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7th INDIA INTERNATIONAL SEAWEED EXPO & SUMMIT 2026:

Seaweed Treasure Hunt-Indian Seaweed Sector (IISE&S 2026)

Organized by

INDIAN CHAMBER OF COMMERCE

CENTENARY (1925 to 2025)

Co-organized by

ICAR CMFRI

CSIR CSMCRI

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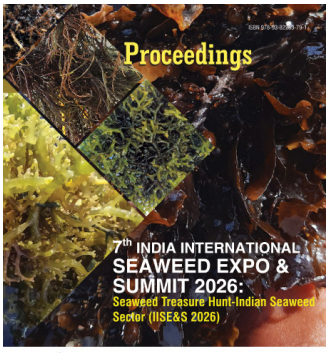
सीएसआईआर CSIR भारत का नवाचार इंजन The Innovation Engine of India सी एस एम सी आर आइ CSMCRI



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29-30 January 2026
at ICAR-CMFRI, Kochi

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MESSAGE

It gives me immense pleasure to know that the Proceedings of the 7th India International Seaweed Expo and Summit are being published as a valuable record of the important deliberations and recommendations that emerged during the event. The summit, held on 29-30 January 2026 at ICAR-Central Marine Fisheries Research Institute, Kochi, provided an important platform for bringing together policymakers, scientists, industry leaders, entrepreneurs, financial institutions, and coastal stakeholders to discuss the future of India's seaweed sector. Seaweed is increasingly being recognized as a strategic marine bioresource with significant potential to contribute to sustainable coastal livelihoods, nutritional security, climate resilience, and industrial growth. Its applications in food, nutraceuticals, pharmaceuticals, agriculture, bio-stimulants, biodegradable materials, and renewable energy make it an important resource for supporting India's blue economy aspirations. The growing policy emphasis under the Pradhan Mantri Matsya Sampada Yojana has provided a strong impetus for scaling up seaweed cultivation and value addition in the country.

The summit discussions clearly highlighted that while significant progress has been made in recent years, India still has immense untapped potential in seaweed cultivation and utilization. Challenges such as seed availability, species diversification, fanning infrastructure, processing facilities, regulatory clarity, financing, and market linkages need to be addressed through a coordinated and mission-oriented approach. There is a clear need for stronger convergence among research institutions, government agencies, industry, financial institutions, and coastal communities to build an efficient and resilient seaweed value chain.

This proceedings volume is a timely and important compilation of the knowledge, experiences, and recommendations shared by diverse stakeholders during the summit. It will serve as a useful reference for policymakers, researchers, industry, and entrepreneurs in shaping future strategies and actions for the sector. I congratulate the organizers for their efforts in hosting this important event and bringing out this publication. I am confident that the insights captured in this volume will help accelerate India's journey toward becoming a global leader in sustainable seaweed production, value addition, and innovation.

23/04/2026

सीएसआईआर
CSIR
भारत का नवाचार इंजन
The Innovation Engine of India
सी एस एम सी आर आइ
CSMCRI

Dr. Arup Ghosh
Director, CSIR CSMCRI
CSIR-CENTRAL SALT &
MARINE CHEMICALS RESEARCH INSTITUTE

FOREWORD

India's vast coastline, rich marine biodiversity, and favourable agro-climatic conditions provide a strong foundation for the development of a vibrant and sustainable seaweed sector. In recent years, seaweed has emerged as a strategic marine resource with immense potential for enhancing coastal livelihoods, strengthening nutritional security, supporting climate resilience, and driving innovation across agriculture, food, pharmaceuticals, cosmetics, and bio-based industries. Recognizing this immense opportunity, the Government of India has accorded high priority to seaweed cultivation and value addition under the Pradhan Mantri Matsya Sampada Yojana, with dedicated investments and policy support to build a robust production and value-chain ecosystem.

The 7th India International Seaweed Expo and Summit, organized on 29-30 January 2026 at ICAR-Central Marine Fisheries Research Institute, Kochi, was a significant milestone in India's seaweed development journey. The summit brought together senior policymakers, scientists, financial institutions, entrepreneurs, startups, industry leaders, and coastal community stakeholders to collectively review sectoral progress, identify bottlenecks, and deliberate on the way forward. The event reflected the growing national momentum toward harnessing seaweed as an important pillar of the blue economy.

The deliberations highlighted that while notable progress has been made in recent years through targeted policy interventions, establishment of seaweed clusters, centres of excellence, seed banks, and industry-led innovations, India's current production remains far below its true potential. It was strongly felt that the time has come to move from fragmented pilot initiatives to a coordinated, mission-driven, and outcome-oriented approach for scaling up cultivation, improving seed systems, strengthening processing infrastructure, and promoting value-added applications.

This proceedings volume is an important compilation of the knowledge, insights, and recommendations shared during the summit. It reflects the collective wisdom of experts and stakeholders and presents a clear roadmap for accelerating the structured growth of India's seaweed sector. I am confident that this publication will serve as a valuable resource for policymakers, researchers, entrepreneurs, investors, and coastal communities, and will help guide future actions toward making India a global leader in sustainable seaweed production and innovation.

10/04/2026

ICAR
CMFRI

Dr Grinson George
Director
ICAR-Central Marine Fisheries Research Institute

PREFACE

The Proceedings of the 7th India International Seaweed Expo and Summit have been prepared to document the key discussions, recommendations, and strategic insights that emerged during this important national event held on 29-30 January 2026 at ICAR-Central Marine Fisheries Research Institute, Kochi. The summit served as a timely platform for reviewing the progress made in India's seaweed sector, understanding persisting challenges, and collectively shaping a future roadmap for sustainable expansion.

Seaweed is increasingly being recognized as a multi-dimensional marine resource with applications in food and nutrition, nutraceuticals, pharmaceuticals, agriculture, animal feed, bio-stimulants, bioplastics, climate mitigation, and renewable energy. Over the last several years, India has made important strides through focused policy support, scientific research, and field-level demonstrations. Institutions such as ICAR-Central Marine Fisheries Research Institute, CSIR-Central Salt and Marine Chemicals Research Institute, ICAR-Central Institute of Fisheries Technology, and the National Fisheries Development Board, along with state fisheries departments and private industry, have laid a strong scientific and institutional foundation for the sector.

Despite this progress, several challenges continue to hinder large-scale adoption and commercialization. These include limited access to quality seed material, inadequate nursery infrastructure, lack of improved strains, regulatory uncertainties, fragmented market linkages, insufficient processing facilities, and the need for stronger farmer capacity building. The summit discussions emphasized that addressing these challenges requires coordinated policy support, institutional convergence, sustained investment, and stronger partnerships among government, research institutions, industry, financial agencies, and coastal communities.

This publication brings together the valuable perspectives, technical inputs, and practical recommendations shared by participants across sessions. It presents actionable short, medium, and long-term strategies to support India's transition from small-scale pilot efforts to a globally competitive seaweed sector. We hope that this publication will serve as a useful reference for policymakers, researchers, entrepreneurs, development agencies, and all stakeholders committed to unlocking the full potential of seaweed as a key contributor to India's blue economy and sustainable coastal development.

Yours sincerely

15/04/2026

INDIAN CHAMBER OF COMMERCE

CENTENARY (1925 to 2025)

Rajeev Singh
Director General
Indian Chamber of Commerce

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Background

The Government of India has identified seaweed cultivation and value addition as a priority area under the blue economy, owing to its potential for livelihood generation, climate resilience, nutritional security, and industrial applications. The Government has allocated a total budget of Rs. 640 crores under the PMMSY (Pradhan Mantri Matsya Sampada Yojana) for seaweed cultivation in India from 2020 to 2025. The Government of India has identified and prioritized seaweed resources as critical to the blue economy growth and has initiated various initiatives such as seed banks, seaweed parks / clusters / CoE, improved seaweed germplasm, climate resilient village and farming models to expand and strengthen the seaweed production ecosystem and value chain.

In this context, the 7th India International Seaweed Expo and Summit was organised on 29th & 30th January 2026, at ICAR-CMFRI, Kochi to review sectoral progress, deliberate on key challenges, and outline a future course of action for the structured development of the seaweed sector in India.

The Summit witnessed participation from senior officials of the Government of India and State Governments, national research institutions, financial institutions, industry representatives, startups, international experts, and coastal community stakeholders.

Deliberations highlighted that despite India's long coastline, favourable agro-climatic conditions, and decades of scientific research, current seaweed production remains far below national potential.

While important progress has been made through policy interventions under PMMSY, establishment of centres of excellence, seaweed clusters, and seaweed parks, the sector continues to face challenges related to scale, seed availability, species diversification, product development, regulatory clarity, financing, and value-chain integration.

The Summit noted with emphasis that the last 7–8 years have marked a clear inflection point in the sector, driven by strong policy recognition, inter-ministerial coordination, and increased industry participation. Institutions such as ICAR–CMFRI, CSIR–CSMCRI, ICAR–CIFT, NFDB, and state fisheries departments have laid a robust scientific and institutional foundation. Industry-led innovations in mechanised and offshore cultivation, bio-stimulants, functional foods, nutra/pharma/cosmeceuticals, energy, industrial bio-products and their application in marine, agriculture, medical sector were recognised as critical enablers for scaling up the sector in the future. Discussions across technical and policy sessions converged on the need to move decisively from pilots and fragmented initiatives toward coordinated, time-bound, and outcome-oriented implementation, with clear roles across Government, research institutions, industry, financial agencies, and coastal communities.

Takeaways

The two-day summit brought together policymakers, researchers, industry leaders, entrepreneurs, and coastal community representatives to deliberate on the current status, challenges, and future roadmap for India's seaweed sector. The following takeaways directly reflect the suggestions, concerns, and proposals articulated by the speakers across sessions. Seaweed derivatives are gaining prominence in agriculture sector as biostimulants and organic fertilizer; in human nutrition and health sector as nutraceuticals and functional foods; in livestock sector as methane emission control agents and performance enhancers; in climate change mitigation, carbon credit systems and as biodegradable polymers / plastics; and in energy sector as potential renewable biofuels. Supply-demand gap, seed shortage, lack of improved strains, species diversification, modernization / transition of farming systems, location-specific environmental challenges, regulatory hurdles and lack of cohesive governance were identified as the major challenges. Rigorous policy dialogues and guidelines, simplified regulatory ecosystem, sustainable seed banks, nearshore to offshore farming systems, capacity building of stakeholders, modernization of the value addition infrastructure, vertical integration and market facilitation, and enhanced coordination between the policy makers, funding agencies, research institutions, industries, farmers / entrepreneurs were suggested as the way forward to build India's seaweed sector and establish it as a seaweed powerhouse globally.

Establish a National Seaweed Mission

Create a dedicated National Seaweed Mission under the Ministry to coordinate policy, funding, and implementation across fisheries, agriculture, MSME, biotechnology, and coastal development sectors.

The Mission should have clearly defined targets for cultivation area, farmer inclusion, processing capacity, and export value.

Notify a Clear Regulatory Framework for Seaweed Farming

Issue a uniform national guideline clarifying leasing, licensing, and environmental approvals for seaweed farming in coastal and island regions.

Provide Financial Incentives and Risk Coverage for Farmers

Introduce capital subsidies, soft loans, and insurance products tailored to seaweed farmers, especially first-time coastal entrepreneurs and SHGs. High initial risk due to weather, crop loss, and market uncertainty, discourage small farmers from scaling up.

Strengthen Seed, Nursery, and Germplasm Infrastructure

Invest in certified seaweed nurseries, tissue culture labs, and germplasm banks to ensure consistent availability of high-quality planting material. Seed scarcity and inconsistent quality -remain major bottlenecks for commercial expansion. Funding mechanisms should also support nurseries after completion of project to enable the sustained delivery of quality planting materials in an efficient and reliable manner.

Support Decentralized Processing and Value Addition Units

Promote cluster-based primary processing units (drying, grading, powdering) near cultivation sites through MSME schemes, SHG, FFPOs. This responds directly to concerns about post-harvest losses, low farm-gate prices, and dependence on distant processors.

Create Assured Market Linkages and Public Procurement Pathways

Develop assured offtake mechanisms through government-backed procurement, price discovery platforms, and linkages with food, pharma, cosmetic, agri and bio-input industries. There was an emphasis that market uncertainty, rather than cultivation practices, is the main constraint faced by farmers.

Invest in R&D for High-Value Applications

Allocate targeted funding for R&D on seaweed-based nutraceuticals, bio-stimulants, animal feed, energy, cosmeceuticals, bioplastics, and pharmaceuticals, with clear pathways for lab-to-market translation. Industry and academic speakers stressed that India risks remaining a raw material supplier without application-driven innovation.

Build Skills and Extension Systems for Coastal Communities

Launch structured training, certification, and extension programs for seaweed cultivation, processing, and entrepreneurship through ICAR institutes, universities, and coastal livelihood missions. Speakers highlighted the absence of trained extension personnel and standardized best practices.

Promote Seaweed as a Climate and Sustainability Solution

Formally recognize seaweed farming within blue economy, climate resilience, and carbon mitigation strategies, including exploration of carbon credits and ecosystem service valuation. Several speakers underscored seaweed's role in coastal protection, nutrient absorption, and low-input farming.

Enable Export Facilitation and Quality Standards

Develop India-specific quality standards, traceability systems, and export facilitation mechanisms for seaweed and seaweed-derived products. Exporters and processors highlighted regulatory gaps, inconsistent quality benchmarks, and lack of international certifications as barriers to global competitiveness.

Actionable Recommendations

Timely policy support, coordinated institutional action, and sustained investment can transform the sector into a major pillar of India's blue economy. The following actionable recommendations are proposed for consideration by the Ministry of Fisheries, Animal Husbandry & Dairying, Government of India.

Short-Term (0–2 Years)

Notify interim guidelines for seaweed leasing and farming across coastal states

These guidelines should clearly define eligibility, tenure, environmental safeguards, and permissible species to reduce uncertainty for states and investors. A uniform framework will enable faster approvals while allowing states to adapt implementation to local coastal conditions.

Support pilot seaweed clusters in priority states and UTs
Pilot clusters with common drying, storage, and primary processing facilities will help demonstrate commercial viability at scale. These pilots should be linked with assured training, seed supply, and buy-back arrangements to build farmer confidence.

Scale up training and demonstration programs with market linkage
Capacity-building initiatives should move beyond short-term demonstrations to structured handholding across multiple crop cycles. Linking training with assured buyers will ensure that skills translate into stable income for coastal households.

Medium-Term (3–5 Years)

Launch a National Seaweed Mission with dedicated budgetary support
A mission-mode approach will enable coordinated action across ministries, research institutions, states, and industry. Clearly defined physical and financial targets will help track progress and attract private investment.

Establish regional centres of excellence for seed, processing, and product development
These centres should focus on year-round seed availability, standardized cultivation protocols, and scalable processing technologies. Regional hubs will reduce dependency on a few locations and address coast-specific challenges.

Integrate seaweed into climate resilience, blue economy, and livelihood programs
Mainstreaming seaweed within existing national programs will allow faster scaling without creating parallel structures. This integration will also position seaweed as a tool for income diversification and climate adaptation.

Long-Term (5+ Years)

Position India as a global hub for sustainable seaweed production and value-added products
Focus should be on scale, quality, and sustainability of the produce to match leading global producers, for which long term planning is required. International benchmarking and collaboration will be critical to achieving competitiveness.

Promote exports through quality certification, branding, and trade facilitation
Developing globally accepted quality standards and traceability systems will improve international market access is important. Strategic branding can help Indian seaweed products command premium value in international global markets. Encourage innovation in high-value applications.

Targeted R&D and industry incentives should promote innovations in bioplastics, biofuels, nutra/cosmeceuticals, pharmaceuticals and functional foods. Over time, these sectors can significantly enhance export earnings and strengthen India's technological leadership in the seaweed sector.

