GOVERNMENT OF TAMILNADU
DEPARTMENT OF FISHERIES AND FISHERMEN WELFARE

DEPARTMENT OF
FISHERIES

NFDB

SEAWEED INDIA 2022

Proceedings & Event Report

28-29 September 2022

Organized by:

SMART AGRI POST
Empowering agripreneurs...

BOBP

ICAR

CMFRI

NCSCM

GOVERNMENT OF TAMILNADU
DEPARTMENT OF FISHERIES AND FISHERMEN WELFARE

DEPARTMENT OF
FISHERIES

NFDB

Seaweed India 2022

Delta Auditorium, NCSCM Campus
28-29 September 2022

Proceedings & Event Report

Organized by

SMART AGRI POST
Empowering agripreneurs...

BOBP

ICAR

CMFRI

NCSCM

Organizing Team

Mr. Pravash Pradhan
Chief Editor
Smart Agripost & Aqua Post
Mobile: +91- 99712 62410
E-mail: ravash.p@gmail.com, infosaweedindia@gmail.com

Dr. P. Krishnan
Director
Bay of Bengal Programme Inter-Governmental Organisation
Mobile: +91 – 94980 50062
E-mail: krishnanars@yahoo.com, krishnanars@bobpigo.org

Mr. Lamek Jayakumar
Deputy Director (Mariculture)
Department of Fisheries & Fishermen Welfare, Government of Tamil Nadu
Mobile: +91 – 98406 70443
E-mail: maricultureho@gmail.com

Executive Summary

An International Conference on the promotion of the seaweed value chain in India – "Seaweed India-2022" was held during 28-29 Sep 2022 at the National Centre for Sustainable Coastal Management (NCSCM) Auditorium in Chennai. The Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO) organized the event jointly with the Smart Agripost, a leading Agriculture Magazine, and ICAR- Central Marine Fisheries Research Institute, in collaboration with the Department of Fisheries and Fishermen Welfare, Government of Tamil Nadu (DFFW), National Fisheries Development Board (NFDB) and Ministry of Fisheries, Animal Husbandry and Dairying, Government of India (MFAHD).

Mr. Jatindra Nath Swain, IAS, Secretary, Department of Fisheries, MFAHD, Mr. A Karthik, IAS, Principal Secretary to Government of Tamil Nadu, Department of Animal Husbandry, Dairying, Fisheries and Fishermen Welfare, Dr. K. S. Palanisamy, IAS, Commissioner of Fisheries, DFFW, Tamil Nadu, Dr. J. K. Jena, DDG (Fisheries), ICAR, New Delhi, Dr. A. Gopalakrishnan, Director, ICAR-CMFRI, Kochi, took part apart from diverse stakeholders comprising industry majors, start-ups, women entrepreneurs, eminent researchers, subject experts, technocrats and policymakers.

The key issues identified during the Conference and the salient recommendations concerning appropriate solutions are summarized hereunder:

Key Issues Impeding the Development of the Seaweed Sector in India

1. The seaweed production potential of India is estimated at 10 million tonnes. Against this potential, the current production is sticky at 34, 000 tonnes (0.0034%) only.
2. The farmers who intend to undertake seaweed cultivation have limited options to choose from with respect to locally appropriate technologies and seed availability of cultivable seaweed species.
3. *Kappaphycus alvarezii*, currently under cultivation, is multiplied by vegetative propagation from the seed material imported in the early 2000s. The existing strain has lost its virulence for fast growth and has also become disease-prone. These factors are seriously impeding the mass production of seaweeds. As the potential yield of available strain has reached its threshold, there is a need for the import of more high-yielding exotic varieties from abroad.
4. The innovation ecosystem in the Indian seaweed sector is too rudimentary. R&D successes in seaweed farming are mostly confined to the labs.
5. There have been multiple reports in the popular print media on the environmental impacts of *Kappaphycus* cultivation in Palk Bay. It is apprehended that the coral reefs in the Gulf of Mannar (GoM) have been invaded by *Kappaphycus*; and that this fast-growing algal species consumes a large amount of nutrients from the seawater which would become a limiting factor for the growth of seagrasses in the area, which in turn affects the ecosystem of the region. Though comprehensive studies undertaken by different national research laboratories prove the contrary, the negative campaign has captured the wider imagination without substantive scientific evidence and a poor understanding of the situation realistically.

6. There are prevailing conflicts and also further scope for future conflicts between the seaweed farmers and fishers in the villages, owing to competition for access to the same areas for exploiting resources and also for farming seaweeds and prevailing differences in the social influence among stakeholders.
7. Small and marginal farmers often suffer heavy losses and are pushed out of the sector due to several risks involved in seaweed culture like: a) loss of rafts and seedlings during cyclones; b) lack of insurance cover; and c) fluctuating market prices.
8. Seaweeds are not traditionally consumed in India unlike in Southeast and Fareast Asian countries. While there is improved awareness now of the benefits of seaweed, the consumption of seaweed as food remains non-existent in India.

Recommendations

Key recommendations

The industry needs to achieve scale economies to help achieve the target of 1 million tonnes of production. In this regard, the regulatory and policy instruments governing the import of exotic varieties, and quarantine rules need to be amended/simplified on a priority, by instituting single-window-clearances for all aspects of seaweed development. The fish farmers, specifically the FFPOs need encouragement to bring scale economies in the value chain of seaweed. There is a need for more active collaboration between R&D institutions and industry in all areas covering seed production, farming, processing, and value chain development.

Other specific recommendations

1. **Spatial planning for the cultivation of seaweeds:** The State Governments should identify and digitally map the areas suitable for seaweed cultivation in consultation with the local communities. There should be an adequate support mechanism in place location/zone-wise to form farmer clusters for enabling market access, environment management, and farm management.

   The government of India may consider devising a regulatory framework and a model leasing policy enabling the practice of mariculture including seaweed culture in inshore and offshore waters. Research institutes can explore sites for seaweed cultivation. Potential regions which cannot be used for fishing due to the presence of rocks on the sea bottom may be identified. Offshore areas, with marginally more depth compared to the current areas of cultivation, have great scope for expanding the farming activity.
2. **Codes and guidelines for seaweed cultivation**: Seaweed culture has to be promoted in identified areas, with adequate environmental safeguards. Ecologically sustainable seaweed culture methods with the least ecological footprints are to be employed.
3. **Enabling policy /regulatory framework:** Currently, the coastal and marine waters are not under the regulatory ambit of the Coastal Aquaculture Authority Act, 2005. This has caused a regulatory vacuum for mariculture activities including seaweed farming. Necessary regulatory frameworks need to be put in place so that the sector is developed in a structured manner under a predictable regulatory ecosystem, with necessary environmental safeguards.
4. **Diversify options of farmed species:** The farming of edible and non-edible seaweed needs to be promoted alike. The potential farmers should be encouraged and facilitated in

insourcing appropriate technologies and quality seed material for fast-growing strains of seaweeds from national and international laboratories, in a short period. There is a need for focused research including genetic improvement of native species and technological development of other commercial seaweed varieties available in the country.

