioner Multipurpose Coop. Society Ltd.	India	MIZORAM
449	Shri Mar Longkumar	Chairman	Dwellers MPCS Limited	India	NAGALAND
450	Bhagwan Singh kevat	Fish farm	Shree ram bhaktkevatmachuashahkari samti	India	MADHYA PRADESH
451	ShikatoChishi	Chairman	Eco Venture MPCS Ltd.	India	NAGALAND
452	ayyorilaxman	suraram	fs cherman	India	TELANGANA
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455	Sandeep manjhi	Prabandhak	Fisheries cooperative society mohna	India	MADHYA PRADESH
456	M. Alila Jamir	President	Imtsalar MPCS Limited	India	NAGALAND
457	Mrs. Sulanbeni	President	Eloe Weaving & Knitting C.S. Ltd.	India	NAGALAND
458	AMJAD BORKAR	Member	Sakhari Nate Machchhimar Cooperative Society limted,,	India	MAHARASHTRA
459	Shri Thepfukralie	President	MariemaKrotho Farming	India	NAGALAND

			C.S. Limited		
460	Bhupendra Phondba	Scientist	NDDB	India	GUJARAT
461	Satyavati	Farmer	Entrepreneur	India	TELANGANA
462	CHELLAIAH PERIYASAMY	Assistant Professor	DEPARTMENT OF BOTANY, MELANEELITHANALLUR	India	TAMIL NADU
463	Rakesh Kumar Jenamani	Proprietor	Meraki Enterprise	India	ODISHA
464	Dr ReetaJayasankar	Principal Scientist	ICAR-Central Marine Fisheries Research Institute	India	KERALA
465	Shri PukhatoKire	Chairman	Vierhe Farming Cooperative Society Ltd.	India	NAGALAND
466	Vaibhav Vhatkar	Sr. Technical Sales Officer	Avanti feeds limited	India	MAHARASHTRA
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472	Milind sarang	Farmer	Tari aqua farm	India	MAHARASHTRA
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515	Shobhit Barman	Chairman	Nishadrajmachuasahkari samiti sohagpur	India	MADHYA PRADESH
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521	Thakurramsinha	Student	College of fisheries	India	CHATTISGARH
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530	Akshaykamtam	Director	Marine Meadow Farms	India	MAHARASHTRA
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532	Mahendersingh Yadav	Ph.D. Research Scholar	CAS In Marine Biology, Faculty of marine sciences, Annamalai university	India	TAMIL NADU
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534	Keita	Mr	Consultant	France	NULL
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550	Elisa d. melendres	sdssu-lc	Fisheries	Philippines	NULL
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557	Rakesh Prashar	Dispatcher	Pitney Bowes	United States	NULL
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564	Mangesh Thale	Secretary	Borli Mandla fisheries cooperative society, Murud Raigad	India	MAHARASHTRA

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574	Rahul Bharati	Junior Assistant	NCDC, RO Jaipur	India	RAJASTHAN
575	Navin Gupta	Senior personal assistant	NCDC	India	KERALA
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Govt eyes seaweed cultivation in a big way to boost fishermen's income

ARCHANA JYOTI ■ NEW DELHI

Though bestowed with more than 8,000 km coastline enriched with seaweeds (macro algae) which has huge potential as a sustainable food source and provide livelihood to coastal communities hit by climate change vagaries, India's share in global production is negligible at .01 per cent when compared to China and Indonesia which have grabbed 80 per cent of the market pie.

Now, keen to be not left behind, the Modi Government is leaving no stone turned and taking a series of measures like providing subsidy, capacity building and awareness through webinars and interaction among others with the interested cooperatives and entrepreneurs to take up seaweed cultivation in a big way, business of which is projected to hit USD 26 billion by 2026.

India's present seaweed value is estimated to be around just USD 500 million ie 50 crore and the officials feel that there is a huge opportunity to exploit the potential of the seaweed business.