Proceedings: Day – 1

Inaugural Session
Blue Gold:
Unleashing the Power of Seaweed

Speakers:

- **Mr. Vinay James Kynadi,** Chairman, ICC Kerala State Council
- **Dr. Kannan Srinivasan,** Director, CSIR-Central Salt and Marine Chemical Research Institute (CSMCRI)
- **Dr. Grinson George**, Director, ICAR Central Marine Fisheries Research Institute (CMFRI)
- **Dr. Pradeep Kumar Sharma,** Head-Movement Planning, Indian Farmers Fertiliser Cooperative Limited (IFFCO)
- **Dr. Shine Kumar C S**, Director, The National Institute of Fisheries Post Harvest Technology and Training (NIFPHATT)
- **Dr. George Ninan, Director**, ICAR-Central Institute of Fisheries Technology (CIFT)
- **Sri Sagar Mehra**, Joint Secretary, Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India
- **Dr. J.K. Jena,** DDG-Fisheries & Education, Indian Council of Agricultural Research (ICAR)
- **Dr. Bijay Kumar Behera**, Chief Executive, National Fisheries Development Board (NFDB), Hyderabad
- **Shri George Kurian**, Union Minister of State Ministry of Fisheries, Animal Husbandry & Dairying and Minority Affairs, Government of India
- **Dr. Johnson B.,** Senior Scientist, ICAR-Central Marine Fisheries Research Institute Regional Centre Mandapam (CMFRI RC, Mandapam)

Welcome Address by Mr. Vinay James Kynadi, Chairman, ICC Kerala State Council (KSC)

Mr. Vinay James Kynadi formally welcomed the participants to the 7th India International Seaweed Expo and Summit on behalf of ICC, CMFRI, and CSMCRI, expressing his honour in addressing a diverse gathering of scientists, policymakers, industry leaders, entrepreneurs, investors, and delegates from India and abroad. He highlighted the significance of hosting the summit at an institution with a long-standing legacy in marine science and fisheries research, noting that the venue itself symbolized the strong scientific foundation underpinning the event's discussions. He also acknowledged the support of the Government of India and expressed gratitude to the Honourable Minister of State for encouraging and patronizing the summit, reflecting the growing national importance of the seaweed sector.

At the outset, Mr. Kynadi conveyed a deep appreciation for the sector's strategic relevance and its immense potential to contribute to India's economic growth and sustainable development. He emphasized that seaweed should not be viewed merely as a marine resource, but as a critical element linked to food security, sustainable and alternative materials, climate resilience, industrial innovation, and the strengthening of coastal livelihoods. These interconnections, he noted, make seaweed a uniquely multidimensional and powerful industry.

Mr. Kynadi then discussed the role of ICC and the broader organizing ecosystem, stressing a strong belief in the transformative power of ecosystems. While science generates value and opportunities, he argued, ecosystems are essential to unlock that value and translate opportunities into real-world outcomes. Platforms such as the summit, he explained, are designed to bring together diverse stakeholders to enable ecosystem building. Effective ecosystems, according to him, unite research institutions, policymakers, industry, investors, and enablers around a shared vision, combining research excellence with supportive policy, patient capital, and active industry participation to create scalable and impactful pathways.

He further observed that ecosystem-driven development is especially relevant in the current era, marked by rapid advances in artificial intelligence, computation, and data science. These technologies are dramatically accelerating the transition from scientific discovery to application, creating major opportunities for the seaweed sector to enhance innovation, efficiency, and sustainability. Mr. Kynadi noted that such periods of technological change often coincide with shifts in the global order, opening opportunities for new leaders to emerge.

In this context, he asserted that India is uniquely positioned to lead, citing its long coastline, strong scientific institutions, expanding startup ecosystem, expertise in AI and deep technology, and young population. He concluded by urging participants to actively collaborate, question, learn, and explore partnerships during the summit, and to think boldly about shaping the future of the global seaweed industry.

Dr. Kannan Srinivasan, Director, CSIR- Central Salt and Marine Chemical Research Institute (CSMCRI)

Positioning himself within the broader R&D ecosystem through his association with CSIR, Dr. Kannan Srinivasan emphasized the shared mandate of institutions such as CSIR and CMFRI: to develop technologies and scientific capabilities and translate them into scalable business and industrial ecosystems. He highlighted the critical role of research institutions in bridging the gap between laboratory innovation and market-driven commercialization

across startups, MSMEs, and regulated industries. He expressed satisfaction that the seventh edition was hosted at ICAR-CMFRI, Kochi, an institute with decades of legacy in seaweed research, tracing India's seaweed research roots back to the 1960s in Mandapam, Tamil Nadu.

Dr. Srinivasan underscored the complementary roles of CMFRI and CSMCRI as flagship institutions under ICAR and CSIR respectively, both focused on harnessing marine resources for national and global benefit. He acknowledged ICC's catalytic role in convening stakeholders and fostering meaningful dialogue. Turning to seaweed research evolution within CSIR, he noted that while foundational research began decades ago, the most impactful translational progress has occurred in the last 10–15 years. He described the three stages of research—development, translation, and commercialization-and highlighted persistent gaps, particularly given India's immense coastal, cultural, and ecological diversity.

Despite a coastline exceeding 12,000 km, he observed that regional variations pose challenges for uniform scaling. Institutions like CSMCRI and CMFRI address these through region-specific research. He expressed pride in CSMCRI's translational achievements over the past two decades and introduced the CSIR-led Seaweed Mission, aligned with CMFRI's national initiatives, to create a pan India cultivation framework. He urged that the Expo serve as a platform to expand seaweed cultivation across all coastal states, envisioning that within two to three years' entrepreneurs would demonstrate large-scale cultivation, signalling true sectoral maturity and supporting PMMSY targets.

Highlighting future opportunities, Dr. Srinivasan spoke about disruptive areas such as seaweed-based bio-stimulants, edible seaweeds for mainstream food and nutrition, and next-generation biopolymers for sustainable packaging. He stressed the need for innovative product formats and a strong supply chain, including seed development centres across all coastal regions. Praising unprecedented Government support and major initiatives by DBT, CSIR, and ICAR, he described the sector as being at a critical inflection point. Concluding, he articulated a bold vision of achieving millions of tons of annual seaweed production and generating value in tens of thousands of crores, urging collaboration, indigenization, and actionable outcomes from the Summit.

Dr. Grinson George, Director, ICAR-Central Marine Fisheries Research Institute (CMFRI)

Dr. Grinson George noted that the event was distinct from conventional academic conferences because of the strong participation of industry representatives, startups, and other stakeholders, with more than half of the delegates coming from the industrial ecosystem. This, he emphasized, was crucial for the growth of the seaweed sector, which depends heavily on close collaboration between research institutions and industry.

Highlighting the central role of technology, Dr. George referred to the pioneering efforts of Indian scientists who initiated seaweed research as early as the 1960s. He observed that seaweed research has evolved steadily alongside the growth of national research institutions, with sustained research and development remaining a core mandate. However, reflecting on his remarks from the previous year's conference, he candidly noted that the overall status of the seaweed industry had not changed significantly. While awareness had increased, tangible progress and large-scale transformation on the ground remained limited.

To illustrate market-related challenges, Dr. George shared a personal anecdote about tasting processed seaweed sheets, noting that although innovative, they did not immediately suit Indian taste preferences. This highlighted the importance of aligning seaweed products with local food habits. He stressed that value addition and product diversification are essential for wider consumer acceptance. National institutes, he explained, are actively working on value chain development and quality assurance, resulting in innovative products such as kheer, wafers, papad, sorbet, and condiments that closely resemble traditional Indian foods and hold strong market potential.

He cautioned, however, that product innovation alone is insufficient without a stable supply of raw materials. Dr. George emphasized the urgent need to make native seaweed available at the household level. Drawing parallels with mushroom cultivation, he proposed small-scale, backyard seaweed farming units along the coast. With India's vast coastline and large coastal population, empowering even one million households with such units could significantly enhance livelihoods and strengthen the value chain.

Addressing nutritional concerns, he noted that malnutrition persists in many coastal communities despite access to marine resources. He advocated incorporating seaweed into nutrition programs such as Anganwadis and early childhood feeding schemes, citing successful marine-based nutritional interventions that improved maternal and child health.

On policy and implementation, Dr. George acknowledged Government initiatives promoting climate-resilient coastal livelihoods, including seaweed farming, while noting delays in execution. He highlighted successful pilot projects across several coastal states and recognized ongoing regulatory, seed availability, and climate-related challenges. Concluding, he urged stakeholders to focus on practical solutions, accelerate scientific and institutional efforts, and work collectively to scale production, strengthen exports, and position India as a major global player in the seaweed industry.

Dr. Pradeep Kumar Sharma, Head- Movement Planning, Indian Farmers Fertiliser Cooperative Limited (IFFCO)

Dr. Pradeep Kumar Sharma began his address by emphasising on the timeliness and importance of the conference, noting that the discussions planned over the two days were highly relevant to the current challenges facing Indian agriculture.

Dr. Sharma drew attention to the declining availability of traditional organic manures such as compost and other bulky organic inputs across the country. This shortage, he explained, has created serious concerns related to nutrient management and soil health for farmers. In this context, he highlighted the growing importance of bio-stimulants, particularly those derived from seaweed, as an effective solution to bridge this gap. He clarified that bio-stimulants function not only as growth promoters but also as supplementary nutrient sources, thereby supporting and enhancing conventional fertilizer use.

Addressing the policy landscape, Dr. Sharma noted that until recently the bio-stimulant sector lacked a clear and stable regulatory framework. He commended the Government of India for introducing a structured policy environment, calling it a landmark step for the industry. Referring to the inclusion of a wide range of bio-stimulants under the Fertiliser Control Order (FCO), he described this move as the breaking of a long-standing "glass ceiling." This regulatory recognition, he stated, has unlocked significant opportunities for innovation, commercialization, and wider access to quality products for farmers nationwide.

In the face of climate change, Dr. Sharma described bio-stimulants as a critical input for modern agriculture, characterizing them as a "match-winner" rather than merely a "game-changer." He cited experimental evidence demonstrating their capacity to mitigate temperature and moisture stress, soil acidity and salinity, and pressures from pests and diseases. Such resilience-building solutions, he emphasized, are indispensable for sustaining productivity in increasingly climate-stressed farming systems.

While acknowledging that the current ecosystem is highly favourable for the growth of bio-stimulants, Dr. Sharma stressed that industry players now bear the responsibility of maintaining farmer trust. He advocated strong quality assurance measures, including barcoding and traceability, to ensure authenticity and reliability. He emphasized that affordable, high-quality products must reach farmers, as farmer prosperity has a multiplier effect on rural livelihoods.

He concluded by underscoring the importance of inclusive development, particularly for coastal families engaged in seaweed cultivation, and linked the sector's growth to livelihood generation and the national vision of Viksit Bharat, thanking ICC for the opportunity to share his views.

Dr. Shine Kumar C S, Director, National Institute of Fisheries Post Harvest Technology and Training (NIFPHTT)

Dr. Shine Kumar C. S. began his address by highlighting the Government of India's decision to designate Lakshadweep as a seaweed cluster under the fisheries sector. He noted that among 34 fisheries clusters identified nationwide, Lakshadweep's selection for seaweed development marked an important milestone in diversifying fisheries-based livelihoods. Soon after this declaration, he was requested by the Secretary of Fisheries to conduct value-addition training in these cluster areas, a task that initially prompted him to reflect on the limited clarity around locally suitable seaweed products.

Drawing on his academic background, Dr. Shine Kumar recalled early exposure to aquatic botany, where he learned about preparing simple seaweed-based foods such as Alwa jam. Although such products were not widely accepted at the time, he observed that with proper processing and flavouring they were palatable and promising. He also revisited his training at CIFT, where he studied traditional agar preparation, and emphasized that even crude methods offered valuable insights into seaweed processing potential.

From his professional experience with MPEDA, he described observing carrageenan production units in Tamil Nadu that utilized Kappaphycus alvarezii, sourcing raw material from the Mandapam region and supplying semi-refined carrageenan to FMCG companies, with limited exports. He acknowledged the debates surrounding large-scale cultivation of this species but emphasized the learning gained from such initiatives. His interaction with innovative farmers in Lakshadweep, particularly one named Saeed, further inspired him to think pragmatically about supporting farmers not only through cultivation but also through product development and market linkage.

Dr. Shine Kumar stressed that seaweed, though administratively placed under fisheries, is fundamentally a plant-based resource and should be viewed as complementary to agriculture. This perspective led to integrating seaweed with agricultural produce, resulting in innovations such as seaweed–pineapple jam to support pineapple farmers and seaweed–tomato products developed during periods of tomato price crashes. Additional products—including seaweed crackers, wafers, ghee, and cutlets—were also developed, bringing the total to nearly seven products. However, he emphasized that scaling up remained a major challenge due to inconsistent raw material supply.

To overcome this, there is a need for enhancing production and introducing more edible species such as Caulerpa and Ulva in which the role of ICAR-CMFRI is important. He highlighted Israel's success in backyard seaweed farming as a model for India and described seaweed farming as "blue-green aquaculture," bridging agriculture and fisheries. He also underscored seaweed's ecological benefits and rich nutritional value. Concluding, he stated that India has all the resources needed for sectoral growth, calling for coordinated action and appreciating ICC's role in fostering collaboration and innovation.

Dr. George Ninan, Director, ICAR-Central Institute of Fisheries Technology (CIFT)

Dr. George Ninan appreciated the well-structured, two-day programme, noting that it comprehensively addressed seaweed as a strategic marine resource across its entire value chain. Describing seaweed as "blue gold," he observed that the summit reflected growing national and international interest in seaweed research, development, and commercialization.

He paid tribute to senior scientists who pioneered seaweed research in India, recalling how early academic exposure and

mentorship shaped his own understanding of the field. Dr. Ninan expressed personal satisfaction at reconnecting with respected seniors and emphasized the importance of foundational research in building current scientific capacity. Commending the organizers, he noted that the summit effectively linked cultivation, processing, utilization, and market development, while offering a roadmap for positioning India as a global leader in the seaweed sector.

Dr. Ninan drew attention to India's ambitious national target of producing 10 lakh tonnes of seaweed. He cautioned that such goals must go beyond general references to coastline length or natural potential and instead be supported by clearly defined responsibilities, timelines, and institutional accountability. Achieving scale, he stressed, requires robust infrastructure, integrated value chains, and strong support mechanisms. Referring to initiatives such as seaweed clusters, centres of excellence, and seaweed parks, he acknowledged these as positive steps but emphasized that their scale and implementation must align with national targets. He described this as both a challenge and an opportunity requiring coordinated action across policy, research, industry, and communities.

Introducing the institution, he represented, ICAR–Central Institute of Fisheries Technology, Dr. Ninan outlined its mandate in harvest and post-harvest technologies and total utilization of aquatic resources. He highlighted CIFT's role as the national referral laboratory for fish and fish products and its progress toward export certification responsibilities. He detailed the institute's long-term seaweed research, including bioprospecting, nutritional profiling, and advanced extraction techniques such as supercritical fluid and enzyme-assisted extraction.

Dr. Ninan described a wide range of application-oriented outcomes, including seaweed-enriched functional foods, biodegradable packaging, agricultural formulations, feed additives, biomedical materials, biochar, and water purification systems. Reflecting on technology development, he proposed adding a fourth "transformative" stage beyond development, translation, and commercialization, emphasizing that true impact occurs only when technologies bring systemic societal change.

Concluding, he outlined priority areas such as germplasm selection, sustainable extraction, quality and safety standards, value-chain development, and supportive policy frameworks. He expressed confidence that focused national action and coordinated follow-up from the summit would enable seaweed to emerge as a transformative resource for coastal communities and the broader economy.

Sri Sagar Mehra, Joint Secretary, Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India (DOF, MoFAHD, GoI)

Sri Sagar Mehra began his address by referring to the theme, "Seaweed Treasure Hunt in the Indian Seaweed Sector,". He noted that it accurately reflects both the immense opportunity and the significant challenges ahead. Despite India's vast coastline of over 11,000 km and a large Exclusive Economic Zone, he pointed out that current seaweed production represents less than 1% of the country's estimated potential, especially when compared to neighbouring countries that dominate global output. He stated that the summit embodies India's collective resolve to change this trajectory.

Sri Mehra recalled that during the formulation of the Pradhan Mantri Matsya Sampada Yojana (PMMSY) nearly six years ago, an ambitious target of producing 10 lakh tonnes of seaweed was set. Since then, systematic interventions have been undertaken across the value chain. Seaweed, he emphasized, is now recognized as a sunrise sector with strong potential for livelihood generation, nutritional security, and diverse industrial applications. Acting on recommendations from NITI Aayog, the Department of Fisheries has formally anchored seaweed within its mandate, issued national guidelines for germplasm import, and established a National Inter-Ministerial Steering Committee supported by a Technical Advisory Committee.