The National Research Laboratories may be permitted to import the seed materials of different seaweed species, quarantine, and standardize the seed multiplication to meet the needs of the sector eventually.

5. **Steady seed supply:** Private players may be encouraged to produce the planting material and tailor-made schemes to be drawn to facilitate the same in a time-bound manner.
6. **Creation of artificial seaweed substrates:** Expanding the substrates for their cultivation is fundamental to increasing the standing crop of seaweeds. Suitable artificial substrates for seaweeds need to be developed and promoted. Artificial seaweed substrates made of rock boulders and calcium carbonate are more durable and the barnacles which grow over them add to their stability. While rock boulders support mostly green and red seaweed, calcium carbonate-impregnated substrates support all seaweeds including brown seaweeds.
7. **Coordination committee to facilitate import of improved seed material:** The procedures for import of live seaweed on a Government-to-Government basis need to be streamlined, with adequate checks and balances in place. This is particularly important in light of the fact that some countries have banned the export of live seaweed. The potential suppliers of seaweed seed material and other required inputs may be empanelled as done in the case of shrimp, *Litopenaeus vannamei.* Since, importing and quarantine fall under the purview of different departments of GoI, an inter-departmental coordination committee needs to be constituted to ensure the smooth flow of the import process.
8. **Robust quarantine regulations:** India has established quarantine procedures and biosecurity protocols in the case of terrestrial plants and aquatic fish/shrimp species (*e.g., Litopenaeus vannamei*). Currently, quarantine procedures for the seaweed are under the ambit of the Dept. of Agriculture, GoI, and there is a need to develop seaweed-specific biosecurity guidelines.
9. **Quarantine infrastructure:** There are no proper seaweed quarantine facilities unlike for fishes and plants. Infrastructure needs to be identified and developed for implementing quarantine procedures for seaweed import into India, and the private sector may be allowed to participate in the process, as per the guidelines developed for the same.
10. **Strengthen research for sustaining the industry:** Considering the challenges in importing live seaweed, research with the end objectives of industrial application must be promoted. There is also a need to establish seaweed seed banks for indigenous candidate species and conduct genetic improvement programmes to ensure a steady and timely supply. Tissue culture methods for different species need to be developed and standardized by research institutions to support sustainable and responsible seaweed farming in India.

    A pilot study on integrated multi-trophic aquaculture (IMTA) in fish cages may be conducted for increasing the production of seaweed by considering the carrying capacity. Collaboration between national laboratories and international expert institutions, such as SEAFDEC, JIRCAS, etc., should be facilitated for this purpose.

11. **Incubation centers to strengthen the Innovation ecosystem:** Business Incubation Centers are needed to be set up in state fisheries colleges and research/academic institutions in the coastal states in association with financial/insurance agencies. The benefits of the emerging innovation ecosystem in the form of Start-up India, Make-in-India, PMMSY, etc., should be consolidated for the benefit of budding entrepreneurs in these incubation centers.

12. **Break myths on the apprehension of *Kappaphycus* impact with reliable scientific studies:** There is a need for debunking the unsubstantiated apprehensions that *Kappaphycus* cultivation has an adverse impact on the environment and biodiversity. The results of the scientific studies undertaken in this regard by the national laboratories need to be widely publicized and discussed in inter-departmental meetings to frame fact and science-based policies.

The comprehensive field surveys, *viz.,* CSMCRI and CMFRI and MoEFCC-NCSCM, which conducted a focused impact study covering all the islands in GoM emphatically conclude that:

(i) *K. alvarezii* has not been found in the coral reefs in Palk Bay, where the seaweed is under cultivation for over 2 decades;

(ii) The *K. alvarezii* spread in Gulf of Mannar could not be attributed in any way to their long-term cultivation in Palk Bay.

(iii) The long-term cultivation of *Kappaphycus* had not caused any significant impact on the hydrography and water quality of Palk Bay and the hydrographic parameters were within the ambient limits recorded historically and currently for this part of the coast, for the respective season.

(iv) The coral reefs in all the islands of the Gulf of Mannar and Palk Bay are impacted significantly by the native seaweed (*Caulerpa sp., Turbinaria sp., Halimeda sp.,), to an extent of 40% (Pullivasal, Poomarichan) and 17% (krusadai), due to natural ecological phenomenon called algal-phase shift.* In comparison, the extent of *K. alverizii* recorded in 3 islands ranged between 0.00022% (Mulli Island) to 2.12 % (Shingle Island).