To spur the sector, the government has already allocated ₹ 637 crore for the cultivation of these nutrition-rich marine plants, as part of the ₹20,050-crore central scheme Pradhan Mantri Matsya Sampada Yojana (PMMSY)—to be spent over the next five years, mainly as subsidy support.

In fact, seaweed cultivation has been the pet project of Prime Minister Narendra Modi, who since his days as Chief Minister of Gujarat, had been stressing on its promotion for the fishermen and coastal communities looking to double their income by 2022 and boost the rural economy.

In this direction, to create awareness and deliberate on the strength, opportunities and challenges, an international webinar is being jointly organized by the Department of Fisheries, Union Ministry of Animal Husbandry , LINAC-National Cooperatives Development Corporation (NCDC), and NEDAC, Bangkok next week ie January 28, 2021.

At the webinar, the stakeholders including scientists, government officials and entrepreneurs from India and countries like Canada, Thailand,

Phillippines and Vitenam will share their views, brought on one platform and steps will be taken work towards forging alliances for promotion of entrepreneurship in the sector through cooperatives. At the same time, the webinar will identify bottlenecks at various levels and will aim at evolving options.

"Much of India's coast is ideal for seaweed cultivation with suitable tropical weather, shallow waters and a rich supply of nutrients. In total, as many as 841 species of seaweed thrive along the region, though only a few are cultivated. The seaweed is not only destined to be a food source, but also a source of biofuels, bio-fertilisers and other products like in pharma and cosmetic," said Sundeep Kumar Nayak, MD of the NCDC. He said the webinar is the part of series of steps planned to promote seaweed cultivation among the cooperatives in the country.

While Dr. Rajeev Ranjan, Secretary of the Department of Fisheries from the Animal Husbandry Ministry will be the chief guest at the webinar, Manoj Joshi, Additional Secretary from Union Ministry of Food Processing will dwell on his Ministry's support for seaweed based food and Dr. Thierry Chopin, Prof of Marine Biology, University of New Brunswick, Canada will talk about 'Seaweeds, a key component of Integrated Multi-Trophic Aquaculture (IMTA) providing important ecosystem services, which should be valued."

The other topics that would be taken up during the webinar will be 'Seaweed based Sagarika for farmers' by Dr. US Awasthi, MD IFFCO, India, Dr. Blossom Kochhar, Chair, Blossom Kochhar Group, India will touch upon 'Seaweeds in the cosmetics industry in India'.

Others who will participate include Kavita Nehemiah, Snap Natural & Alginate, India, Dr. Nguyen Van Nguyen, Dy Dir, Res Inst for Marine Fish, Vietnam, Dr. Anicia Q Hurtado, University of the Philippines Visayas, Philippines, Prof Krishna R Salin, Director, NEDAC Bangkok and Dr. Atul Patne, Commissioner Fisheries, Gov of Maharashtra, India among others.

The key beneficiaries of this webinar will be seaweed farmers, budding entrepreneurs, youth, women and vulnerable communities. The webinar also aims at augmenting awareness about seaweed farming as a business and to come up with an actionable, time bound plan which will contribute towards attaining 'Atmanirbhar Bharat,' said Nayak.

It has been estimated that lndia can produce one million tonnes of dry seaweed providing employment to nearly 2 lakh fishers with an annual income of ₹1 lakh per individual.

Nayak further said that seaweed farming is one of the few sectors in developing countries that allow a certain level of flexibility besides tackling climate change threats. As a result, women can work in this business and gain an independent income without neglecting their traditional household work. For instance, Tanzania has seen women emerge as leaders in the seaweed world, and they have even moved onto producing seaweed flour in addition to farming, he added.

As per the PMMSY guidelines, seaweed farming will be promoted in a mission mode and supported through financial, marketing and logistical support to ensure income and welfare gains to small fisher population especially women and fisherwomen headed households.

Seaweed seed banks, nurseries, tissue culture units, processing and marketing units, etc. would be supported.

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