He highlighted that the Mandapam Regional Centre of CMFRI has been designated as a national Centre of Excellence for Seaweed Farming and Research, supporting innovation in cultivation, seed banks, sustainable practices, and value addition. Under PMMSY,

projects worth around Rs.200 crore have been approved over the past six years, including the Tamil Nadu Multipurpose Seaweed Park, where Phase-I infrastructure is nearing completion and is expected to benefit nearly 10,000 people across 136 villages.

Sri Mehra also outlined major capacity-building efforts, including training over 3,000 fishers, establishing seaweed banks and tissue culture facilities with ICAR-CMFRI and CSIR–Central Salt and Marine Chemicals Research Institute, and supporting cooperatives and women-led producer organizations. He highlighted Lakshadweep's designation as a seaweed cluster, noting its potential to support thousands of households while contributing to climate resilience and carbon sequestration.

Concluding, he observed that global demand for seaweed is rising rapidly across food, agriculture, pharmaceuticals, bio-energy, and green materials. While acknowledging challenges related to supply chains, processing, finance, and regulation, he called for coordinated action across stakeholders. He described India as being on the cusp of a "blue revolution within the blue revolution" and reaffirmed continued Government support to position the country as a global seaweed powerhouse by 2030.

Dr. J.K. Jena, DDG-Fisheries & Education, Indian Council of Agricultural Research (ICAR)

Dr. J. K. Jena began his virtual address by warmly greeting the participants and thanking the organizers for the opportunity to speak, explaining that parliamentary commitments prevented his physical presence.

Reflecting on earlier presentations, Dr. Jena noted that while the scientific foundations of seaweed research in India were laid five to six decades ago, sectoral development did not progress as expected. Drawing on his own academic training in marine culture nearly 35 years ago, he recalled that seaweed culture was once taught alongside finfish and crustacean farming, with extensive knowledge on taxonomy, distribution, cultivation, and utilization. Despite early research on products such as agar, algin, carrageenan, fertilizers, and medicinal compounds, seaweed farming failed to gain sufficient momentum until recent years.

He emphasized that the past 7–8 years have marked a turning point, driven by strong policy support from the highest levels of Government. Strategic interventions by NITI Aayog, ICAR-CMFRI, NAAS, and the Department of Fisheries, along with investments under the Pradhan Mantri Matsya Sampada Yojana (PMMSY), have provided renewed impetus to the sector. He highlighted CMFRI's identification of nearly 25,000 hectares across around 300 sites for seaweed farming, while cautioning that this estimate may significantly underrepresent actual potential. Offshore areas, deeper waters, and island territories such as Lakshadweep and the Andaman Islands, he noted, remain largely untapped.

Dr. Jena acknowledged CMFRI's achievements in developing nutraceuticals, bioactive compounds, fertilizers, and foliar sprays, but stressed that much greater scale and diversification are now required. He pointed out growing industry readiness to invest in production and R&D, citing innovative products such as seaweed-based wine, chocolates, and ice cream as examples of diversification beyond traditional applications. He emphasized the need for consumer awareness and gradual dietary acceptance.

Addressing technical challenges, he cautioned against overdependence on a single species such as Kappaphycus and called for diversification into Gracilaria and indigenous species, supported by improved stocks and advanced breeding approaches. He highlighted emerging research in genomics and genome editing and cited landmark studies showing that seaweed supplementation in livestock feed could reduce methane emissions by 30–45%, presenting a massive future demand opportunity.

Concluding, Dr. Jena advocated for systematic prioritization of species, markets, and applications, the creation of dedicated seaweed farming zones, and clearly defined roles across the value chain. He expressed confidence that the summit would yield a pragmatic, time-bound roadmap and reaffirmed institutional support for coordinated follow-up and collaborative progress.

Dr. Bijay Kumar Behera, Chief Executive, National Fisheries Development Board (NFDB),

Dr. Bijay Kumar Behera expressed his gratitude to the organizers, particularly ICAR-Central Marine Fisheries Research Institute and the Indian Chamber of Commerce. He clarified that his intent was not merely to speak, but to listen to industry concerns and expectations.

Dr. Behera observed that although several Government programmes exist to promote seaweed cultivation, development, and utilization, implementation has been fragmented and has not yet achieved the desired commercial scale. Reflecting on the sector's long history, he noted that despite decades of research and India's vast coastline, seaweed has not reached its true potential. He emphasized the need to consolidate actionable strategies with institutions such as National Fisheries Development Board and the Department of Fisheries, stressing that seaweed development has been highlighted as a national priority by the Hon'ble Prime Minister and must now translate into tangible outcomes.

Highlighting key initiatives, Dr. Behera explained that Lakshadweep has been officially notified as a seaweed cluster with a comprehensive approach covering cultivation, processing, value-chain development, and marketing, supported by sanctioned funds for seed banks and farming activities. He cited successful pilot demonstrations under NFDB-supported technology programmes in regions such as Andhra Pradesh. He also challenged the perception that seaweed can only be farmed in the sea, describing successful pond-based trials in Chennai where Gracilaria salicornia was integrated with shrimp culture, improving both shrimp quality and seaweed productivity. Similar demonstrations are underway in Andhra Pradesh with encouraging private-sector participation.

Dr. Behera drew attention to major infrastructure investments, including a large seaweed park in Ramanathapuram, Tamil Nadu, and the declaration of Mandapam as a Centre of Excellence. However, he candidly acknowledged that commercial exploitation still lags behind potential. He identified major policy bottlenecks, including limited species diversification, regulatory ambiguity around species importation, and the absence of clear sea-area leasing policies, reassuring stakeholders that efforts are underway to address these constraints with state Governments.

Emphasizing value addition, he highlighted the wide application spectrum of seaweed—from food and nutraceuticals to bioplastics, biofuels, and high-value inputs like agarose, which India currently imports at high cost. He advocated for domestic processing ecosystems supported by subsidies, concessional loans, cooperatives, and Farmer Producer Organizations, along with stronger awareness of credit instruments such as Kisan Credit Cards. Concluding, Dr. Behera stressed capacity building, standard operating procedures, advanced technologies, and above all, convergence among ministries, research bodies, and industry. Without coordinated action, he warned, discussions would not yield impact. He reaffirmed the Government of India's commitment and urged collective effort to transform seaweed into a commercially viable and empowering sector.

Shri George Kurian, Union Minister of State, Ministry of Fisheries, Animal Husbandry & Dairying and Ministry of Minority Affairs, Government of India

Shri George Kurian, Union Minister of State, addressed the gathering at the 7th International Seaweed Expo and Summit 2022 and expressed his happiness at participating in the event jointly organized by Indian Council of Agricultural Research, Central Marine Fisheries Research Institute, CSIR–Central

Salt and Marine Chemicals Research Institute, and Indian Chamber of Commerce. He warmly acknowledged senior officials, scientists, stakeholders, and participants, and appreciated the collaborative efforts of these institutions in advancing seaweed research and development in India.

In his address, the Minister described seaweed as a holistic, multi-utility marine resource with wide-ranging applications in nutrition, pharmaceuticals, and industry. He emphasized that seaweed cultivation has emerged as a powerful livelihood option for fishermen and coastal farmers, offering sustainable income opportunities while strengthening coastal economies. According to him, seaweed farming represents a unique blend of economic development, environmental sustainability, and social upliftment.

Shri Kurian placed special emphasis on women empowerment through seaweed cultivation, sharing insights from his visit to Mandapam the previous year. He recalled interacting with women beneficiaries who reported that their incomes had increased dramatically—from a few thousand rupees earlier to several lakhs annually through seaweed farming. He highlighted this as a compelling example of how scientific interventions, combined with Government support, can directly improve the socio-economic status of rural women and coastal households.

Commending ICAR, CMFRI, and CSIR-CSMCRI, the Minister noted their sustained efforts in reaching economically weaker sections and transforming scientific research into tangible development outcomes. He highlighted India's long coastline of nearly 11,000 km and its favourable climatic conditions as major advantages for large-scale seaweed cultivation. He further pointed out that India's coastline and Exclusive Economic Zone together provide enormous potential for expanding seaweed-based industries.

Referring to the flagship Pradhan Mantri Matsya Sampada Yojana, Shri Kurian stated that seaweed cultivation has been identified as a priority activity. Over the past five years, projects worth Rs.195 crore have been approved under the scheme, including the establishment of a Seaweed Park in Tamil Nadu, aimed at employment generation and income diversification for coastal communities. He also highlighted key institutional initiatives such as the notification of Lakshadweep as a seaweed cluster and the declaration of the Mandapam Regional Centre of ICAR-CMFRI as a Centre of Excellence for seaweed farming and research.

The Minister cited concrete evidence of progress, noting that India's seaweed production increased from 18,890 tonnes in 2015 to 74,083 tonnes in 2024. He attributed this growth to coordinated policy support, focused research, and active stakeholder participation. In conclusion, Shri Kurian linked seaweed sector development to India's broader vision of becoming a developed nation by 2047. He expressed hope that the summit would generate actionable recommendations to help India emerge as a global seaweed powerhouse by 2030, and conveyed his best wishes for the success of the event.

Dr. Johnson B., Senior Scientist, ICAR-Central Marine Fisheries Research Institute Regional Centre Mandapam (CMFRI, RC, Mandam)

Dr. Johnson B. delivered the vote of thanks by warmly greeting the audience and expressing sincere appreciation, on behalf of the organizers, to all those who contributed to the successful inauguration of the prestigious seaweed event. He began by thanking the Honourable Union Minister of State, Shri George Kurian, for gracing the occasion as Chief Guest and for delivering an inspiring address. Dr. Johnson acknowledged the Minister's vision, encouragement, and guidance, particularly in advancing the development of the Indian seaweed sector.

He then conveyed heartfelt gratitude Dr. Bijay Kumar Behera, Chief Executive, NDFB, Hyderabad, for presiding over the session. He noted that Dr. Behera's Presidential Address added authority and depth to the inaugural proceedings. Dr. Johnson also thanked Dr. J.K. Jena, DDG-Fisheries & Education, Indian Council for Agricultural Research (ICAR), the Guest of Honour, appreciating his leadership in guiding the Fisheries Science Division and his forward-looking address on the sector's future.

Acknowledging senior officials, Dr. Johnson expressed gratitude to Shri Sagar Mehra, Joint Secretary, Department of Fisheries, Government of India, for joining the programme virtually and sharing valuable insights while extending continued support to fisheries and seaweed development. He also thanked distinguished speakers including Dr. Pradeep Kumar Sharma, Head- Movement Planning, IFFCO, Dr. Shine Kumar C S, Director, The National Institute of Fisheries Post Harvest, Technology and Training (NIFPHATT) and Dr. George Ninan, Director, ICAR-Central Institute of Fisheries Technology (CIFT), noting that their presence and special addresses enriched the inaugural session.

Special appreciation was extended to Dr. Kannan Srinivasan, Director, CSIR- CSMCRI (Central Salt and Marine Chemical Research Institute), for delivering the keynote address and for his sustained contributions to seaweed research and industry growth. Dr. Johnson highlighted the pivotal role of Dr. Grinson George, Director, ICAR-CMFRI, in guiding the planning and execution of the event, and thanked him for the insightful theme address that set the vision for the summit.

Dr. Johnson acknowledged the extensive efforts of the organizing committee, led by the Indian Chamber of Commerce, and its leadership and team, along with the co-organizers from ICAR–CMFRI and CSIR–CSMCRI. He recognized the tireless work of various committees, convenors, and partners who worked behind the scenes to ensure the event's success.

He expressed sincere thanks to sponsors, exhibitors, national and international delegates from 11 countries, session chairs, speakers, media representatives, and all participants whose engagement made the conference meaningful and complete. Dr. Johnson concluded by reiterating heartfelt gratitude to everyone who contributed directly or indirectly, formally closing the vote of thanks with appreciation to one and all.

Glimpses of inaugural of seaweed stall during seaweed expo 2026


Bio Pesticide
TROPICAL AGRO
CREATING A SUSTAINABLE AGRICULTURAL ECOSYSTEM
Taglife - V
Tag Monas
Tag Nem
Tag Veria


SATHYAN KISSAN CARE
SPECIAL FORMULATIONS


SPREADABLE AGAR AGAR
APPLICATIONS OF AGAR AGAR
AGAROSE
STABILIZERS
FLAVOURED MILK STABILIZER
MILKSHAKE STABILIZER
MALLOW SOFT


IFFCO
AquaAgri


ICAR-Central Marine Fisheries Research Institute
CMFRI

Session 1

Government Policy & Regulatory Framework, Financing, Supply Chain & Market Development

Session Chair: Dr. V.S.K. Chennubhotla, Former Principal Scientist, ICAR-Central Marine Fisheries Research Institute Regional Centre Mandapam (CMFRI)

Speakers:

1. **Dr. Mohammed Koya,** Fisheries Development Commissioner, DoF-GoI, New Delhi
2. **Mr. Nagesh Kumar Anumala,** Chief General Manager, NABARD
3. **Mr. P. Pradeep Kumar,** Deputy Director (Mariculture), Department of Fisheries & Fishermen Welfare, Govt. of Tamil Nadu
4. **Mr. Jafer Hisham,** Asst. Director, Department of Fisheries, U.T of Lakshadweep
5. **Mr. Tanmaye Seth,** Director, Aquagri Processing Private Ltd.
6. **Mr. Vipin Saini,** CEO, BASAI

Opening Remarks by the Session Chair Dr V.S.K. Chennubhotla, Former Principal Scientist, ICAR-CMFRI

Dr. V.S.K. Chennubhotla emphasized that seaweeds, more appropriately referred to as marine algae, constitute a uniquely valuable marine bio-resource rather than an ordinary or marginal commodity.

He elaborated that marine algae are exceptionally rich in proteins, carbohydrates, lipids, vitamins, amino acids, trace elements, minerals, iodine, bromine, and a wide spectrum of bioactive compounds. Because of this diverse biochemical composition, marine algae serve multiple uses including human food, animal fodder, organic manure, pharmaceuticals, nutraceuticals, and as raw material for extraction of industrial phycocolloids such as agar, algin, carrageenan, fucoidan, and sugar alcohols like mannitol.

Dr. Chennubhotla highlighted the historical misnomer "seaweed," noting that the term originated from early mariners who considered these organisms as useless floating plants. He recalled that in a national-level roundtable conference held in 2004 under the Indian Council of Agricultural Research, it was formally resolved that the term "marine algae" should be used to accord the resource scientific and economic respect. However, he acknowledged that despite this resolution, the term "seaweed" continues in common usage.

Drawing attention to India's early scientific contributions, he cited the role of agar derived from marine algae in vaccine production during World War II, including work undertaken in erstwhile Travancore. He stressed that India possesses a growing inventory of marine algal biodiversity, with the number of recorded species increasing steadily due to improved exploration and coastal changes.

With these contextual remarks, he formally initiated the technical proceedings of the session and invited the speakers to address the themes of policy, finance, supply chains, and market development.

Dr. Mohammed Koya, Fisheries Development Commissioner, Department of Fisheries, Government of India, New Delhi (DoF, GoI)

Dr. Mohammad Koya reflected on the continuation of early ICAR-CMFRI-led research in Lakshadweep and provided an update on current developments.

He explained that Lakshadweep's lagoon ecology has undergone significant changes over the years, including loss of seagrass meadows and macroalgal cover, partly due to grazing pressures. Since lagoon ecosystems are central to live-bait fisheries that support tuna fishing, restoration through seaweed cultivation has become ecologically and economically important. He emphasized that seaweed farming contributes positively to lagoon health, biodiversity restoration, and coastal resilience.

From a policy perspective, Dr. Koya underscored that fisheries and aquaculture are state subjects, with the Department of Fisheries at the national level playing a facilitative and enabling role. He noted that since 2014, seaweed has been prioritized by the Government of India as a key livelihood and blue economy activity. Following the establishment of the Ministry and Department of Fisheries, seaweed has received focused policy attention across schemes and programs.