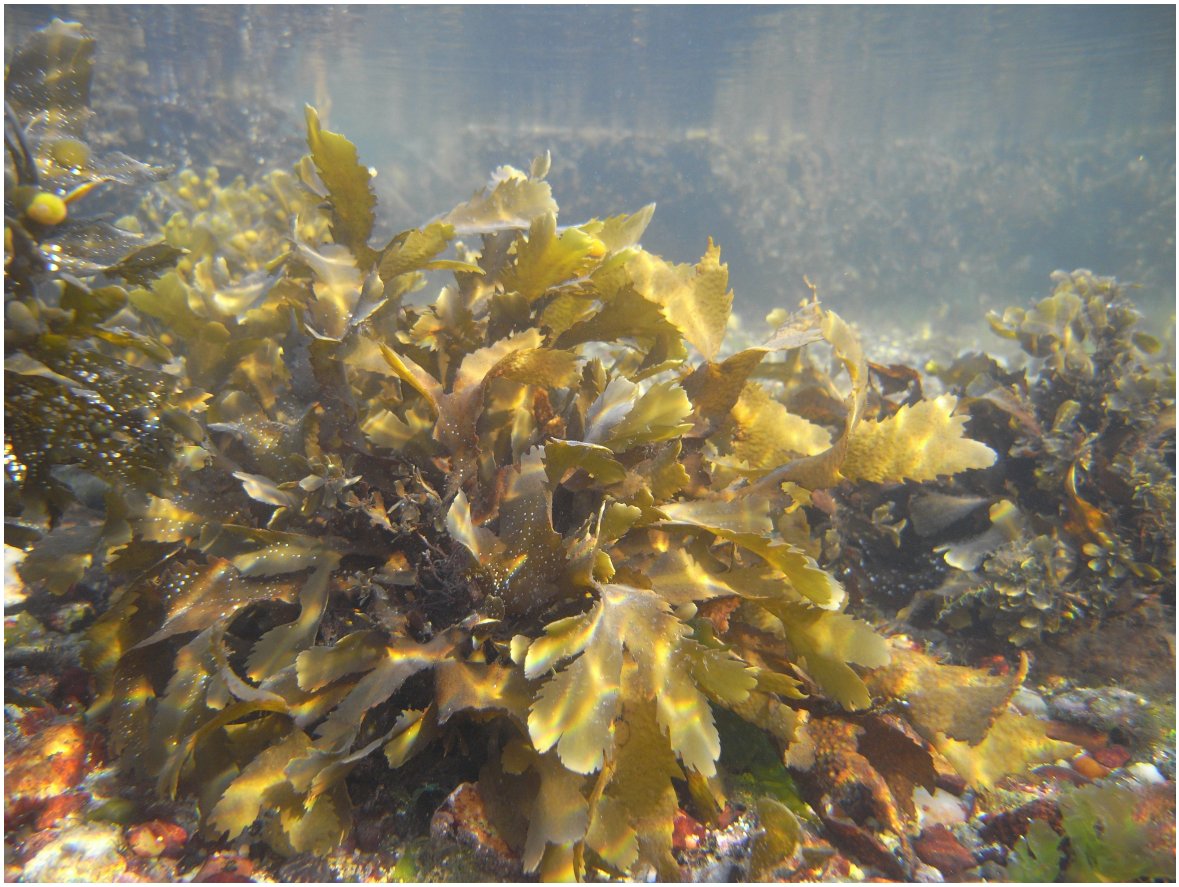
(v) Both zooplankton and phytoplankton densities and diversity were higher in the culture area. The culture rafts act as a refuge and shading to a variety of crustacean larvae thereby increasing the plankton abundance.

13. **Strengthening social security for the seaweed farmers:** The government of India should issue licenses to the seaweed farmers as done in the case of fishermen and also institute an insurance scheme for the seaweed farmers for risk mitigation and price support. Further, the construction of proper infrastructure facilities in the farming areas to store farming materials and seeds during cyclones or any extreme weather events has to be made. Kissan Credit Card (KCC) support should be extended to seaweed farmers and necessary efforts have to be made to provide adequate credit to the seaweed farmers.

14. **Create and nurture a domestic market for edible seaweeds:** The Government may consider boosting domestic consumption of seaweed to meet the growing nutritional requirement and bridge the large nutritional gap existing in the country. This may be done

through a focus on product development, marketing and championing. The Government may also consider the declaration of a "National Seaweed Day", for raising awareness of the benefits of seaweed.

15. **Seaweed-specific food safety standards** should be formulated and strictly implemented to boost consumer confidence in this new product line. Government should take steps to popularize seaweed-based nutraceuticals.
16. **Exploit the carbon trading potential of seaweed:** The Government may seek collaboration with suitable agencies to explore the potential of seaweed in carbon trading. Such strategies could be implemented in the protected areas, where other uses of the waters are prohibited. Such a low-impact activity, if viable can bring benefits to the communities living in the protected areas.
17. **Market intelligence and sensitization:** Market intelligence need to be strengthened and farmers need to be sensitized to plan harvest schedule to benefit from the best economic value.
18. **Seaweed Hub in Tamil Nadu**: The Tamil Nadu Government has made all plans to operationalize the Sea Weed Hub plan within a period of one year. Until then, appropriate norms and schemes may be drawn to facilitate private players to use the existing infrastructure with national and state research and academic institutions for quality seed production and supply. The regulatory issues in the proposed seaweed sites are eased/resolved in a time-bound manner and TN Govt may explore setting up a Seaweed Promotion Board, in alignment with its ambition to remain as the country's seaweed capital.



CONTENTS


SEAWEED
INDIA 2022
28-29 September 2022

1. Overview of the event

The two days' international conference, Seaweed India 2022, was held on the 28th & 29th of September 2022 in Chennai. It is one of the significant conferences conducted in India. Whole seaweed supply chain issues were discussed in detail. Most important was the well-organized interactions with Shri Jatindra Nath Swain, IAS, Secretary, Department of Fisheries, Government of India. The other important speakers and delegates at this conference were Mr. A Karthik, IAS, Principal Secretary, Animal Husbandry, Dairying, Fisheries and Fishermen Welfare Department, Government of Tamil Nadu, Chennai, Dr. K S Palanisamy, Commissioner of Fisheries, Government of Tamil Nadu, several industry stalwarts, entrepreneurs, scientists, and seaweed farmers (mostly women) who shared their thoughts on the subject.

Inaugural Session

Inauguration of Industry Expo Stalls

2. Session 1: Sectorial Overview

The first session focused on 'Seaweed Industry in India: An Overview' which was chaired by Dr. K.S. Palanisamy IAS, Commissioner of Fisheries, Govt. of Tamil Nadu.

The first presentation was given by Dr. K.S. Palanisamy IAS on "Seaweed Park in Tamil Nadu-Opportunities for Investors".

- Dr. Palanisamy elaborately explained the Detailed Project Report (DPR) prepared and submitted to the Union Govt of India on Seaweed Park in Tamil Nadu.
- He said the Seaweed Park in Tamil Nadu would have Hub 1 and Hub 2. Hub 1 will be established in Ramanathapuram District while Hub 2 will come in the Cauvery Delta basin in Pudukkottai District.
- Hub 1 will have an Elite Seaweed Seedling Production facility exclusively based on the tissue culture technique. Private Entrepreneurs would be encouraged to operate the facility on a lease basis for seedling production and mass supply. Space for R& D Centre will be allotted at the facility where CSIR-CSMCRI and ICAR CMFRI will provide technical support. Hub 2 will establishment of seaweed-based industries, a Training campus, an Administrative Office, and Incubation centers.
- In Hub 2 land, water supply, electricity supply, and drainage system will be provided to the industry. About 20 new entrepreneurs will be encouraged to start the industry in Hub 2
- The complete DPR was submitted to the Govt of India and sanction from Govt is expected at any time. The total budget is Rs. 122 lakhs, of which 60% is the contribution from the Central Govt and 40% is from State Govt.

The second presentation was made by Dr. A. Gopalakrishnan, Director, Central Marine Fisheries Research Institute (CMFRI), Cochin.