He elaborated on financial and schematic support under PMMSY, which includes both central sector and centrally sponsored components. Under PMMSY, substantial funding has been extended to ICAR institutions such as CMFRI and CSIR-CSMCRI, state fisheries departments, and universities for basic research, pilot projects, hatcheries, demonstrations, and capacity building. Special focus areas include ecologically sensitive and geographically remote regions such as Lakshadweep and Kutch. Dr. Koya also discussed emerging national priorities such as seaweed-based biofuels and bio-crude, including large-scale pilots being undertaken in collaboration with multiple ministries and private industry partners. Tamil Nadu and Puducherry were cited as states that have proactively identified sites and supported pilot initiatives.

He concluded by mentioning the release of standard operating procedures and leasing guidelines for mariculture, encouraging states to adopt transparent leasing frameworks that provide tenure security to farmers and industry while ensuring sustainable use of marine space.

Mr. Nagesh Kumar Anumala, Chief General Manager, National Bank for Agriculture and Rural Development (NABARD)

Mr. Nagesh Kumar Anumala focused his address on the financing architecture for seaweed cultivation and value chain development. He explained NABARD's role as a developmental financial institution that facilitates access to both short-term and long-term credit while building institutional capacity within the banking system.

He clarified that working capital requirements for seaweed farming are eligible under the Kisan Credit Card (KCC) framework, enabling farmers to access loans at concessional interest rates, subject to inclusion of seaweed in the district and state scale of finance. NABARD plays a key role in guiding District-Level Technical Committees (DLTCs) and State-Level Technical Committees (SLTCs) that determine scale of finance norms.

On investment credit, he described NABARD's role in developing unit cost norms and bankable project models for seaweed cultivation systems such as bamboo raft culture, monoline culture, and IMTA. In Tamil Nadu, unit costs have already been finalized for multiple cluster-based models, and similar exercises are underway in other coastal states.

He further elaborated on NABARD's preparation of Potential Linked Credit Plans (PLCPs) at block, district, and state levels, which guide banks in allocating credit to priority sectors, including seaweed where potential exists. NABARD also provides refinance support to banks for both short-term and long-term lending to seaweed farmers.

He concluded by reaffirming NABARD's commitment to expanding financing and institutional support as the seaweed sector matures.

Mr. P. Pradeep Kumar, Deputy Director (Mariculture), Department of Fisheries & Fishermen Welfare, Government of Tamil Nadu

Mr. Pradeep Kumar presented a comprehensive overview of Tamil Nadu's seaweed sector, covering status, challenges, and strategic initiatives. He stated that Tamil Nadu leads the country in both seaweed cultivation and collection due to its long coastline, calm sea conditions, and minimal freshwater influx in key regions such as the Palk Bay and Gulf of Mannar.

He reported that 136 villages and approximately 2,000 farmers, largely women, are engaged in seaweed cultivation, primarily of *Kappaphycus alvarezii.* Traditional collection of Gracilaria, Sargassum, and other species has been practiced for over five decades. However, he acknowledged the absence of robust, centralized data on production, collection, and industrial processing capacity.

He explained the existing value chain, where farmers use monoline and raft culture methods, retain part of their harvest as seed, and market the remainder either through buyback contracts with processors or via intermediaries. Tamil Nadu hosts around 25–30 seaweed processing units with substantial installed capacity, much of which is underutilized due to insufficient domestic raw material supply.

A major focus of his address was the Multipurpose Seaweed Park being developed under PMMSY at a cost of Rs.127.71 crore (60:40 Centre–State share).

The project aims to address seed degeneration, ensure supply of high-virulence planting material, and strengthen the entire value chain from seed to processing.

He also highlighted training initiatives under alternative livelihood missions, KCC facilitation, formation of FFPOs, and ongoing efforts to develop a comprehensive mariculture policy for Tamil Nadu.

Mr. Tanmaye Seth, Director, Aquagri Processing Private Ltd.

Mr. Tanmaye Seth provided an industry-centric assessment of why the seaweed sector has not grown commensurate with policy and financial support. He noted that historically, seaweed lacked clear ministerial ownership, resulting in fragmented policy action until its formal alignment with the Ministry of Fisheries.

He emphasized global realities, noting that despite thousands of species, global seaweed cultivation depends on a handful of commercially viable species, with only a few suited to tropical waters. India's dependence on a single species has constrained scalability, making import and development of new germplasm critical.

He welcomed recent import guidelines but pointed out practical challenges, including small import volumes, long multiplication timelines, and the need for industry-led quarantine and propagation facilities. He stressed that training and financing without assured seed availability is ineffective.

Mr. Seth raised concerns regarding regulatory uncertainty around invasive species classification and bio-stimulant regulation, emphasizing the need for inter-ministerial coordination. He also highlighted climate-related challenges such as rising sea temperatures, monsoon disruptions, and lack of infrastructure to safeguard seed and biomass during extreme weather.

Mr. Vipin Saini, CEO, Biological Agri Solutions Association of India (BASAI)

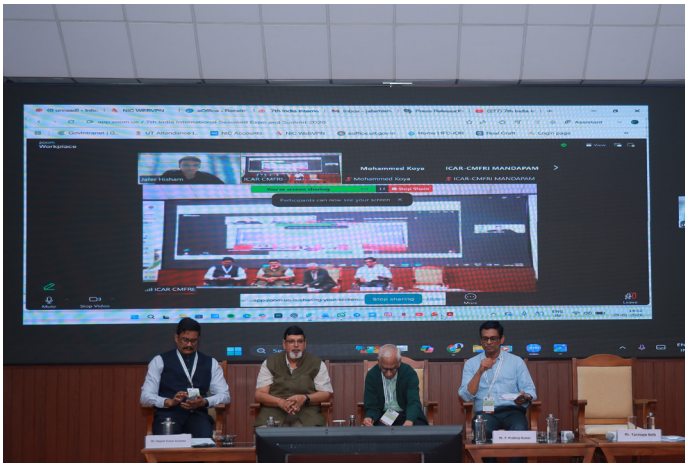
Mr. Vipin Saini contextualized India's seaweed sector within the global regulatory and market environment. He cited rapid growth in global seaweed markets and recent regulatory frameworks introduced by the EU, USA, UK, and Northern Ireland.

He highlighted critical regulatory gaps in India, particularly the absence of legally recognized seaweed-based biofertilizers and fragmented oversight across multiple ministries. Drawing on parliamentary records, he pointed out the stark gap between India's potential cultivation area and actual area under farming, as well as negligible export performance.

He discussed recent regulatory developments, including bio-stimulant notification, import guidelines for seaweed germplasm, and emerging quarantine requirements. He cautioned about inconsistencies within regulations, particularly references to genetically improved material, which conflict with national biosafety laws.

He concluded by stressing the urgent need for harmonized, science-based regulation to unlock India's seaweed potential.

Mr. Jafer Hisham, Assistant Director, Department of Fisheries, U.T of Lakshadweep



Mr. Jafer Hisham presented an overview of the status, potential, and governance framework of seaweed cultivation in Lakshadweep, emphasizing its role as a sustainable livelihood option and an environmentally compatible activity for island ecosystems. He noted that Lakshadweep has recently been designated as a Seaweed Cluster, underscoring the strategic importance of seaweed farming in the region.

The speaker highlighted that seaweed cultivation in Lakshadweep contributes to livelihood diversification, environmental sustainability, and climate mitigation through carbon sequestration. The island waters support diverse seaweed resources, including red, green, and brown algae. Prominent species identified include *Gracilaria* and *Hypnea* (red algae), *Ulva* and *Caulerpa* (green algae), and Sargassum (brown algae), with *Gracilaria* edulis emerging as the dominant cultivated species.

Pilot-scale seaweed cultivation was initiated in 2021 through collaborative efforts between the Department of Fisheries and ICAR-CMFRI, followed by the commencement of commercial farming by a private enterprise. Capacity-building initiatives have been undertaken across islands such as Kavaratti, Agatti, and Kadmat, while active cultivation is currently concentrated in Chetlat.

Mr. Hisham explained that the Department of Fisheries, Union Territory of Lakshadweep, functions as the nodal agency for seaweed cultivation, working in close coordination with the Departments of Environment, Forest, and Science & Technology, with technical support from ICAR-CMFRI. The initiative is further strengthened through convergence under the Seaweed Cluster framework and the PMMSY programme. He informed that a draft Lakshadweep Seaweed Farming Policy is under formulation, and in-principle approvals have been accorded to two private firms to undertake seaweed farming on a trial basis. Site identification and environmental safeguards are being simultaneously addressed to ensure ecological sustainability.

The presentation emphasized a community-based partnership model, with particular focus on women empowerment. Women Self-Help Groups, fishermen youth, and Farmer Producer Organizations (FPOs) are actively involved, and seaweed cultivation is promoted as an additional source of income rather than a replacement for existing livelihoods. Engagement with the private sector is also being facilitated through field visits and pilot demonstrations.

Infrastructure-related constraints, particularly the limited availability of quality seed material and significant losses during transportation from the mainland, were identified as major challenges. To address these issues, the Department has initiated the establishment of a seaweed hatchery in Chetlat and a seed bank in Kiltan, with the objective of strengthening local seed production and reducing external dependency.

Environmental benefits of seaweed farming, including improved water quality, nutrient absorption, and contribution to climate action goals, were highlighted. The initiative aligns with India's Nationally Determined Contributions (NDCs) and the Sustainable Development Goals. However, challenges such as monsoon-related risks, grazing pressure, and higher input costs due to transportation constraints were acknowledged.

In conclusion, the speaker emphasized that Lakshadweep presents a strong governance-led model for seaweed development, supported by institutional synergy and community participation. Seaweed cultivation is envisioned as a key pillar for enhancing island livelihoods, advancing climate action, and strengthening the blue economy of Lakshadweep.

Session 2
Cultivation System & Farming Innovation

Session Chair: Dr. Johnson B. Senior Scientist, ICAR-CMFRI RC, Mandapam

Speakers:

- **Dr. V. Veeragurunathan,** Senior Principal Scientist, CSIR-CSMCRI
- **Dr. Sekar Megarajan**, Senior Scientist (Aquaculture), ICAR-CMFRI, Visakhapatnam
- **Dr. Nelson Vedassery,** Co-Founder & CTO, Sea6 Energy
- **Dr. Stefan Kraan** Director & CSO Oceana Organic Products Ltd. (Ireland)

Opening Remarks by the Session Chair Dr. Johnson B. Senior Scientist, ICAR-Central Marine Fisheries Research Institute, Regional Centre, Mandapam

Dr. Johnson B. opened the technical session by underlining that seaweed cultivation forms the backbone of the seaweed industry and is central to building a sustainable and scalable sector in India. He acknowledged the post-lunch challenge for both speakers and participants, and committed to keeping the session practical, engaging, and information-rich.

He traced the evolution of seaweed cultivation systems in India, beginning with nearshore manual methods and progressing through bamboo raft systems, monoline and tube-net techniques, to the emerging offshore and mechanised cultivation models. He highlighted that innovations have been incremental and location-specific, shaped by wave exposure, water depth, and coastal morphology.

A key emphasis of his address was the need for strong integration between research institutions, industry stakeholders, and coastal communities. He cautioned that without this triadic linkage, even technically sound innovations would fail to deliver sustained outcomes. He cited Indian examples where different methods—bamboo rafts, monoline, and tube nets—have succeeded under specific regional conditions, particularly noting the suitability of tube-net systems in rough sea environments.

Dr. Johnson highlighted the contribution of ICAR–CMFRI in developing HDPE raft–based tube-net systems designed to withstand rough seas, as well as the role of industry players like Sea6 Energy in advancing mechanised and offshore farming. He briefly recalled the early collaboration with industry partners such as PepsiCo since 2004, which laid the foundation for commercial cultivation of *Kappaphycus alvarezii* in India.

He presented a stark comparison between global and Indian seaweed production trends, noting that while global production stands at approximately 37.8 million tonnes with nearly 90% from cultivation, India contributes less than 1% globally and still depends predominantly on wild harvests. He stressed that reversing this ratio—moving from 10% cultivation to at least 50–90%—is a strategic priority.

Another major concern raised was species concentration. He observed that 94% of global production is dominated by just eight species, prompting reflection on whether India should focus on these dominant species or diversify cultivation portfolios based on ecological and regional suitability. He concluded by setting the tone for the session as a practice-oriented dialogue linking scientific research, field experience, and industry-led innovation to scale up seaweed farming in India.

Dr. V. Veeragurunathan, Senior. Principal Scientist, CSIR-CSMCRI

Dr. Veeragurunathan delivered a comprehensive overview of seaweed cultivation in India, drawing on six decades of CSIR–CSMCRI research in marine algal resources and open-sea cultivation technologies. He began by outlining the global seaweed scenario, noting that although over 10,500 seaweed species exist worldwide, only about 221 species have commercial significance.

He explained that global seaweed aquaculture is overwhelmingly cultivation-driven, with nearly 97% of production coming from farming systems, dominated by red and brown algae. In contrast, India's production remains largely dependent on wild collection, a pattern that poses sustainability and supply risks.

Dr. Veeragurunathan articulated the rationale for seaweed cultivation, highlighting reduced pressure on natural stocks, consistent and homogeneous raw material quality, opportunities for genetic improvement, and employment generation for coastal communities. He noted that Indian cultivation relies almost entirely on vegetative propagation, with spore-based systems still limited.

Tracing the history of cultivation in India, he described early efforts in the 1970s to cultivate Gracilaria edulis for food-grade

agar using monoline and raft-based methods. Over time, bamboo raft systems enabled commercial-scale production with improved yields. He highlighted region-specific suitability of methods: polypropylene rope systems in southern Tamil Nadu, tube-net systems along the Gujarat coast, and net-bag and net-pouch methods for seed conservation.

He discussed several economically important species, including Gracilaria dura, valued for direct agarose yield; Gelidiella species for bacteriological-grade agar; and Gracilaria salicornia for both agar and bio-stimulant production. He emphasized that most Indian seaweeds show optimal growth from October to March.

A significant portion of his address focused on Kappaphycus alvarezii (K5), describing its introduction, strain diversity (red, green, brown morphs), and large-scale promotion. He detailed CSIR–CSMCRI's role in distributing over 375 tonnes of quality seed material to nearly 370 beneficiaries, helping revive cultivation after setbacks caused by mass mortality events.

Dr. Veeragurunathan addressed concerns around ecological impacts, presenting experimental evidence showing that Kappaphycus cultivation does not suppress indigenous species, thereby dispelling long-standing myths. He also described innovations such as HDPEcircular rafts designed to withstand monsoon conditions, hormone-based seed rejuvenation to restore vigour, and improved drying techniques to enhance carrageenan quality.

He concluded by reiterating that seaweed aquaculture is a critical pathway for food security, income generation, and environmental sustainability, supported by strong scientific evidence and long-term institutional commitment.

Dr. Sekar Megarajan, Senior Scientist (Aquaculture), ICAR-CMFRI, Visakhapatnam

Dr. Sekar Megarajan focused on the realities of seaweed farming in exposed nearshore environments, particularly along the east coast of India. He noted that despite India's extensive coastline, seaweed farming remains geographically concentrated, largely due to the absence of technologies suited to diverse and exposed coastal conditions.

He contextualised India's position within the global seaweed market, highlighting rapid market growth and the dominance of Asia-Pacific countries. He emphasized that globally, cultivation has progressively replaced wild harvest, a transition India must urgently adopt.

Dr. Megarajan explained the concept of nearshore farming, typically extending up to 20 nautical miles and influenced strongly by coastal hydrodynamics. He outlined why nearshore systems dominate globally: accessibility, cost efficiency, and scalability. However, he cautioned that Indian nearshore areas—especially outside Tamil Nadu—are often exposed, deeper, and unsuitable for conventional bamboo raft or pole-based systems.

Presenting findings from ICAR-CMFRI's preliminary coastal assessments, he reported identification of 333 potential sites covering nearly 25,000 hectares, with an estimated production potential of about 9.7 million tonnes. Realising this potential, he argued, requires new farming systems tailored to exposed waters.

He described the development of an HDPE0 raft–based tube-net system, integrating the resilience of tube nets with floating HDPE rafts and strengthened mooring systems. Designed for rough seas, the system demonstrated stability under wave heights of up to 1.6 metres and strong winds. He detailed technical specifications, including raft dimensions, mesh size, and single-point mooring using heavy anchors.