- He explained that CMFRI has identified areas along the Indian coast that are suitable for undertaking seaweed cultivation on a substantial scale.
- He said IMTA (Integrated Multi Tropic Aquaculture) trials and demonstrations combining Cage culture and Seaweed culture were successful. The harvest of Fish and seaweed could be increased by 20% more through IMTA. Seaweed absorbed ammonia and other nutrients released by the fish while fish got more oxygen that was released to the seawater surroundings by seaweed.
- He further said, in the study conducted by CMFRI for the last 20 years, they never come across any attachment of seaweed on a coral reef in Palk Bay and the Gulf of Mannar.

The third presentation was on "Seaweed Farming in India - Technologies Perspective" by Dr. Dinabandu Sahoo from the University of Delhi

- He narrated his successful endeavour in the cultivation of *Gracilaria verrucosa* in Chilka Lake, Orissa.
- He said India was very much lagging behind China and Indonesia in the commercial cultivation of seaweeds even though our fishers on some coasts have been doing it for the last 20 years.
- He highlighted the large-scale cultivation *of Laminaria*, *Enteromorpha*, and *Porphyra* being done in Japan.

The fourth presentation was on "Seaweed Farming in India and Environmental Perspective" by Dr. Deepak Samuel from National Centre for Sustainable Coastal Management (NCSCM), Chennai.

Explorative studies had been conducted by the Institute to understand the positive and negative impacts of *Kappaphycus alvarezii* introduction in Palk Bay and the Gulf of Mannar and the long-term impact due to *K. alvarezii* cultivation. He presented the following findings from the study:

- *K. alvarezii* occurrence on the coral reef was found in Krusadai, Shingle, and Mully Islands.
- No impact on nutrient concentration was observed due to *K. alvarezii* cultivation.
- Phytoplankton and zooplankton densities were considerably high
- Seaweed cultivation increased the biodiversity in the surrounding areas.
- No single plant of *K. alvarezii* was found in reef of Palk Bay.
- The invasion of *K. alvarezii* in Krusadai Island was not due to the spread from Palk Bay.

He pointed out that *K.alvarezii* cultivation can be very well carried out in Gulf of Mannar and Palk Bay inshore areas by adopting safe measures to ensure the health of coral reefs in these ecologically sensitive areas.

The fifth presentation was on "Seaweed Farming in India an Industrial Perspective" was by Shri. Abhiram Seth, Managing Director of Aquagri Industries P.Ltd., Delhi. He stressed the following points:

- *Kappahycus alvarezii* is a potential candidate for carbon sequestration.
- *K. alvarezii* has high potassium chloride.
- Organic biostimulants from *K. alvarezii* reduce the usage of chemical fertilizers by 25%.
- There is a huge opportunity for undertaking seaweed cultivation throughout the coastal stretches of India under PMMSY.
- However, no seed materials are available to culture in all maritime states. Therefore, there is an urgent need to import new strains of *K. alvarezii* to get a 5 times increase in growth.
- Deep sea cultivation should be encouraged to get more biomass and also to avoid the conflict between seaweed cultivators and fishermen while cultivation near-shore waters.
- New regulations are to be framed to increase the market potential.
- He appreciated NCSCM for the study and recommendations made in their report on the impact of *K. alvarezii* cultivation on the coral reef that Cultivation of *K. alvarezii* along the Palk Bay coast and Gulf of Mannar did not affect the Coral reef.

Presentation and discussion during Session on Sectorial Overview

Highlights and Recommendations

- The Palk Bay region from Nagapatnam to Ramanathapuram Districts of Tamil Nadu covering 293 Km of coastal areas had been allowed to grow seaweeds. In addition to the above, the coastal areas along the Kanyakumari, Kilakarai, and Yervadi along the Gulf of Mannar should be permitted to grow seaweeds since the adjacent Islands are situated more than 600 Km away from the shore.
- Common seaweed drying and storage facilities with appropriate construction designs and paraphernalia should be established to cater for the needs of the seaweed farmers and industries to protect the seaweed materials from cyclones and rainy seasons.
- The discussion made on the red seaweed *Kappaphycus alvarezii* brought out the following observations:

  a) This seaweed was brought into the magnitude of mass cultivation around 2003 in coastal areas. The starter seed material of 5.0g is being used to grow vegetative plants to date.

  b) The income generation through *K. alvarezii* was high till 2014 since a raft containing 60 Kg of seed material could produce up to 300 Kg of marketable seaweed within 45 days. In recent years the average yield has declined to 150 Kg.

  To overcome production/productivity problems, the following suggestions were made:

- Permission should be given to import the fast-growing, virulent, and viable strains of *Kappaphycus*, besides, other economically important seaweeds also to promote their cultivation in the Indian waters after following the biosafety regulations of the Government of India. It was also suggested to follow regulations similar to the import of *Penaeus vannamei* shrimp seeds into India. The Honorable Secretary, Government of India indicated that steps would be taken to import seed materials of seaweeds after necessary consultations. He also suggested that the import of seaweed material and promotion of large-scale cultivation in Indian waters should be taken up with a long-term vision since safety protocols concerning environmental clearance etc. are mandatory.
- Secondly, it is possible to produce robust and fast-growing seed material of *K. alvarezii* through micro-propagation and tissue culture techniques from the currently available seaweed material of *K. alvarezii*. Therefore, there is an immediate need to establish indoor and offshore facilities to establish seed banks for different cultivable seaweeds. Initially, we can follow the techniques promoted by the Scientists of the Philippines by taking 5.0 mm apical portions of *K. alvarezii* as inoculum and disinfecting them to remove pathogens like bacteria, etc., and grow them under controlled laboratory conditions by using seawater media amended with brown seaweed extracts as low concentration. Further, the seawater and nutrients like nitrate and phosphate, in particular, are replenished at regular intervals to achieve robust and faster growing seed materials, the process continuing for about nine months. Subsequently, they should be transferred to the open sea for further growth and development. This way grown seaweed should be supplied in lots to the seaweed farmers as seed material for mass

cultivation. The above procedure should be a continuous process to re-establish robust and fast-growing seed material for mass cultivation of seaweeds.