Operational results showed average daily growth rates exceeding 4.5% and harvests of nearly 200 kg per raft per cycle. An economic analysis indicated that a 100-raft unit could generate approximately Rs.11 lakh annually over five production cycles.

Dr. Megarajan highlighted the social dimension of the initiative, particularly the involvement of women self-help groups and

partnerships with NGOs, private companies, and state fisheries departments. He acknowledged challenges such as high initial capital costs and the need for awareness-building but expressed confidence that durability and scalability would offset these constraints.

He concluded by stressing that such region-specific innovations are essential to expanding seaweed farming beyond sheltered coasts and ensuring inclusive growth.

Dr. Nelson Vedassery, Co-Founder & CEO, Sea6 Energy

Dr. Nelson Vedassery presented an industry-driven perspective on offshore and mechanised seaweed farming, drawing from field experience in India and Southeast Asia. He began by asserting that seaweeds thrive in rough waters, benefiting from nutrient-rich, high-energy environments, while the main challenge lies in designing systems that allow humans to farm safely and economically in such conditions.

He focused primarily on anchoring and mooring systems, describing early experiments off the coast of Kanyakumari where traditional concrete anchors proved logistically difficult and prone to displacement during storms. While concrete provides reliability, he noted limitations related to effective holding power, transport, and deployment costs.

Dr. Vedassery discussed alternatives such as steel anchors, which offer higher holding ratios but pose theft risks and durability concerns. This led to the adoption of helical screw anchors, which are drilled into the seabed, offering superior holding power (up to 1:50 or higher) and reduced risk of removal. He described both diver-assisted and diver-free installation systems. In deeper waters, diver-based methods proved impractical due to depth and safety constraints, prompting C6 Energy to develop sensor-enabled, boat-mounted installation rigs capable of deploying anchors in under ten minutes without divers.

These anchoring innovations enabled the development of large, rope-based offshore farms, reducing material costs and improving scalability. He shared examples of hectare-scale farms deployed in Indonesia and highlighted additional innovations, including automated seeding, mechanised harvesting, specialised workboats, and digital monitoring platforms.

Dr. Vedassery concluded by noting that such technologies are best suited for entrepreneurial and cluster-scale operations, rather than small single-raft farms, and are critical for India's transition toward offshore seaweed cultivation.

Dr. Stefan Kraan, Director & CSO, Oceana Organic Products Ltd. (Ireland)

Dr. Stefan Kraan provided an international perspective on seaweed farming innovation, particularly from Europe, where high labour and fuel costs necessitate optimisation and mechanisation. He explained that without efficiency-driven innovation, Western countries cannot remain competitive in seaweed production.

He showcased advanced systems such as continuous loop farms, enabling single-point harvesting of long cultivation lines, and submersible HDPE offshore farms capable of being lowered during severe storms—systems designed to withstand extreme wave conditions far exceeding those typical in India.

Dr. Kraan highlighted the importance of on-board processing, including blanching and fermentation, to preserve quality and reduce post-harvest losses. He also introduced biodegradable cultivation ropes, developed from wood-based materials, to replace plastic components and reduce marine pollution.

Turning to India, he identified key bottlenecks: lack of baseline environmental data, limited scalability of raft systems, nutrient depletion in dense farming zones, and chronic shortages of seed material after monsoon seasons. He emphasised the need for regional hatcheries, seed banks, and rapid seed-line deployment systems.

He described collaborative initiatives in India, including hatchery development using deep, nutrient-rich seawater and experimental offshore seed banks that exploit vertical nutrient gradients. While acknowledging differences between European kelp systems and Indian tropical species, he suggested selective adaptation of loop and mechanised systems for Indian conditions.

Dr. Kraan concluded by stressing that achieving India's ambitious seaweed production targets will require long-term investment, infrastructure development, and coordinated innovation across research, industry, and government.

Session 3
Seaweed Value Chain – Applications & Usefulness of Seaweed in Different Sectors

Session Chair: Dr. Kamalesh Prasad, Chief Scientist, CSIR-CSMCRI

Speakers:

- **Mr. Shrikumar Suryanarayan,** Managing Director & Co-Founder, Sea6 Energy
- **Dr. R. Srinivasan**, Vice President – Biological Products, Tropical Agrosystem (India) Private Limited
- **Dr. J Helen Fitton,** Director, RD Advisor (Australia)
- **Mr. Suresh Manavasi Ramamoorthy**, Lead-Global Strategy, Trishul Biotech
- **Dr. Remya. S,** Senior Scientist, ICAR-CIFT

Opening Remarks by the Session Chair Dr. Kamalesh Prasad, Chief Scientist, CSIR-CSMCRI

Dr. Kamlesh Prasad, Chair of Session 3, opened the session by contextualising seaweed as a critical marine bioresource with immense potential for value addition across sectors. He explained that seaweeds are fundamentally carbon-rich biological systems, containing a wide range of organic molecules such as phycocolloids, lipids, proteins, pigments, minerals, and polysaccharides. These carbon-rich compounds fall under the category of blue carbon, which plays a significant role in long-term climate regulation and carbon sequestration. He emphasized that seaweeds are not merely raw biomass but complex biochemical factories capable of generating diverse molecules with industrial, agricultural, pharmaceutical, and environmental relevance.

Dr. Prasad elaborated on the diversity of seaweed-derived products, highlighting compounds such as fucoidan, ulvan, laminaran, polyunsaturated fatty acids, pigments, and bioactive polysaccharides. He noted that these molecules exhibit a wide range of biological activities including antioxidant, anti-inflammatory, anticoagulant, antiviral, antibacterial, and anticancer properties. Because of this biochemical diversity, seaweeds can be processed into biofuels, bioplastics, biochar, sugars, furfurals, nutraceuticals, pharmaceuticals, and food hydrocolloids. He emphasized that dehydration of seaweed sugars can yield platform chemicals such as furfurals, demonstrating seaweed's relevance even in green chemistry and industrial bioprocessing.

He further discussed the global seaweed production scenario, pointing out that although seaweed farming is expanding rapidly worldwide, India remains absent from the list of leading producers. China alone contributes nearly 50% of global production, and the global seaweed market has shown steady growth, reaching tens of millions of tonnes with a market value exceeding USD 16 billion. Despite this growth, India's production remains limited and largely dependent on wild harvest, with Kappaphycus alvarezii being the only seaweed cultivated commercially at scale.

Dr. Prasad highlighted that in India, the only well-established seaweed-based market at present is plant biostimulants. He explained the forms in which seaweed biostimulants are sold—liquids, gels, granules, flakes, and water-soluble powders—and identified global players dominating this sector. He stressed that the biostimulant market is growing rapidly and is projected to reach approximately USD 3 billion by 2031. He also presented his own proof-of-concept research demonstrating that a single seaweed species could be processed into multiple products such as potassium salts, organic acids, glycerides, leaf sprays, freshwater derivatives, and even advanced carbon materials like graphene, thereby establishing the feasibility of a multi-product biorefinery model.

He also addressed major challenges in the Indian policy and regulatory ecosystem. He pointed out that while the Food Safety and Standards Authority of India (FSSAI) lists "seaweed" generically under fruits and vegetables, it does not specify approved species or applications, making food product certification difficult. Similarly, seaweed consumption as food remains culturally underdeveloped in India, and consumer acceptance is low. He concluded by emphasizing the urgent need for policy clarity, species-level regulatory recognition, diversification of cultivated seaweeds, and integration of sustainability principles into the seaweed value chain.

Mr. Shrikumar Suryanarayan, Managing Director & Co-Founder, Sea6 Energy

Mr. Shrikumar Suryanarayan delivered a comprehensive address focusing on the industrial and commercial scalability of tropical red seaweeds. He began by explaining why tropical red seaweeds are particularly attractive as industrial feedstocks: they have year-round growth cycles, very high biomass productivity, rapid maturity, and a long history of cultivation. Unlike cold-water seaweeds, tropical species such as *Kappaphycus, Eucheuma*, and *Gracilaria* offer continuous harvest potential, making them suitable for large-scale industrial processes.

He described seaweed biomass as a highly versatile feedstock that can be processed fresh or dried, with dried seaweed having a long shelf life comparable to grains such as rice or

wheat. This allows seaweed to be transported globally and processed near end markets. Mr. Suryanarayan explained that the economic viability of seaweed applications is directly linked to biomass cost. When seaweed is manually farmed, only high-value applications such as bio-stimulants and niche food products are feasible. However, mechanized farming dramatically reduces costs, unlocking opportunities in biodegradable plastics, food ingredients, and eventually fuels.

A significant portion of his address focused on seaweed-derived bio-stimulants. He explained that while raw carrageenan is not inherently bioactive, controlled hydrolysis to specific molecular weight ranges (typically 400–5000 Daltons) produces sulphated galacto-oligosaccharides with strong biological activity. He presented evidence showing that these molecules enhance plant growth by activating specific genetic pathways, increasing root and leaf development, and improving fertilizer use efficiency. He emphasized that bio-¬stimulants not only improve yields but also positively alter soil microbiomes, countering the long-term soil degradation caused by excessive chemical fertilizer use.

Mr. Suryanarayan also discussed applications beyond agriculture, including aquaculture and animal health. He shared results from field trials demonstrating improved shrimp survival, immunity, and resistance to white spot syndrome virus through seaweed-derived polymers. Similar benefits were observed in poultry and cattle, where seaweed extracts improved gut immunity, milk fat yield, and reproductive performance. He emphasized that these outcomes were validated through collaborations with reputed institutions such as ICAR.

He further elaborated on emerging applications such as biodegradable plastics, grease-resistant paper coatings, water-soluble packaging films, and natural marine flavors and pigments. He concluded with a strategic discussion on seaweed-based biofuels, explaining how hydrothermal liquefaction can convert seaweed into crude oil and sustainable aviation fuels. He stressed that seaweed cultivation could play a transformative role in India's energy security, potentially reducing crude oil imports while creating millions of jobs through large-scale ocean farming.

Dr. R. Srinivasan, Vice President – Biological Products, Tropical Agrosystem (India) Private Limited

Dr. R. Srinivasan focused his address on agricultural applications of seaweeds, particularly as biostimulants and organic fertilizers. He began by highlighting India's rich seaweed biodiversity, with over 800 species distributed mainly along the coasts of Tamil Nadu, Gujarat, Lakshadweep, and Andaman & Nicobar Islands. Despite this diversity, he pointed out that only a few species are commercially utilized.

He explained that seaweed-based agricultural inputs have become central to sustainable farming due to their ability to enhance crop yields, improve soil health, and increase resistance to abiotic stress such as drought and salinity. He detailed the regulatory framework under the Fertilizer Control Order (FCO), noting that several seaweed species have been officially notified as biostimulants. Among these, *Kappaphycus alvarezii* has gained significant acceptance as an organic fertilizer, particularly in the form of potash derived from Rhodophytes, which contains a minimum of 20% potassium along with sulphur.

Dr. Srinivasan provided extensive market insights, noting that seaweed-based biostimulants now constitute more than one-third of India's biostimulant market, surpassing traditional products such as humic acids and amino acids. He discussed the commercialization of both indigenous and imported seaweed species, including Ascophyllum nodosum and Laminaria digitata. He also highlighted that out of 145 biostimulant products notified in India, nearly 50 are seaweed-based, underscoring the sector's rapid growth.

He concluded by emphasizing that regulatory clarity, industry readiness, and growing farmer acceptance make agriculture the most mature entry point for seaweed value chains in India, while also stressing the need to expand domestic cultivation to reduce reliance on imports.

Dr. J. Helen Fitton, Director, RD Advisor (Australia)

Dr. J. Helen Fitton delivered a detailed virtual address on global commercialization of seaweed extracts, with particular emphasis on food, nutraceuticals, and health sectors. She began by discussing established alginate industries in Australia and Europe, where wild-harvested bull kelp is processed and exported over long distances due to its high value. She used this to illustrate that logistics become secondary when product value is sufficiently high.

She emphasized that successful commercialization requires securing raw material supply, establishing scalable processing systems, ensuring sustainability, protecting intellectual property, and complying with regulatory frameworks in domestic and export markets. Drawing from Australian case studies, she showcased vertically integrated models where seaweed cultivation, processing, R&D, and product development occur within a single ecosystem.

Dr. Fitton discussed clinical research on seaweed-derived carbohydrates, highlighting their anti-inflammatory effects and ability to modulate gut microbiomes. She cautioned that pharmaceutical development from seaweeds is highly capital-intensive, with long timelines and low success rates, making it unsuitable for most seaweed enterprises. However, she cited successful niche examples such as carrageenan-based antiviral nasal sprays and emerging medical device applications.

She concluded by identifying nutraceuticals and functional foods as the most realistic and scalable health-related applications for seaweed bio-actives, provided they are supported by strong scientific evidence, regulatory compliance, and well-structured business models.

Mr. Suresh Manavasi Ramamoorthy, Lead-Global Strategy, Trishul Biotech

Mr. Suresh Manavasi Ramamoorthy spoke from an entrepreneurial and value-chain perspective, describing seaweed as a bridge from marine biomass to functional solutions. He emphasized that raw seaweed has limited economic value, but strategic processing and extraction can dramatically enhance its worth. He discussed advanced extraction techniques such as enzymatic, ultrasonic, microwave, and supercritical fluid extraction for efficient recovery of bio-actives.

He highlighted the role of seaweed extracts in precision agriculture, focusing on improving nutrient use efficiency rather than simply supplementing nutrients. He explained how potash derived from Rhodophytes enhances potassium bioavailability, thereby improving crop resilience, stress tolerance, and productivity. He also stressed the advantage of tropical seaweeds, which are naturally adapted to heat stress and therefore offer superior performance under climate change conditions.

He concluded by advocating for strong collaboration between scientists, farmers, and entrepreneurs, and emphasized the "Make in India, Sell to the World" vision for seaweed-based products.

Dr. Remya. S, Senior Scientist, ICAR-CIFT

Dr. Remya. S, began by outlining the global scenario of seaweed production, noting a significant increase over the past two decades, with aquaculture dominating production. Asia leads global production, with China, Indonesia, the Republic of Korea, and the Philippines as major contributors. In contrast, India's seaweed production remained around 26,000 tonnes during 2010–2018 and continues to rely largely on wild harvesting. Despite India's limited contribution globally, recent initiatives under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) have created strong momentum for expanding seaweed farming. Dr. Remya emphasized that this renewed focus also presents substantial opportunities for post-harvest handling, processing, and value addition, areas that were previously underexplored.

She explained that seaweed applications span multiple sectors, including human food, pharmaceuticals, agriculture, hydrocolloids, bioenergy, animal feed, cosmetics, and packaging. Globally, products for human consumption account for nearly 85% of the total seaweed industry value, while hydrocolloids contribute around 10–15%, with the remainder from fertilizers, feed additives, and other niche applications.
Focusing on food applications, Dr. Remya described seaweed as a nutritious, high-fiber, low-calorie food with a long history of consumption in countries such as Japan, China, and the Republic of Korea. She categorized seaweed food products into edible seaweeds (fresh, dried, or powdered), snacks, extruded and baked products, gluten-free foods, functional foods, and hydrocolloid-based foods. Key species used globally include *Pyropia, Porphyra, Undaria, Saccharina, Gracilaria, Sargassum*, and *Kappaphycus*. Products such as dried wakame, kombu, and nori sheets were highlighted for their growing popularity in both Asian and non-Asian markets.

The presentation placed strong emphasis on functional and designer foods, driven by the rising prevalence of lifestyle-related diseases. Dr. Remya explained ICAR-CIFT's work on developing symbiotic functional foods, combining seaweed-derived prebiotics with probiotic bacteria. She noted that seaweed polysaccharides demonstrated prebiotic scores comparable to commercial inulin, and these ingredients were successfully incorporated into beverages, snack products, dairy items, soups, and gluten-free foods.

Dr. Remya further discussed hydrocolloids—agar, alginate, and carrageenan—as the backbone of industrial seaweed utilization. She pointed out that India's indigenous production of these hydrocolloids meets only a fraction of domestic demand, indicating strong scope for expansion. Beyond food applications, she described nutraceutical and pharmaceutical uses, including dietary fibers, mineral supplements, and bioactive compounds such as fucoxanthin, fucoidan, and porphyrins, extracted using advanced techniques like ultrasonication, microwave-assisted extraction, and supercritical fluid extraction.

Additional applications covered included animal and aquaculture feed additives, agricultural biostimulants, cosmetics, biodegradable packaging materials, edible films and sachets, biofuels, wastewater treatment, biomedical materials such as wound dressings, and environmental remediation. Dr. Remya also highlighted ICAR-CIFT's work on safety and quality evaluation, including nutritional profiling and contaminant analysis.

Concluding her presentation, Dr. Remya showcased several technology transfers and commercialized products developed at ICAR-CIFT, including seaweed-based dietary supplements, functional foods, dairy products, beverages, and post-COVID antimicrobial sanitizers, licensed to various industry partners. She emphasized that with increasing policy support and market demand, seaweed value addition offers significant opportunities for sustainable growth, entrepreneurship, and diversification in India's fisheries and allied sectors.

Session 4
Seaweed Bioprospecting and Biotechnology as Emerging Area for Product Development

Session Chair: Dr. Arup Ghosh Chief Scientist CSIR-CSMCRI

Speakers:

- **Dr. Sandhya Sukumaran** Principal Scientist, Marine Biotechnology Division ICAR-CMFRI, Kochi
- **Prof. Valsamma Joseph Director** - National Centre for Aquatic Animal Health Cochin University of Science and Technology

Opening Remarks by the Session Chair Dr. Arup Ghosh, Chief Scientist, CSIR-CSMCRI

The session commenced with an introductory address, from the Session Chair Dr. Arup Ghosh, highlighting the need to move beyond the traditional utilization of seaweeds for polysaccharides, bio-stimulants, and animal feed towards advanced bioprospecting and biotechnology-driven product development. Emphasis was laid on the Government of India's Bio-E3 Policy, which prioritizes biotechnology-based products from marine resources, including seaweeds

Dr. Sandhya Sukumaran Principal Scientist, Marine Biotechnology Division ICAR-CMFRI, Kochi

Dr. Sandhya Sukumaran delivered a comprehensive presentation on the role of seaweed genomics in enhancing bio-manufacturing and product quality. She emphasized that despite the immense potential of seaweeds in food, feed, nutraceuticals, pharmaceuticals, and sustainable polymers, genomic and transcriptomic resources for Indian seaweed taxa remain scarce, constraining selective breeding, domestication, quality control, and conservation efforts

She highlighted ongoing efforts at ICAR–CMFRI, including the whole genome and transcriptome sequencing of the red seaweeds Gracilaria edulis and Gracilaria salicornia, which are currently under analysis. The availability of such datasets enables identification of biosynthetic gene clusters, functional genes, biomarkers, and metabolic pathways linked to agar biosynthesis, sulfation patterns, and associated antiviral and anticoagulant bioactivities

The presentation also covered insights from global seaweed genome studies, illustrating unique genome features such as compact gene structures, high transposable element content, horizontal gene transfer, and viral integrations that contribute to stress tolerance, metabolic novelty, and adaptation to marine environments. Applications of genome-informed bioprospecting, including in silico identification of therapeutic peptides and anti-cancer compounds, were discussed as promising pathways for future product development

Dr. Sandhya further discussed the scope of marker-assisted selection and genome-assisted breeding for improving growth rate, stress tolerance, and polysaccharide yield. However, she noted significant challenges in seaweed genome editing, including lack of stable transformation systems, complex cellwall barriers, incomplete genome assemblies, poorly understood DNA repair mechanisms, and long or complex life cycles of seaweeds.

Prof. Valsamma Joseph Director - National Centre for Aquatic Animal Health, Cochin University of Science and Technology

Prof. Vallasamma Joseph, in her talk, addressed the challenges and prospects of seaweed bioprospecting and biotechnology, stressing that the most critical bottleneck for industry expansion is the consistent availability of quality seaweed biomass.

She advocated for integrated systems biology approaches, combining genomics, transcriptomics, proteomics, metabolomics, and microbiome studies, to support sustainable seaweed biotechnology.

She highlighted that most existing seaweed research is derived from temperate regions and underscored the need

for tropical-specific data on growth requirements, life cycle regulation, and environmental responses. Challenges related to polyphyletic origins, codon bias, complex genomes, and diverse life histories of seaweeds were discussed, along with the limitations in applying conventional plant biotechnology tools directly to seaweeds

Prof. Vallasamma also elaborated on emerging areas such as seaweed micropropagation, protoplast fusion, microbiome manipulation, disease diagnosis and management, and the development of integrated multi-trophic aquaculture (IMTA) and recirculating aquaculture systems (RAS) incorporating seaweeds as extractive species. She concluded by emphasizing that basic biological research, alongside advanced biotechnology, is essential to realize the full potential of seaweed-based industries in India

The session concluded with a discussion reiterating the enormous opportunities in seaweed bioprospecting and the need for coordinated national efforts in genomics, cultivation, and industry linkages.

Proceedings: Day – 2

Session 1
The State of World Seaweed – Cultivation, Innovation, Processing, marketing & Supply Chain

Session Chair: Dr. Arup Ghosh, Chief Scientist, CSIR-CSMCRI

Speakers:

- Dr. Pi Nyvall, Scientific Affairs Director, Olmix (France)
- Dr. Mozart Marins, Coordinator of the Biotechnology Postgraduate Program, Ribeirão Preto (UNAERP) (Brazil)
- Mr. Sivaram Kulendran, Seaweed Development Consultant (Srilanka & Maldives)
- Dr. Morty Fazal, Director, C-Weed Mwani (Tanzania)
- Mr. Steven Hermans, Founder, Phyconomy (Belgium)

Opening Remarks by the Session Chair Dr. Arup Ghosh, Chief Scientist, CSIR-CSMCRI

Dr. Arup Ghosh formally opened the session by situating seaweed within the broader global bioeconomy and blue economy discourse. He noted that global seaweed production is currently estimated at approximately 38 million tonnes per annum, largely dominated by East and Southeast Asian countries. Despite the scale of production, he pointed out that recent years have shown a plateauing of growth, reflecting emerging systemic constraints such as climate variability, disease outbreaks, and saturation of near-shore farming systems.

Dr. Ghosh drew attention to India's paradoxical position: possessing an extensive coastline and favourable marine environments, yet contributing only a marginal share to global production. He highlighted that national targets for large-scale seaweed cultivation would require a transition from fragmented, opportunistic farming models to structured, science-led mariculture systems. Emphasis was placed on the need for validated site selection, species diversification beyond limited commercial varieties, mechanisation, and integration of cultivation with processing and markets.

He concluded his opening remarks by underscoring the importance of learning from international experiences and aligning research, policy, and industry efforts to enable sustainable scaling of the sector.

Dr. Pi Nyvall, Scientific Affairs Director, Olmix (France)

Dr. Pi Nyvall presented a global industry perspective, focusing on the increasing demand for seaweed-derived products, particularly in agriculture and animal nutrition. He explained that seaweed-based biostimulants and biofertilisers have demonstrated significant benefits in improving crop resilience, nutrient uptake, and soil health, and that these products are experiencing strong global market growth.

However, Dr. Nyvall cautioned that the expansion of these markets is increasingly constrained by limitations in biomass supply. He elaborated on challenges faced by major producing regions, including climate-induced stress, disease incidence, rising labour costs, and declining productivity in traditional farming zones. According to him, the industry is entering a phase where demand growth is outpacing the ability of current production systems to deliver consistent, high-quality biomass.

He emphasized that future competitiveness will depend on improving productivity per unit area, ensuring quality consistency, and establishing traceable supply chains. Dr. Nyvall stressed the importance of long-term partnerships between farmers and processors, supported by contractual arrangements that provide price stability and investment confidence. He concluded by noting that without systematic improvements in cultivation efficiency and governance frameworks, the full potential of high-value seaweed applications will remain unrealized.

Dr. Mozart Marins, Coordinator of the Biotechnology Postgraduate Program, Ribeirão Preto (UNAERP, Brazil)

Dr. Mozart Marins shared insights from Brazil's experience in developing seaweed cultivation within a regulated coastal management framework. He emphasized that one of the most critical enablers for sector growth in Brazil has been the establishment of clear regulatory processes for marine leasing and site authorization. Without legally defined access to

marine space, he noted, neither farmers nor private investors are willing to commit resources over the long term.

He discussed Brazil's approach to integrating seaweed farming into broader coastal development and environmental planning processes. This includes conducting site-specific feasibility studies, assessing carrying capacity, and ensuring compatibility with existing marine uses and sensitive ecosystems. Dr. Marins stressed that environmental safeguards are not a constraint but rather a prerequisite for long-term industry credibility and social acceptance.

He further highlighted the importance of adaptive management, noting that cultivation practices must evolve in response to changing environmental conditions. According to him, sustainable scaling requires continuous monitoring, research support, and close collaboration between academic institutions, regulators, and industry stakeholders.

Mr. Sivaram Kulendran, Seaweed Development Consultant (Sri Lanka & Maldives)

Mr. Sivaram Kulendran focused his address on practical lessons from seaweed development initiatives in Sri Lanka and the Maldives. He emphasized that while seaweed farming is often promoted as a livelihood activity requiring minimal investment, ultra-smallholder models frequently fail to deliver sustainable incomes unless supported by aggregation, infrastructure, and assured markets.

He elaborated on the importance of organizing farmers into clusters or cooperatives to enable economies of scale, shared services, and access to mechanisation. Mr. Kulendran highlighted that centralized nurseries and quality-controlled seed supply systems are essential for maintaining productivity and reducing disease-related losses.

Drawing from island nation experiences, he stressed that long-term tenure security through government-backed leasing arrangements is fundamental to farmer confidence and private sector participation. He also noted that policy-backed procurement mechanisms and structured value chains have been instrumental in stabilizing production and preventing market distortions caused by unregulated buying practices.

Dr. Morty Fazal, Director, C-Weed Mwani (Tanzania)

Dr. Morty Fazal presented a detailed account of Tanzania's seaweed sector, which has historically been one of the largest in Africa. He explained that while the country achieved rapid expansion in earlier decades, the sector is now facing declining productivity, particularly in near-shore farming areas. Factors contributing to this decline include rising seawater temperatures, disease outbreaks, and increased grazing pressure.

He emphasized the urgent need to transition toward deeper-water and offshore cultivation systems that are less vulnerable to near-shore stressors. Dr. Fazal discussed the role of mechanisation in improving efficiency and reducing the physical burden on farmers, many of whom are women. He highlighted that women constitute a significant proportion of the seaweed farming workforce and that protecting their livelihoods requires addressing price volatility and declining yields.

Dr. Fazal stressed the importance of fair pricing mechanisms, stable buyer relationships, and diversification into higher-value products to ensure long-term sustainability of the sector. He concluded by noting that without targeted interventions, traditional seaweed farming communities risk being marginalized despite the sector's global growth potential.

Mr. Steven Hermans, Founder, Phyconomy, Belgium

Mr. Steven Hermans addressed the future trajectory of the seaweed sector, focusing on emerging applications such as biomaterials, alternative proteins, bioplastics, and climate-positive solutions. He emphasized that seaweed is increasingly viewed not merely as an agricultural commodity, but as a strategic bio-resource capable of supporting multiple industrial value chains.

He cautioned, however, that many of these emerging markets are highly cost-sensitive and require large volumes of consistent-quality biomass. Innovation in product development, must be matched by equal investment in cultivation systems, logistics, and supply chain coordination.

Mr. Hermans stressed that fragmented production systems and unreliable supply remain major barriers to commercialisation of advanced applications. He advocated for a systems-level approach that aligns farming scale, processing capacity, and market demand. He concluded by emphasizing that policy frameworks must recognize seaweed as a critical component of the blue economy and support long-term infrastructure and investment planning.

Session 2
Seaweed for Climate Resilience & Environmental Sustainability

Session Chair: Dr. K.S. Sobhana Principal Scientist & Head-In-Charge, MBEMD ICAR-CMFRI

Speakers:

- **Dr. Deepak Samuel V,** Scientist – E, Conservation of Coastal & Marine Resources Division, NCSCM
- **Dr. Divu**. D, Senior Scientist, ICAR-CMFRI, Veraval
- **Dr. Amitha Ganapathy**, B DGM – Agri Services, Zuari Farmhub Ltd.
- **Professor Juliet Brodi**e, Merit Researcher, Phycology Research, Natural History Museum, London, (UK)
- **Professor Elizabeth Cottier-Coo**k, Professor in Marine Biology, University of the Highlands and Islands and the Scottish Association for Marine Science (Scotland)

Opening Remarks by the Session Chair Dr. K.S. Sobhana Principal Scientist & Head-In-Charge, MBEMD ICAR-CMFRI

Dr. K.S. Sobhana formally opened the session by situating seaweeds within the broader context of climate change impacts on marine and coastal systems, including ocean warming, acidification, biodiversity loss, and heightened vulnerability of coastal communities. She emphasized that seaweeds represent one of the most promising nature-based solutions for both climate mitigation and adaptation.

She outlined the multiple ecosystem services provided by seaweeds, including carbon uptake, nutrient absorption, bioremediation, and their emerging role in methane emission reduction when incorporated into animal feed. In addition to environmental benefits, she highlighted seaweed farming as a viable livelihood option for coastal communities, particularly women, drawing from experiences at ICAR-CMFRI's Mandapam Regional Centre.

Dr. Sobhana stressed that while national goals increasingly emphasize inclusive and climate-smart development, realizing the full potential of seaweed-based interventions requires close collaboration among researchers, industry stakeholders, policymakers, and coastal communities. She noted that the India International Seaweed Expo and Summit was conceived as a platform to foster such collaboration and knowledge exchange. She concluded by introducing the session's speakers, whose expertise spanned regulation, climate science, aquaculture, industry, conservation, and biosecurity.

Dr. Deepak Samuel V, Scientist – E, Conservation of Coastal & Marine Resources Division, NCSCM

Dr. Samuel provided a regulatory and planning perspective on seaweed farming under India's coastal governance framework. Representing the Ministry of Environment, Forest and Climate Change through NCSCM, he explained that seaweed cultivation must operate within clearly defined zones under Coastal Regulation Zone (CRZ) notifications. NCSCM plays a central role in preparing CRZ maps, Coastal Zone Management Plans, and vulnerability assessments for all Indian coastal states and union territories.

He elaborated on the development of Coastal Vulnerability Indices (CVI), which integrate physical, ecological, and socio-economic parameters such as storm surges, sea-level rise projections, biodiversity sensitivity, livelihood dependence, demographic structure, and exposure to hazards. These tools, he emphasized, are essential for identifying areas suitable for aquaculture and seaweed farming, as well as areas where cultivation should be avoided.

On climate mitigation, Dr. Samuel discussed the carbon sequestration potential of seaweeds, distinguishing clearly between short-term biomass harvest and long-term sequestration through sediment burial, deep-sea sinking, and biological storage. He noted that while wild seaweeds contribute significantly to carbon cycling, cultured seaweeds removed during harvest cannot automatically be counted as long-term carbon sequestration.

He highlighted that brown seaweeds generally exhibit higher carbon uptake potential and cited species-specific estimates, while cautioning against oversimplified claims of carbon credits from farming alone. He also addressed climate-related challenges such as rising sea surface temperatures, disease outbreaks (including ice-ice syndrome), epiphytes, endophytes, and grazing pressure from herbivorous fish.

Dr. Samuel emphasized the need to avoid cultivation near sensitive ecosystems such as coral reefs, mangroves, seagrasses, and salt marshes, and advocated diversification away from mono-specific farming. He concluded by stressing that while seaweed farming is a key pillar of India's blue economy vision and supported through schemes like PMMSY, expansion must be scientifically guided, environmentally safeguarded, and socially inclusive to avoid repeating past mistakes.

Dr. Divu. D, Senior Scientist, ICAR-CMFRI, Veraval

Dr. Divu's presentation focused on positioning seaweed farming as a nature-based solution that simultaneously advances climate resilience, environmental sustainability, and economic development. He emphasized that blue economy initiatives must generate tangible livelihoods and revenue to remain socially viable, particularly in densely populated coastal regions.