- Seaweed-based industries should be permitted to share the seawater circulation facility and areas of CSMCRI to undertake research for the promotion of production of robust and fast-growing seed materials of seaweeds and *K. alvarezii*, in particular initially, with the nominal fees as might be prescribed by the Institute.
- Environment Impact Assessments before initiating mass cultivation of seaweeds should be made mandatory.
- In addition to *K. alvarezii*, the native species of agarophytes like *Gracilaria*, alginophytes like *Sargassum*, and edible seaweeds like *Monostroma* and *Ulva*, should be given importance for mass cultivation. Among them, *Sargassum* has been harvested extensively for a long time from our coasts for alginate production, besides, using in the preparation of Bio-stimulants to increase the yields of different agricultural crops at low concentrations they contained not only macro- and micronutrients but also Plant Growth Regulators like Auxin and Cytokinins. Cultivation of *Sargassum* has been in vogue adopting two cultivation practices:
  a) Onshore/Indoor cultivation - For the liberation of oospores and growth and development into young seedlings on artificial reefs for 25 days.
  b) Inshore sea cultivation - The artificial reefs along with seedlings will be transferred to low tide areas at a depth of 1.5 meters for further growth and development. It will attain maximum harvestable size within 9 months. Harvesting the wet mass by leaving the holdfasts will be helpful for further growth and development in the subsequent cycles on the Artificial Reefs. The oospores were not only derived from the mother plants but also from the adjacent *Sargassam* plants that could attach and grow. Artificial Reefs can withstand seawater for more than 10 years and support seaweed growth.
- It was also suggested to create Deep sea cultivation models for seaweeds.

3. Session 2: Innovation Readiness of the Sector

The second session focused on the technologies and innovations developed by the research institutes and industries and their usefulness and commercialization.

The session was chaired by Shri. Chhabilendra Roul, IAS, Former Secretary, Department of Fertilizer, Government of India.

The first presentation was made on "Seaweed as a treasure house of bioactive compounds and nutraceuticals" by Dr. Kajal Chakraborty, Principal Scientist, ICAR-CMFRI.

- He emphasised that the seaweed nutraceutical market will reach $ 385 million by the year 2030
- He highlighted many pharma products developed by CMFRI which are commercialized.
- CMFRI has isolated several compounds from seaweed-associated Microbes.

- He pointed out the challenges in formulating the regulatory guidelines to enable the physician to prescribe the appropriate seaweed pharma product.
- He further pointed out that the low level of COVID-19-positive cases deducted in Japan is due to the consumption of seaweeds by Japanese people in their regular diet.

The second presentation was made by Dr. Veeragurunathan, Scientist in-charge, MARS, CSIR-Central Salt & Marine Chemicals Research Institute (CSMCRI) on "Technologies and value-added products developed by CSMCRI and their potential for commercialization"

- He highlighted the cultivation technologies developed by CSIR-CSMCRI for various industrially valuable seaweeds like *Kappaphycus alvarezii*, *Gracilaria edulis, G.debilis,* and *Gelidiella acerosa* adopting raft, long line rope, and cement stone methods.
- He informed that biostimulant extracted from *K. alvarezii* increases the yields of all land crops to 17-35%.
- He highlighted that CSIR-CSMCRI has successfully developed a novel technology for obtaining Agarose directly from *Gracilaria dura*.
- He told that the CSMCRI is recently working on using seaweed as animal feed.

The third presentation was done by Dr. Noladri, Senior Scientist, ICAR-Central Institute of Food Technology (CIFT) Kochi on "Opportunities and challenges of food and functional food from seaweeds".

- He said that fucoxanthin extracted from brown seaweeds, such as *Fucus, Laminaria, Sargassum*, and *Turbinaria* had been marketed to the tune of US$ 95 million in 2020.
- Fucoidan obtained from the same general market of US$.30 million
- He urged to use green chemistry for better quality and yield of land crops.
- The genus *Padina* is an excellent source for getting fucoxanthin.
- Turbinaria has rich Iodine content.
- Various snacks like Kurkure obtained from seaweeds are healthy for children.
- He emphasized the need for hygienic practice in handling and processing seaweeds.
- He further stressed that the intervention of modern technology is highly essential in drying and grinding practices.

Presentation and Discussion during Session on Innovation Readiness of the Sector

4. Session 3 (Parallel Session 1): Markets- Current & Future

The third session focused on the current market scenario and the future prospects of seaweed-based products. The lead presentation was given by Dr. M. Karthikeyan, Director, MPEDA. The following points were discussed and recommended for making policy decisions.

Species Selection

Though around 9900 species of seaweeds have been reported so far in the world (Khan et al. 2009), India has so far recorded 1153 species with a total wet standing crop of 6, 77, 309 to 6, 82, 759 tonnes (wet weight) (Subba Rao and Mantri 2006). Among the 1153 species standardized cultivation technology is profusely adopted in less than 10 species, of which, commercial technology is being practised only for *Kappaphycus alvarezii*.

Central Salt and Marine Chemicals Research Institute (CSMCRI – CSIR), Bhavnagar, and Central Salt and Marine Chemicals Research Institute (CMFRI – ICAR), Cochin have scientifically formulated the detailed modalities of cultivation of indigenous seaweeds - *Gracilaria* spp, *Gelidiella acerosa*, *Ulva* spp, *Enteromorpha* spp, *and Hypnea* spp. But these technologies were not yet commercialized due to various reasons that include detachment and dissemination of grown seaweed from the cultivation site before harvesting, irregular spore formation at the growth cycle, lack of proven standard income, seasonal dependency on the growth of some species, etc.

Commercial farming practices on a pilot scale were tried using *Gelidiella acerosa* by Central Salt and Marine Chemicals Research Institute – Marine Algal Research Station (CSMCRI – MARS), Mandapam Camp in Ervadi (Ramanathapuram - Gulf of Mannar region) funded by the Department of Biotechnology, New Delhi. Also, the Tamil Nadu Forest Department – Gulf of Mannar Biosphere Reserve Trust (GOMBRD), Ramanathapuram, and Department of State Fisheries – Ramanathapuram funded various projects for the cultivation *of Gracilaria* spp from 2003 to 2020 to achieve a standard regular income for Self Help Groups (SHG's), but certain flaws restricted them from actually achieving the goal. So, the industrialists desired to import viable plantlets of *Kappaphycus* from South Asian countries like Indonesia and the Philippines owing to its success stories in those countries in commercial farming since 2003.

Based on the viable results, industrialists have now been recommending the following species for India as commercially cultivated in the world: 1. *Kappaphycus alvarezii;* 2. *Eucheuma denticulatum;* 3. *Porphyra* sp*;* and 4. *Gracilaria* sp.

Formidable challenges in Kappaphycus farming

In India, the growth of *Kappaphycus* has been affected by climate change, lack of wave motion in some coastal areas, fluctuation in the nutrient contents of seawater, etc., from 2013 onwards. The result was that many growers did not further turn up for seaweed farming.