He outlined the ecological functions of seaweeds as foundational habitats supporting marine biodiversity, shoreline protection, and water quality improvement. He explained that seaweeds absorb dissolved nutrients, reduce eutrophication, and act as efficient carbon sinks through high primary productivity, with rapid biomass doubling cycles of 40–60 days.

Dr. Divu stressed the minimal resource footprint of seaweed farming, noting that it requires no freshwater, no fertilizers, and can be practiced in saline or marginal coastal areas unsuitable for terrestrial agriculture. He discussed co-benefits such as reduced land and freshwater pressure, circular bioeconomy opportunities, and substitution of high-emission products through seaweed-based alternatives.

He elaborated on methane reduction through seaweed-based animal feeds, citing research showing significant reductions in emissions even at low inclusion rates. He also discussed integrated multi-trophic aquaculture (IMTA), advocating systematic integration of seaweeds with fish and shrimp farming to recycle nutrients and improve overall system efficiency.

On carbon markets, Dr. Divu cautioned that while seaweed farming can contribute to carbon absorption, standardized methodologies, traceability systems, and policy frameworks are still evolving. He emphasized that value addition near production sites and reduced transport emissions are essential for improving the net climate benefits of seaweed-based value chains.

Dr. Amitha Ganapathy B, DGM – Agri Services, Zuari Farmhub Ltd.

Dr. Amitha Ganapathy B presented an industry perspective, framing seaweeds as an underutilized marine resource with significant potential for climate resilience, environmental sustainability, and agricultural productivity. She traced the origins of climate change to industrialization and fossil fuel use, highlighting the scale of global carbon emissions and the ocean's role in absorbing atmospheric CO_2.

She explained the concept of blue carbon and described how seaweeds mitigate ocean acidification by absorbing carbon dioxide and buffering pH levels, thereby supporting calcifying organisms such as corals and shellfish. Beyond climate functions, she emphasized seaweeds' role in wave attenuation, sediment stabilization, nutrient removal, and biodiversity enhancement.

Dr. Ganapathy focused extensively on agricultural applications, describing seaweed-based bio-stimulants that enhance nutrient uptake, soil health, stress tolerance, and crop productivity. She detailed several commercial products derived from brown and red seaweeds, explaining their modes of action, extraction technologies, and agronomic benefits.

She concluded by asserting that seaweed-based solutions represent a unique convergence of climate mitigation, environmental sustainability, and economic value creation, particularly when integrated into agriculture and allied sectors.

Professor Juliet Brodie, Merit Researcher, Phycology Research, Natural History Museum, London (UK)

Professor Juliet Brodie focused on the conservation of wild seaweed species and habitats as a prerequisite for a resilient seaweed aquaculture industry. She emphasized that seaweeds form diverse and extensive marine habitats, most of which lack adequate legal protection compared to mangroves, seagrasses, and coral reefs.

She highlighted the risks posed by climate change, habitat degradation, and over-reliance on a narrow set of cloned cultivars that have been moved globally over decades. Using examples from tropical carrageenan species, she illustrated declining plant sizes, increased disease susceptibility, and loss of wild source populations.

Professor Brodie stressed the importance of protecting wild stocks as reservoirs of genetic diversity for future climate-resilient cultivars. She warned against unregulated transboundary movement of seaweed material, which carries hidden microbiomes and pathogens. She also outlined ongoing initiatives such as Global Seaweed Protect and the Seaweed Breakthrough, aimed at integrating conservation, restoration, and industry development within global biodiversity and climate frameworks.

She concluded by calling for seaweeds to be explicitly included in international conservation targets, marine protected area planning, and biodiversity policy instruments.

Professor Elizabeth Cottier-Cook, Professor in Marine Biology, University of the Highlands and Islands and the Scottish Association for Marine Science (Scotland)

Professor Cottier-Cook addressed biosecurity as a critical determinant of long-term sustainability in seaweed farming. She explained that 15–20% of global seaweed production can be lost annually due to pests and diseases, with severe socio-economic impacts on farming communities.

She introduced the Progressive Management Pathway (PMP) for seaweed biosecurity, adapted from aquaculture health management frameworks used in finfish and shrimp sectors. The PMP outlines staged actions from baseline risk assessment and planning to full implementation of sustainable national biosecurity systems.

Professor Cottier-Cook emphasized practical, low-cost biosecurity measures at farm level, alongside national surveillance, diagnostics, traceability, and contingency planning. She highlighted capacity-building efforts underway in Southeast Asia and stressed the importance of prioritizing native species domestication over importing non-native cultivars.

She concluded by reiterating that while disease outbreaks cannot be entirely prevented, structured biosecurity systems can significantly reduce risks, safeguard livelihoods, and build confidence in national and international seaweed trade.

Session 3
Building Ecosystem for Start-up Innovation & Industrial application

Session Chair: Mr. V. Senthilkumar, Founder & MD, Sathyam Group of Companies

Speakers:

- **Ms. Runa Ray,** Founder, KelpTex
- **Mr. Kaviraj,** Manager-R&D, Sathyam Kissan Care
- **Dr. Bhavani Rao R,** Director, Centre for Women's Empowerment and Gender Equality (CWEGE)
- **Mr. Evanjalist Pathrose**, Managing Director, Emineotech

Opening Remarks by the Session Chair Mr. V. Senthilkumar, Founder & MD, Sathyam Group of Companies

Mr. V. Senthilkumar opened the session by reflecting on his own entrepreneurial journey in the seaweed sector, having built a company over two decades that now operates across fertilizers, animal feed, and food-related applications. He emphasized that startups are no longer peripheral players but are becoming central drivers of industrial growth, especially in emerging sectors such as seaweed and bio-inputs.

He highlighted the importance of government-led initiatives, including Atmanirbhar Bharat, Make in India, and startup-focused funding schemes, which have lowered entry barriers for new entrepreneurs through easier access to loans, R&D support, land, and institutional facilitation. According to him, such support has led to a surge of new startups entering the seaweed and fertilizer industries, transforming them into scalable and commercially viable sectors.

The Chair stressed that the success of startups depends not merely on individual effort but on the presence of a supportive ecosystem that integrates policy, finance, research, and markets. He concluded by welcoming the panelists and expressing confidence that the session would offer practical insights into building such ecosystems for sustainable industrial application.

Ms. Runa Ray, Founder, KelpTex

Ms. Runa Ray approached the theme of startup innovation from a creative and environmental design perspective, emphasizing that innovation must address not only scalability but also responsibility. As a fashion environmentalist, she explained how her work emerged from questioning the fashion industry's excessive consumption of water, chemicals, and energy, and its indirect but severe impact on marine ecosystems.

She described her exploration of seaweed and microalgae as regenerative materials, beginning with traditional water-based dyeing techniques that dramatically reduced water usage. Through this process, she realized that design could collaborate with natural systems rather than dominate them. Her fieldwork with seaweed-farming communities in coastal Tamil Nadu revealed that seaweed is not merely a raw material but an ecological connector that supports biodiversity and livelihoods, particularly among women.

Ms. Ray highlighted that despite the ecological value of seaweed farming, artisanal communities often earn minimal returns due to middlemen and ecosystem degradation caused by pollution and overfishing. She connected these local challenges to global issues, explaining how land-based industries—especially fashion—contribute to marine pollution through chemicals, dyes, and microplastics.

She emphasized circularity, where materials are designed to return safely to natural systems. Drawing from collaborations with international research institutions and scientists, she demonstrated how macroalgae can serve as a next-generation regenerative textile material that requires no land, freshwater, or chemical inputs.

She concluded by stressing that future innovation in the blue economy must be collaborative rather than extractive, integrating science, indigenous knowledge, and cultural context, with India playing a crucial role due to its deep-rooted coastal and seaweed traditions.

Mr. Kaviraj, Manager – R&D & Quality, Sathyam Kissan Care

Mr. Kaviraj focused on the industrial and commercialization dimension of startup ecosystems, asserting that no innovation can succeed in isolation. He defined an ecosystem as a mutually dependent network involving farmers, manufacturers, logistics providers, R&D institutions, and Government agencies working in a win–win arrangement.

Drawing from his company's experience in bio-stimulants and seaweed-based products, he explained how a properly structured ecosystem enables timely execution, cost efficiency, energy efficiency, and circular economy outcomes. He emphasized that customer-driven innovation emerges only when ecosystems are stable and responsive.

A key concern highlighted was the absence of standardized quality benchmarks in the seaweed sector, particularly for raw material parameters such as moisture content and sand levels. He argued that establishing standards at the primary processing stage would improve consistency across the entire value chain.

Mr. Kaviraj advocated for shared infrastructure models, including common drying yards, sand-removal units, and chopping facilities, which would benefit both farmers and processors. He cited the coir cluster model in Kerala as a successful example of how Government-supported clustering can reduce costs and enhance value addition.

He also emphasized resource optimization and responsible cultivation practices to ensure sustainability of marine resources. Concluding his address, he underscored the importance of farmer involvement, continuous training, and Government facilitation, stating that the ocean economy holds immense potential if managed through collaboration and respect for natural systems.

Dr. Bhavani Rao R, Director, Centre for Women's Empowerment & Gender Equality (CWEGE)

Dr. Bhavani Rao R presented a gender-inclusive perspective on ecosystem building through her initiative titled "Blue is the New Pink," which integrates blue economy development with women's empowerment. She explained that while seaweed cultivation offers livelihood opportunities, skill development alone is insufficient without addressing broader social, economic, and environmental vulnerabilities.

She outlined her organization's holistic intervention framework, which maps women's vulnerabilities across livelihoods, health, education, safety, environment, and mental well-being. Using participatory and technology-enabled approaches, the initiative has trained over 200 women in sustainable seaweed cultivation, safety practices such as swimming and diving, and marine ecosystem awareness.

Dr. Rao highlighted that women's engagement extended beyond cultivation to include ecosystem stewardship, such as seagrass restoration, beach cleanups, and biodiversity mapping. She emphasized that sustainability cannot be achieved if industries operate without community participation.

Recognizing the fragility of income streams dependent solely on industrial buyers, her team introduced household-level value addition, including seaweed pickles, soaps, and small-scale biofertilizer applications. These products enabled women to generate income independently, particularly in tourism-driven coastal regions.

She also shared insights on scaling these interventions through partnerships with Government agencies and research institutions, including expansion into Andhra Pradesh. She concluded by emphasizing that a resilient blue economy requires empowered local communities, diversified livelihoods, and inclusive governance structures.

Mr. Evanjalist Pathrose, Managing Director, Emineotech

Mr. Evanjalist Pathrose contextualized the discussion within the broader startup ecosystem framework, defining startups as organizations created to develop new products under conditions of extreme uncertainty. He cautioned that startups are not smaller versions of large companies and face high failure rates, primarily due to market–product mismatch.

Using global examples, he explained how successful startups begin by identifying real customer problems rather than building solutions without market validation. He then described startup ecosystems as interconnected systems, inspired by natural ecosystems, where investors, incubators, accelerators, service providers, and Government agencies function symbiotically.

He highlighted India's rapid rise as one of the world's largest startup ecosystems, supported by national and state-level initiatives such as Startup India, seed funding schemes, tax incentives, and dedicated startup hubs. According to him, startups have become significant contributors to employment generation and economic growth.

Concluding his address, he emphasized adaptability as the defining factor for startup survival, noting that those best aligned with their ecosystem are most likely to succeed. He reaffirmed that sustained innovation requires policy support, ecosystem maturity, and entrepreneurial resilience.

Session 4
Seaweed 2030: Visioning India's Rise as a Global Seaweed Powerhouse (Panel Discussion)

Moderator: Dr. V. V. R. Suresh, Head, Mariculture Division, ICAR–CMFRI

Panellists:

- **Dr. Sushant Kundu**, Executive Director, Climacrew
- **Dr. Stefan Kraan**, Director & CSO, Oceana Organic Products Ltd., Ireland
- **Dr. K. Suresh Babu**, Chief Scientist, Department of Natural products and medicinal Chemistry, CSIR–Indian Institute of Chemical Technology
- **Dr. Satish Lakakkula**, Scientist, CSIR–CSMCRI (MARS Mandapam)
- **Dr. Rajeev Dwivedi,** Business Development Manager – Plant Health, Novonesis

Opening Remarks by the Session Moderator Dr. V. V. R. Suresh, Head, Mariculture Division, ICAR–CMFRI

Dr. V. V. R. Suresh opened the session by contextualising it as the culminating and most forward-looking segment of the conclave. He acknowledged the post-lunch and end-of-conference fatigue among participants, but emphasized that this session carried a special responsibility—to envision India's seaweed sector in the year 2030, a horizon now less than four years away.

He reflected on the breadth of discussions over the previous two days, noting that the conclave had comprehensively addressed policy frameworks, regulatory issues, financing, supply chains, market development, cultivation systems, farming innovations, bioprospecting, product development, climate resilience, startup ecosystems, industrial applications, and even the emerging interest of the fashion industry in seaweed-derived materials. According to him, the sector had been examined from "seed to shelf," making this final session critical for synthesis and direction-setting.

Dr. Suresh presented a realistic assessment of India's current position, stating that national seaweed production remains around 0.02 million tonnes, despite an estimated farming potential of over nine million tonnes. While some stakeholders have articulated ambitions of achieving one million tonnes per annum, he cautioned that current growth rates do not support such optimism. Based on conservative projections, India may reach only about 0.2 million tonnes by 2030 unless there is a fundamental shift in approach.

Drawing parallels with the National Pulses Mission and Millet Mission, he argued that incremental schemes are insufficient to generate transformative change. Instead, he proposed the creation of a dedicated "Seaweed Mission", operating in mission mode with clearly defined targets, timelines, and accountability. Although seaweed farming is included under PMMSY and Blue Economy initiatives, it remains only a component rather than a focal priority.

A major concern highlighted was institutional fragmentation. Multiple ministries, research institutions, state Governments, industries, and growers currently operate in silos, with no single convergence platform. Dr. Suresh stressed the urgent need for an umbrella mechanism—whether a mission, authority, or coordinated scheme—that can align these diverse stakeholders.

He further emphasized the policy ambiguity surrounding seaweed farming, noting that it currently falls between fisheries and agriculture, resulting in the sector being deprived of benefits enjoyed by either. He strongly advocated for bringing seaweed farming at par with agriculture, enabling access to subsidies, insurance, credit, and structured incentives.

Dr. Suresh elaborated on the unique governance challenge of marine farming, contrasting it with land-based agriculture. Since oceans are common property resources, individual farmers cannot independently initiate cultivation without clear policies, zonation, and security of tenure. In India, fisheries being a state subject means that each coastal state must proactively frame seaweed-specific policies, identify suitable farming zones, and open them for investment.

He expressed concern over the limited representation of coastal states at the conclave and urged organizers to ensure broader state participation in future editions so that policy insights translate into on-ground action.

Concluding his opening remarks, Dr. Suresh invited panellists to share their perspectives, urging them to focus on actionable pathways to elevate India's seaweed sector into a globally competitive position by 2030.

Dr. Sushant Kundu, Executive Director, Climacrew

Dr. Kundu spoke from a strong industry and practitioner perspective, noting his long association with the conference series and observing that while the sector has evolved over seven editions, progress remains slower than required to achieve global relevance.

He began by underscoring that biomass availability is the foundational constraint. Without sufficient and consistent biomass, downstream activities—processing, value addition, exports, and innovation—cannot scale. At present, India does not rank among the top ten global seaweed producers, which limits its industrial credibility.

Dr. Kundu highlighted the absence of affordable engineering and mechanization solutions for seaweed cultivation. He cited ICAR's agricultural engineering divisions as a model, where tools and implements are designed with farmer needs in mind and made available at subsidized costs. He proposed that a similar institutional mechanism be created for seaweed cultivation, covering seed production, seeding, harvesting, and processing, thereby enabling large-scale, cost-effective operations.

A critical social issue raised was the lack of insurance coverage for seaweed farmers. Unlike land-based agriculture, seaweed cultivation has no insurance safeguards against crop loss, climate events, or accidents. Given that coastal women form the backbone of seaweed farming, he stressed that insurance must be treated as a priority policy intervention.

Dr. Kundu also cautioned against overdependence on a few species, such as *Kappaphycus* and Sargassum. He argued for identifying five to ten region-specific species, preferably indigenous, so that each coastal region can develop its own ecological and economic specialization.