The appropriate solution would be the import of viable plantlets of *Kappaphycus alvarezii*, aimed at promoting sustainable seaweed farming (more so by extending farming areas and utilizing the feasible sites of the deep sea). It is the need of the hour to facilitate the seaweed growers by providing viable seed material.

Micro Propagation of Kappaphycus

Micropropagation of *Kappaphycus alvarezii* was succeeded in India way back in 2001 by Scientists of CSMCRI, Bhavnagar and subsequently, the field trials were conducted in CSMCRI – MARS, Mandapam Camp, Ramanathapuram. However, the observed results were not encouraging after a few generations and the tissue-cultured propagules acted like a parent. In the biological world, there is no scientific report on the success story of commercial utilization of micro-propagated *Kappaphycus* plantlets, though it exists in Juvenile form.

Seaweed micropropagation techniques involve growing the explants in the nutrient-rich medium under optimum physicochemical conditions but it does not involve any nuclear modifications as in higher plants. Further, micropropagation requires considerable time and huge infrastructure facilities. For instance, one hectare of *Kappaphycus* farming needs 50,000 propagules/plantlets/seed plants (10000M x 20 cm spacing). Further, a minimum tenure of 6 months is required to produce 50,000 propagules/plantlets/seed plants. In one hectare area, only one family of 3 to 4 members (with an output of 15 to 20 Tons) can be rehabilitated along the coast.

To prevent the loss of initial investment in infrastructure development and longtime consumption for micropropagation, it is ideal to go with importing more plantlets from different locations in different countries. Further, it is better to bring *Kappaphycus* sp to achieve maximum scale in the field of commercialisation by the coastal fishers/entrepreneurs in India.

Exporting Raw seaweed

As per the National Biodiversity Act 2002, all brown and red seaweeds are banned to export as raw material. As for as cultivated species (e.g., *Kappaphycus* sp) are concerned, permission is required from the National Biodiversity Authority (NBA), Director General of Foreign Trade (DGFT), and Marine Products Development Authority (MPEDA).

It is the need of the hour to simplify the procedures concerned with the export of dried raw seaweed to enhance the foreign exchange on one hand and to get high prices for their produce by the growers on the other hand.

Bionutrients / Biostimulants

Bionutrients / Biostimulants are being utilized by the farmers (as foliar spray – liquid or as granules or as powder) for crop improvement and good yield. Augmented growth and nutrient content of crops and yield were reported in most of the Indian crops by various Government and non-government agencies as well as various industries. Further scientific research is required by using certain productive techniques and it is possible for the identification, isolation, production, and commercialization of certain bioactive components from the potential stock of promising seaweeds.

Further, these potential bio-nutrients should be promoted for the use of farmers by the Department of Agriculture in India.

Bio-invasion of Kappaphycus alvarezii

In Kurusadai and Van Islands, the *Kappaphycus alvarezii* occupied the spaces of *Acropora* corals which was claimed as Bio-invasion by the officials of the Forest Department. But, as per the Environmental Impact studies conducted by various Government Agencies, viz., CSMCRI

– Bhavnagar (CSIR Institute), Madras University – Chennai, and National Centre for Sustainable Coastal Management (NCSCM – Institute under MoEFCC), Chennai, there is no adverse impact and evidence of bio-invasion caused by *Kappaphycus* cultivation in spite of commercial farming going on since 2003 in Palk Bay waters. The Impact of *Kappaphycus* has to be studied in cultivation areas and not in abandoned cultivation sites which are not accessible even to remove the residual debris.

In Kurusadai Island, the bioinvasions report was published in Current Science by academicians in May 2008. This happened due to the following reason:

The CSMCRI – MARS, Mandapam Camp had carried out a commercial field trial cultivation of *Kappaphycus alvarezii* in Kurusadai island (near the abovementioned bioinvasion reported area) from 2000 to 2003 and during this period the Island was under the control of the Department of Fisheries. Once this Island came under the control of the Tamil Nadu Forest Department, they forced the officials of CSMCRI - MARS, Mandapam Camp to evacuate their infrastructure and operations immediately. So, the CSMCRI MARS, Mandapam Camp officials abandoned their *Kappaphycus* farms. This led to the possible of escaping of *Kappaphycus* plantlets to surrounding areas to a limited extent. The drifting plantlets were trapped in branched *Acropora* corals, and started growing within the spaces between branches of colonies. From 2008 to till date, this issue lacked scientific management control. After the bioinvasion report, *Kappaphycus* buying companies were interested to fund the corrective measures along with Tamil Nadu Forest Department. But Tamil Nadu Forest Department started an initiative on its own to control this bio-invasion.

Now also, industrialists are willing to fund the implementation of corrective measures if the Tamil Nadu Forest Department allows them for removing *Kappaphycus* patches from the above-said island by implementing scientific management control under their intensive supervision. Since the industrialists are enthusiastic about promoting seaweed culture as an alternative livelihood prospect to the coastal fishers, appropriate measures have to be put in place to mitigate the entrapment of fragments of the aforesaid seaweed on corals.

Regulating the Companies

Kappaphycus cultivation technology in India was developed by Central Salt and Marine Chemicals Research Institute, Bhavnagar (CSMCRI – CSIR) and after repeated experimentation and domestication at Mandapam, PepsiCo India Holdings Pvt. Ltd., Gurgaon, took up this cultivation after getting it transferred in 2001 and expanded the same on the Palk Bay side of the Bay of Bengal from 2003 onwards. It was also taken up by self-help groups (SHGs) for their livelihood. Aquaculture Foundation of India (AFI, Chennai) was instrumental to introduce five members' of Self-Help Groups (SHGs) through a project sanctioned by the Department of Biotechnology (DBT) to rehabilitate Tsunami affected families in Ramanathapuram and Pudukkottai Districts. In July 2008, PepsiCo India Holdings Pvt. Ltd., Gurgaon, transferred this project to Aquagri Processing Pvt. Ltd., New Delhi. The SHGs were trained by the Aquaculture Foundation of India (AFI, Chennai) and facilitated by PepsiCo India Holdings Pvt. Ltd., Gurgaon, and Aquagri Processing Pvt. Ltd., New Delhi with buyback arrangements made with State Bank of India in the coastal waters of Ramanathapuram, Pudukkottai, Tuticorin and Tanjore districts in Tamil Nadu.