Another major bottleneck identified was seed availability, particularly during monsoon seasons when seed stock is often wiped out, forcing farmers to restart from zero. He strongly advocated for seed banks supported by Government or state agencies to ensure year-round availability.

Finally, he addressed quality inconsistency, noting that while aggregators collect biomass from multiple farmers, quality is often compromised. Industry requires uniform, high-quality raw material, and unless quality standards are embedded at the cultivation stage, India will struggle to build reliable value chains.

Dr. Stefan Kraan, Director & CSO, Oceana Organic Products Ltd., Ireland

Dr. Kraan approached the discussion through strategic visioning and international comparison. He recalled that the Hon'ble Prime Minister's announcement targeting one million tonnes of seaweed production served as a catalytic moment, elevating seaweed from a sub-component of fisheries to a sector of independent importance under PMMSY.

He acknowledged that tangible progress has occurred over the last two years, particularly in awareness, funding allocation, and institutional engagement. However, he identified two critical gaps that must be addressed urgently:

The absence of a robust baseline study, and The lack of a long-term national roadmap. Dr. Kraan emphasized the need for comprehensive mapping of cultivation zones, nutrient regimes, temperature profiles, and monsoon impacts to determine when and where specific species can be grown optimally. Without this scientific foundation, scaling efforts risk inefficiency and failure.

He called for a 20-year strategic roadmap, detailing phased interventions, subsidies, and regulatory reforms. According to him, even with optimal coordination, India may realistically reach 200,000 tonnes by 2030, with global top-ten status more likely by 2035 or beyond.

Dr. Kraan cautioned against competing directly with China and Indonesia in commodity hydrocolloids like agar and carrageenan, where cost structures are difficult to match. Instead, he urged India to focus on niche, high-value applications, particularly plastic alternatives and sustainable materials, where innovation and sustainability can provide competitive advantage.

Dr. K. Suresh Babu, Chief Scientist, Department of Natural products and medicinal Chemistry, CSIR–Indian Institute of Chemical Technology

Dr. Suresh Babu spoke from the perspective of a chemist and marine bio-actives researcher. He reinforced earlier points on biomass, species diversification, and mission-mode approaches, while bringing attention to the untapped potential of marine chemicals.

He emphasized that marine bioactive compounds derived from seaweeds already contribute significantly to global pharmaceuticals, including antibiotics, anti-cancer agents, and HIV drugs. Despite India's extensive coastline, marine chemical exploration remains underdeveloped.

He argued that alongside bio-fertilizers and hydrocolloids, marine natural products should be a strategic priority under any Seaweed Mission. According to him, this would not only strengthen India's health and pharmaceutical sectors but also dramatically enhance the value per unit biomass.

Dr. Satish Lakakkula, Scientist, CSIR–CSMCRI (MARS Mandapam)

Dr. Lakakkula provided one of the most comprehensive and operationally detailed interventions of the session. He observed a clear increase in startups, MSMEs, and SHGs entering the seaweed sector, as evidenced by the current exhibition.

He traced the expansion of seaweed farming beyond Tamil Nadu and Gujarat to new states including Andhra Pradesh, Odisha, West Bengal, Karnataka, Kerala, Goa, Maharashtra, and island territories. This expansion, he noted, has been enabled by coordinated efforts of national R&D institutions and supportive state Governments.

Addressing biomass shortages, he cited the establishment of a seed bank in Bapatla district, holding nearly 15 tonnes of material, as a model for replication. He also highlighted India's first commercial deep-sea seaweed farming initiative, calling it a scalable demonstration model.

Dr. Lakakkula stressed that employment generation is a powerful driver—estimating that 20,000 hectares of farming can generate up to one lakh jobs. However, he warned that startups cannot survive on cultivation alone; value addition is essential.

He emphasized the need for 100% subsidies in new states, continuous technical support, safety infrastructure, boats, expert divers, disease-free seed systems, and improved post-harvest management to enhance product quality and pricing. He concluded by strongly advocating for single-window clearance mechanisms, warning that bureaucratic complexity discourages even highly motivated entrepreneurs.

Dr. Rajeev Dwivedi, Business Development Manager – Plant Health, Novonesis

Dr. Dwivedi approached the discussion from a market, branding, and agribusiness lens. He questioned the very term "seaweed," noting its negative connotation, and supported reframing it as "marine biomass" or "sea vegetables" to influence mindset and market perception.

He highlighted the global seaweed market size (USD 7–9 billion) and its strong double-digit growth, contrasting this with

India's marginal share. According to him, India possesses the processing and scientific capabilities required for global leadership but lacks consistent quality and branding.

Dr. Dwivedi emphasized that industrial success depends on backward integration, molecular consistency, science-backed claims, and branding, not merely livelihood narratives. Farmers and buyers ultimately value performance and reliability, and India must align its seaweed products with these expectations.

Journalism Of Inclusiveness

India aims to boost seaweed production: Minister George Kurian

Kochi

Union Minister of State for Fisheries, George Kurian, on Thursday said that India's seaweed production has seen a near threefold increase over the past decade, rising from 18,890 tonnes in 2015 to 74,083 tonnes in 2024.

Kochi to Host Seventh India International Seaweed Expo and Summit 2026

India eyes major expansion in seaweed production: Union Minister George Kurian

ThePrint

AGRI BUSINESS

Kochi to host international seaweed expo and summit on Jan 29-30

The event will be organised by the Indian Chamber of Commerce (ICC), CMFRI and CSIR-Central Salt and Marine Chemicals Research Institute (CSMCRI)

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AGRI BUSINESS

With rise in production, India looks at expansion of seaweed cultivation

PREMIUM

India is poised for a major expansion in seaweed cultivation and seaweed-based industries, with the sector identified as a key driver of sustainable livelihoods and coastal development

Pictures of seaweed at 7th India International Seaweed Expo and Summit at the ICAR–Central Marine Fisheries Research Institute.

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Seaweed output triples in a decade as India targets scale-up in cultivation and processing

By IANS | Updated: January 29, 2026 18:40 IST

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Kochi Jan 29 India's seaweed production has nearly tripled over the last decade, rising from 18,890 tonnes in ...

Seaweed output triples in a decade as India targets scale-up in cultivation and processing

Kochi Jan 29 India's seaweed production has nearly tripled over the last decade, rising from 18,890 tonnes in 2015 to 74,083 tonnes in 2024, as the Centre positions the sector as a new pillar for coastal livelihoods and bio-based industries, Union Minister of State for Fisheries George Kurian said on Thursday.

Seaweed production increased nearly threefold, says Minister

Published - January 29, 2026 07:30 pm IST - KOCHI

THE HINDU BUREAU

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Seaweed production in India has increased nearly threefold over the past decade, rising from 18,890 tonnes in 2015 to 74,083 tonnes in 2024, Minister of State for Fisheries George Kurian said here on Thursday.

LOCAL

ERNAKULAM

കടൽപായൽ കൊണ്ട് നിർമിച്ച ജാം, പക്കവട, നോസ് മുച്ചിക്കാം: വ്യവസായ സാധ്യതകൾ തുറന്നിട്ട് എക്സ്പോ

Seaweed Expo: कोच्चि में लगेगा 7वां इंडिया इंटरनेशनल सीवीड एक्सपो और समिट, कई देशों के प्रतिनिधि होंगे शामिल

Kerala

India eyes major expansion in seaweed production: Union Minister George Kurian

India eyes major expansion in seaweed production: Union Minister George Kurian

Agency: PTI

Last Updated: January 29, 2026, 17:30 IST

Rapid Read

Representational Image: Image: News18

Kochi, Jan 29 (PTI) Union Minister of State for Fisheries George Kurian on Thursday said that seaweed production in India has nearly tripled over the last decade, increasing from 18,890 tonnes in 2015 to 74,083 tonnes in 2024.

He was delivering the inaugural address at the 7th India International Seaweed Expo and Summit at the ICAR–Central Marine Fisheries Research Institute (CMFRI).

കേരള കൗമുദി

കടൽപായലിൽ വൻപ്രതീക്ഷ: കേന്ദ്രമന്ത്രി ജോർജ് കുര്യൻ

കടൽപായൽ ഉല്പാദനം മൂന്നിരട്ടിയായെന്ന് കേന്ദ്ര മന്ത്രി ജോർജ് കുര്യൻ

മലയാള മനോരമ

എറണാകുളം സിഎംഎഫ്ആർഐയിൽ ആരംഭിച്ച ഇന്ത്യ ഇന്റർനാഷനൽ സീ വീഡ് ഉച്ചകോടിയിൽ കടൽപായലിൽ നിന്നു നിർമിച്ച ഭക്ഷ്യോൽപന്നങ്ങൾ രുചിച്ചു നോക്കുന്ന അതിഥികൾ.

കടൽപായൽ ഉൽപാദനം മൂന്നു മടങ്ങായി: കേന്ദ്രമന്ത്രി

കൊച്ചി• രാജ്യത്തെ കടൽപായൽ ഉൽപാദനം കഴിഞ്ഞ 10 വർഷത്തിനിടെ മൂന്നു മടങ്ങ് ആയെന്നു കേന്ദ്ര മന്ത്രി ജോർജ് കുര്യൻ. സിഎംഎഫ്ആർഐയിൽ ആരംഭിച്ച ആഗോള കടൽപാ

സെൻട്രൽ സോൾട്ട് മറൈൻ കെമിക്കൽസ് റിസർച് ഇൻസ്റ്റിറ്റ്യൂട്ട് എന്നിവർ ചേർന്നാണ് ഉച്ചകോടിയും എക്സ്പോയും സംഘടിപ്പിക്കുന്നത്. ഇന്നു സമാപിക്കും.

സുപ്രഭാതം

കടൽപായൽ ഉൽപാദനം മൂന്നിരട്ടിയായി വർധിച്ചു: കേന്ദ്രമന്ത്രി ജോർജ് കുര്യൻ

കൊച്ചി ▸ രാജ്യത്തെ കടൽപായൽ ഉൽപാദനം കഴിഞ്ഞ പത്തു വർഷത്തിനുള്ളിൽ ഏകദേശം മൂന്നിരട്ടിയായി വർധിച്ചെന്ന് കേന്ദ്ര ഫിഷറീസ് സഹമന്ത്രി ജോർജ് കുര്യൻ. കേന്ദ്ര സമുദ്രമത്സ്യ ഗവേഷണ സ്ഥാപനത്തിൽ (സി.എം.എഫ്.ആർ.ഐ) ആരംഭിച്ച ഏഴാമത് ഇന്ത്യ ഇന്റർനാഷനൽ കടൽപായൽ ഉച്ചകോടി [illegible] ഉൽപാദനവും ഉപഭോഗവും ചെയ്യുന്ന രാജ്യമായി ഇന്ത്യ മാറിക്കഴിഞ്ഞു. ഇതിൽ 90 ശതമാനവും കൃഷിയിലൂടെയാണ്. കടൽപായൽ കൃഷിയിലൂടെ തീരദേശ മേഖലയിലെ സ്ത്രീകൾക്ക് ഉൾപ്പെടെ വലിയ തൊഴിലവസരങ്ങൾ സൃഷ്ടിക്കാനാകുന്നുണ്ടെന്നും മന്ത്രി പറഞ്ഞു. കടൽപായൽ കൃഷിയും അനുബന്ധ വ്യവസായങ്ങളും വൻതോതിൽ വികസിക്കുന്നതിനുള്ള നടപടികളുണ്ടാകും. തിരുവനന്തപുരം കടൽപായൽ ഗവേഷണ കേന്ദ്രത്തിലും കടൽപായൽ കൃഷി നിർണായക പങ്ക് വഹിക്കുമെന്നും കേന്ദ്ര മന്ത്രി പറഞ്ഞു. സാഷെ ഫിഷറീസ് ഡെവലപ്മെന്റ് ബോർഡ് ചീഫ് എക്സിക്യൂട്ടീവ് ഡോ. ബി. കെ ബെഹറ അധ്യക്ഷത വഹിച്ചു. ഇന്ത്യൻ ചേംബർ ഓഫ് കൊമേഴ്സ്, സി.എം.എഫ്.ആർ.ഐ, സെൻട്രൽ സാൾട്ട് മറൈൻ കെമികെമിക്കൽസ് റിസർച്ച് ഇൻസ്റ്റിറ്റ്യൂട്ട് എന്നിവ സംയുക്തമായാണ് രണ്ടു ദിവസത്തെ എക്സ്പോയും ഉച്ചകോടിയും സംഘടിപ്പിക്കുന്നത്.

ഡോ.ബ.കെ.കെ ബെന, സാഗർ മെഹ്റ, ഷൈൻ കുമാർ സി.എസ്, കണ്ണൻ ശ്രീനിവാസൻ, ഗ്രീൻസൺ ജോർജ്, ജോർജ് മൈനാൻ, പ്രദീപ് കുമാർ ശർമ, വിനയ് ജെയിംസ് കൈനാടി, .ബി ജോൺസൺ സംസാരിച്ചു. ഇന്നു സമാപിക്കും.

നഷ്ടപ്പെട്ടു

എന്റെ ഹാൻഡ്ഓട് നമ്പർ KS361772 kottand നിന്ന് വെക്കം യാത്രയിൽ നഷ്ടപ്പെട്ടിരിക്കുന്നു കണ്ടു കിട്ടുന്നവർ താഴെ കാണുന്ന ആളുടുമ്പോ ഫോൺ നമ്പറോ അറിയിക്കണമെന്ന് അപേക്ഷിക്കുന്നു.

എന്ന്
DILEEP E.K
EDHATHAN KULANGARA (H)
THANEER CODE P.O THALAKKASSERY
PALAKKAD679534, Ph: 8089434980

മാതൃഭൂമി

കടൽപ്പായൽ ഉത്പാദനത്തിൽ വൻ കുതിച്ചുചാട്ടം-കേന്ദ്രമന്ത്രി ജോർജ് കുര്യൻ

എറണാകുളം സിഎംഎഫ്ആർഐയിൽ ആരംഭിച്ച രണ്ടാമത് ഉച്ചകോടിയുടെ ഉദ്ഘാടനം

ആരോഗ്യത്തിനും സൗന്ദര്യത്തിനും കടൽപായൽ ഉൽപന്നങ്ങൾ

30/01/2026 KOTHAMANGALAM MUVATTUPUZHA Pg 02

ചന്ദ്രിക

ഇന്ത്യ ഇന്റർ നാഷണൽ കടൽപായൽ ഉച്ചകോടിയും പ്രദർശനവും തുടങ്ങി

സിഎംഎഫ്ആർഐയിൽ ആരംഭിച്ച ഏഴാമത് ഇന്ത്യ ഇന്റർനാഷനൽ സീവീഡ് ഉച്ചകോടിയിൽ വിവിധ കടൽപായലുകൾ നോക്കിക്കാണുന്നവർ

Kochi Express

31-01-2026 SATURDAY

SEAWEED STEPS INTO THE SPOTLIGHT

Scenes from the International Seaweed Expo and Summit

'Seaweed production increased nearly threefold'

The Hindu Bureau
KOCHI

Seaweed production in India has increased nearly threefold over the past decade, rising from 18,890 tonnes in 2015 to 74,083 tonnes in 2024, Minister of State for Fisheries George Kurian said here on Thursday.

He was delivering the inaugural address online at the 7th India International Seaweed Expo and Summit at the ICAR-Central Marine Fisheries Research Institute (CMFRI). India is poised for a major expansion in seaweed cultivation and seaweed-based industries, with the sector identified as a key driver of sustainable livelihoods and coastal development, he was quoted as saying in a release issued here.

He said that seaweed was included as an output component under the PM Dhan-Dhaanya Krishi Yoja-

കടൽപായൽ ഉൽപാദനം മൂന്നിരട്ടിയായി -കേന്ദ്ര മന്ത്രി

മെട്രോ വാർത്ത

കടൽപായൽ ഉൽപാദനം മൂന്നിരട്ടിയായി വർധിച്ചു: കേന്ദ്രമന്ത്രി ജോർജ് കുര്യൻ

ദേശാഭിമാനി

Fri, 30 January 2026

ആഗോള കടൽപ്പായൽ ഉച്ചകോടിക്ക് കൊച്ചിയിൽ തുടക്കം

കൊച്ചി


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