In 2012, several companies came forward to purchase this *Kappaphycus* seaweed without involving themselves in any facilitation work, like buyback agreement, loan arrangement, monitoring the cultivation forms, etc. This was a major setback in *Kappaphycus* farming promotion. The only positive impact was that the growers got a higher price for their produce for one year (2012). But, during this period, the farmers were not following the crop logging procedure stipulated harvesting period (many harvested before the stipulated 45 days to get immediate money), less initial seed material (seeding less than the recommended 150 gm plantlets to save money), drying procedure (they sold product with high moisture content), etc. This was also one of the major reasons of decreased growth/non-viability of *Kappaphycus* seaweed.

Government can work out a suitable screening mechanism to avoid these conflicts among producers and buyers.

Seaweed Training Program

In the coastal waters of Ramanathapuram, Pudukkottai, Tuticorin, and Tanjore, several training programmes (multiple training programs) were conducted by the Aquaculture Foundation of India (AFI), Chennai – DBT Project, NFDB Project, and FIT Project, CSMCRI – MARS, Mandapam Camp, CMFRI – Mandapam Camp, State Fisheries Department – Ramanthapuram, Rameshwaram and Mandapam, and CAS in Marine Biology, Annamalai University, Parangipettai – NFDB Project. More than 1000 fishers were trained and more than 620 fishers were rehabilitated from 2006 onwards through DBT, NFDB, and FIT projects by AFI Chennai. But, due to lesser growth and production output, most of the fishers did not pursue seaweed farming since 2014. Evidently, mere training does not fulfil the purpose of the rehabilitation program but what is important is the motivation and capacity building to successfully pursue the enterprise.

So, to rehabilitate the fishers, we have to ensure a regular supply of seaweed plantlets to start commercial cultivation and handholding support in following best management practices under guidance.

Presentation and Discussion during Session on Markets- Current & Future

5. Session 3 (Parallel Session 2): Regulatory Frameworks

The third session focused on the current policies and the need for developing regulatory frameworks to help the faster growth of the sector.

The session was chaired by Mr. M.G. Arumugam, Additional Director, Department of Fisheries, Government of Tamil Nadu.

Highlights and Recommendations:

- The conflicts that might arise between the fishing fleet owners and seaweed growers due to the access to the same space in the open sea are to be settled and managed in a balanced approach.
- Since the forest department is keen on the protection of the environment in Palk Bay and the Gulf of Mannar region, there should be a coordinated and concerted effort to identify suitable places for seaweed farming and for wild collection of seaweeds without any disturbance to the existing ecosystems of Palk Bay and Gulf of Mannar.
- The Gulf of Mannar has been declared a National Park and further, has been included in the Ramsar Convention recently. Hence, the scope for the culture of invasive species like *Kappaphycus* in the Gulf of Mannar Biosphere Reserve seems to be very limited and hence, there should be proper guidelines to promote the wild collection of natural seaweeds by providing scope for the rejuvenation of native seaweeds in the GoM.
- Since Palk Bay is identified as one of the potential places for the Promotion of Seaweed farming, a baseline survey has to be conducted to demarcate the locations/areas for the culture of seaweeds.

- An urgent measure has to be taken to establish a legal framework and policy guidelines for the promotion of Seaweed farming in the Palk Bay Region.
- At present, dry seaweed is listed in the import guidelines of the Dept of Agriculture, GoI.
- Action has to be initiated to include live seaweed in the importation list for which PQ forms 23 and 24 have to be submitted through the Department of Quarantine.
- The fisheries department, Govt of Tamilnadu, has to identify potential agencies abroad to facilitate the import of quality live seaweed and germplasm.
- Concerted efforts have to be taken to collaborate with research institutes in the establishment of the Hub-1 facility in the proposed seaweed park.

Presentation and Discussion during Session on Regulatory Frameworks

6. Session 4: Global Perspectives and Experience Sharing

The fourth Session focused on 'Global and regional perspectives on seaweed mariculture and lessons for India'. The lead presentation was made by Dr. Simon Funge Smith, Director, APFIC, Bangkok & Senior Fishery Officer, FAO, Regional Office, Bangkok.

Global Perspectives & Experience Sharing: Highlights and Recommendations

- Spatial planning has to be done to resolve conflicts with different sectors;
- Formulation of food safety standards for seaweed products;
- Improve nearshore systems complemented with insurance and stabilization of the market price;
- Explore offshore opportunities for culture (e.g., Conduct pilot study, focus on technological improvements, etc.);
- Integrated multi-trophic aquaculture should be given prominance for promoting seaweed farming;
- India should have specific policies for seaweeds like in the Philippines;
- Regulation of wild seed gathering for culture is to be ensured;
- Enhancement of Biosecurity measures should be in focus;
- Integration of the seaweed sector in climate change adaptation planning is to be among the priorities;
- Steering multi-stakeholder partnership is to be explored;
- India should have a code of good aquaculture practices for seaweed; and
- Seaweed tissue culture should be popularized.

Presentation during Session on Global Perspectives and Experience Sharing

7. Overall Issues identified and possible interventions

Issue: ***The seaweed production potential of India is estimated at 10 million tonnes. Against this potential, the current production is sticky at 34, 000 tonnes (0.0034%) only. Over-dependence on Kappaphycus alvarezii, which is losing its virulence for fast growth and becoming disease-prone is a major factor for slow growth.***

Possible interventions: A two-pronged strategy is suggested. First, new varieties and strains of different seaweeds and standardized culture methodologies for both indigenous and exotic species may be imported. Second, private players may be encouraged and given sops to produce planting material for uninterrupted supply. However, considering the challenges in importing live seaweed, indigenous research with the end objectives of industrial application must be promoted. There is also a need to establish seaweed seed banks for candidate species and conduct genetic improvement programmes to ensure a timely and steady supply. A pilot study on integrated multi-trophic aquaculture (IMTA) in fish cages may be conducted for increasing the production of seaweed. Technical collaborations with the institutes, such as SEAFDEC, JIRCAS, etc. could be explored.

Issue: **Seaweed rafts anchored in the nearshore region pose problems to the fishing crafts operating in the area.**

Possible interventions: The concerned State Government should consider carrying out marine spatial planning in the territorial waters and demarcate the areas for seaweed farming in a democratic and consultative manner. A committee for spatial planning should be formed to study the level of seaweed farming suitability. Affected fishers may be given preference and adequate support to move to seaweed farming.

Issue: **The near-shore waters are congested due to fishing activities and further due to global warming, the temperature in the near-shore waters is increasing and it may become unsuitable for growing Seaweeds. Therefore, seaweed farming in deep-sea/offshore waters may be explored.**

Possible interventions: The waters beyond 12 nautical miles come under the jurisdiction of the Union Government. Therefore, the Government of India may consider devising a regulatory framework for area allocation and seaweed culture in offshore waters. Research institutes can explore sites for seaweed cultivation. Potential regions which cannot be used for fishing at Sea due to the presence of rocks on the bottom may be identified. The State Government, which is primarily responsible for fisher's welfare, should devise a complimentary framework to support such an initiative.

Issue: **Several countries have banned the export of live seaweed over concerns about biosecurity and invasion**.

Possible interventions: Government should take initiatives to import live seaweed on a Government-to-Government basis. Also, a proper framework needs to be developed for the import of planting material with all adequate checks and balances in place. Since the purview of importing and quarantine falls under different departments, the Government of India should facilitate the smooth flow of the import process by forming an inter-departmental coordination committee.

Issue: **Leading seaweed-producing countries like Indonesia and the Philippines have seaweed-specific policies. In India, there are no such regulations and policies.**

Possible interventions: Framing of seaweed-specific policy guidelines with a special focus on promoting conservation of wild seaweed species, strengthening infrastructure for consistent supply of seedlings, enhanced biosecurity measures, and integration of seaweed sector in climate change planning is to be immediately taken up. While preparing the framework, Government should involve Research institutions, Private organizations, and Farmers. Also, Code for Good Aquaculture Practices for seaweed and a National Seaweed policy should be devised.

Issue: **In India, there are no proper seaweed quarantine facilities unlike for fish and plants**

Possible interventions: Infrastructure needs to be addressed for quarantine procedures of seaweed in India. Further, as in the case of plants, the private sector can be licensed to have a Seaweed quarantine facility, following the procedures given by the research committee. Research institutes should devise a procedural framework for Seaweed quarantine. However, this policy is subject to a larger decision on importing live seaweed.

Discussion session with Secretary, Department of Fisheries, Government of India

Media Coverage of the Event

THE TIMES OF INDIA

Tamil Nadu: 'Seaweed the next big thing in agriculture'

KOMAL GAUTHAM / TNN / Sep 29, 2022, 04:53 IST

A Karthik, principal secretary, animal husbandry, dairying, fisheries and fishermen welfare department inaugurating the national conference on seaweed on Wednesday

CHENNAI: Tamil Nadu has identified land in Ramanathapuram and Pudukottai to set up a 128 crore seaweed park and is awaiting the Centre's nod. "Seaweed is the next big thing in agriculture as its uses are diverse and potential untapped," said commissioner of fisheries K S Palanisamy at a national conference on seaweed here on Wednesday.

The full potential of the seaweed is yet to be realized as it is only being used by the pharmaceutical and food industry now, he added.

Making Tamil Nadu "a one-stop destination for the seaweed sector"

Indian officials have voiced their ambitions for the growth of the seaweed sector at the Seaweed India Conference, which opened in Chennai today.

A Karthik inaugurating the Seaweed India Conference in Chennai

SOCIAL NEWS XYZ

TN to become hub for seaweed industry

BUSINESS

PUNJAB NEWS EXPRESS

AE All-round English

Chennai, Sep 28 (Ajit Weekly News) Tamil Nadu will become a seaweed industry hub with its proposed seaweed park, and the state government is on a mission mode to uplift the seaweed farming, said a senior state government official.

Inaugurating the Seaweed India-2022 Conference here, A. Karthik, Principal Secretary Animal Husbandry, Dairying, Fisheries and Fishermen Welfare Department, said the state is poised for growth as a modern seaweed hub.

"We are creating a unique opportunity for the investors and entrepreneurs to make Tamil Nadu a one-stop destination for the seaweed sector," he said.

The two-day conference is organised by Smart Agripost jointly with Bay of Bengal Programme (BOBP) and Central Marine Fisheries Research Institute at National Centre for Sustainable Coastal Management (NCSCM) Auditorium.

"The government is on a mission mode to uplift the seaweed farming in the state with an integrated, tech-savvy and end-to-end approach catering to the need of fishers, industries and new entrepreneurs of the seaweed industry," he said.

Karthik said despite various efforts, the potential of seaweed farming at home remains unrealised.

"The current annual demand of seaweed in Tamil Nadu for industrial use is about 115 thousand tonnes while the current production is staggering around 15 thousand tonnes, which is 13 per cent of the installed processing capacity", Karthik added.

become hub for seaweed industry

mber 28, 2022 03:50 PM

amil Nadu will become a seaweed industry hub with its proposed rk, and the state government is on a mission mode to uplift the seaweed farming, said a senior state government official.

Inaugurating the Seaweed India-2022 Conference here, A. Karthik, Principal Secretary Animal Husbandry, Dairying, Fisheries and Fishermen Welfare Department, said the state is poised for growth as a modern seaweed hub.

ue opportunity for the investors and entrepreneurs to top destination for the seaweed sector," he said.

s organised by Smart Agripost jointly with Bay of Bengal Central Marine Fisheries Research Institute at National stal Management (NCSCM) Auditorium.

ission mode to uplift the seaweed farming in the state integrated, tech-savvy and end-to-end approach catering to the need of he seaweed industry," he said.

TN to become hub for seaweed industry

By info@ Chennai, Sep 28 (IANS) Tamil Nadu (NS:) will become a seaweed industry hub with its proposed seaweed park, and the state government is on a mission mode to uplift the seaweed farming, said a senior state government official.

Inaugurating the Seaweed India-2022 Conference here, A. Karthik, Principal Secretary Animal Husbandry, Dairying, Fisheries and Fishermen Welfare Department, said the state is poised for growth as a modern seaweed hub.

"We are creating a unique opportunity for the investors and entrepreneurs to make Tamil Nadu a one-stop destination for the seaweed sector," he said.

The two-day conference is organised by Smart Agripost jointly with Bay of Bengal Programme (BOBP) and Central Marine Fisheries Research Institute at National Centre for Sustainable Coastal Management (NCSCM) Auditorium.

"The government is on a mission mode to uplift the seaweed farming in the state with an integrated, tech-savvy and end-to-end approach catering to the need of fishers, industries and new entrepreneurs of the seaweed industry," he said.

Karthik said despite various efforts, the potential of seaweed farming at home remains unrealised.

UNI BREVITY ACCURACY SPEED

United News of India

India's Multi Lingual News Agency

Wednesday, Apr 12 2023 | Time 12:39 Hrs(IST)

TN poised to grow as modern seaweed hub

Chennai, Sep 28 (UNI) Unveiling the state government's plan to upscale seaweed farming, a top official today said that Tamil Nadu was poised for growth as a modern seaweed hub with the setting up of multi-purpose

Tags: #TN poised to grow as modern seaweed hub

Please log in to get

SEAWEED
INDIA 2022