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Seaweed Farming can touch a million lives

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Executive Summary

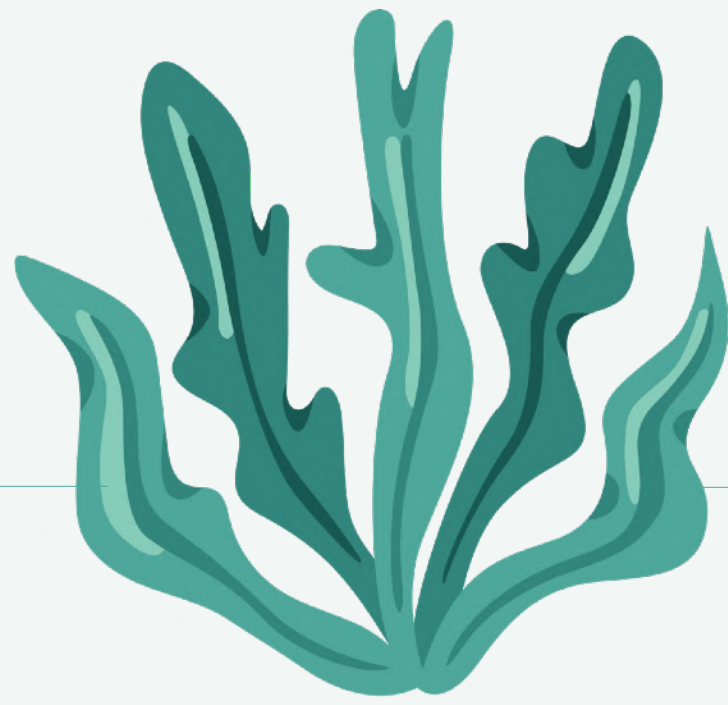
Seaweed Farming has the potential to touch a million lives. In fact, the expert estimations are that given the right support to the ecosystem, 4,00,000 families or **~1.6 mn lives** can be positively impacted by seaweed farming. This is a massive growth projection from the current 40,000+ families involved with this ecosystem.

In terms of revenues, India's seaweed sector, estimated to be worth **₹200 crore** in 2022, could surge to **₹3,277 crore** within the next **10 years.**

This growth is driven by rising demand across industries such as food, pharmaceuticals, cosmetics, biomaterials and agriculture, alongside strong government support and increasing consumer interest in sustainable products.

India's diverse coastal regions, including Maharashtra, Tamil Nadu, Orissa, Goa, Gujarat, Lakshadweep, and the Andaman & Nicobar Islands, present untapped potential for large-scale seaweed farming.

Seaweed Farming holds immense potential for India



Total Revenue

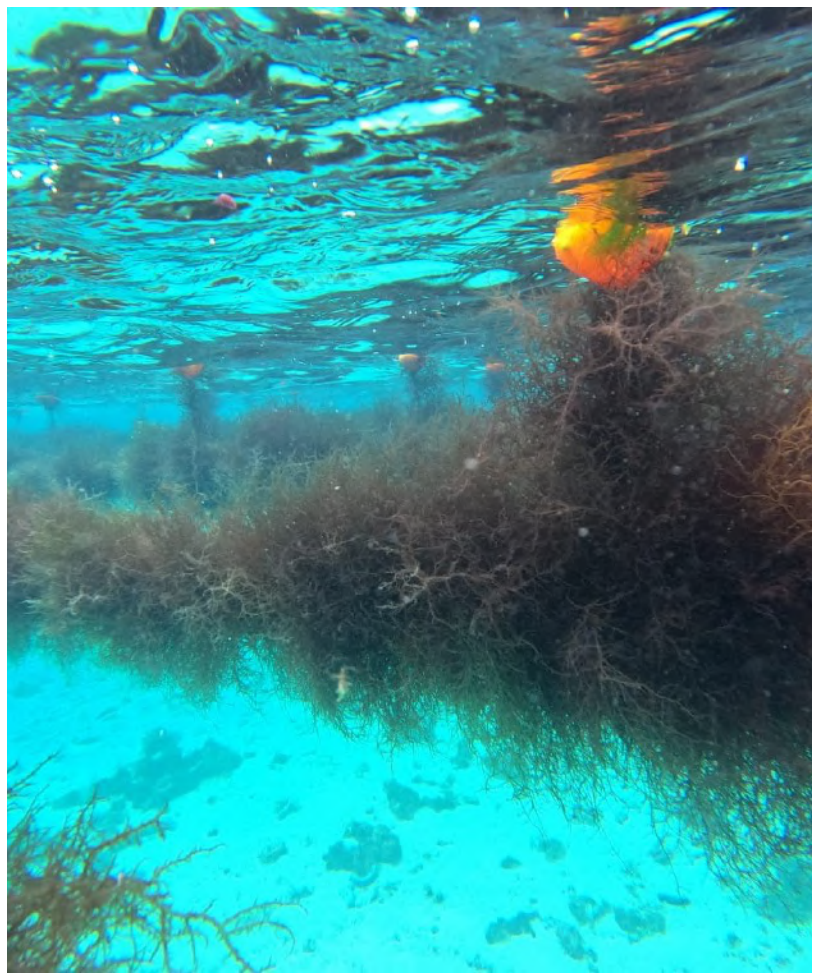
2022 (estimated)
₹200 Crore

2032 (projected)
₹3,277 Crore

Families Impacted

2022 (estimated)
40,000+

2032 (projected)
4,00,000+



Lakshadweep, in particular, has emerged as a key location. Typically, the final dry seaweed production per unit of seeds is ~5X; however, some regions in Lakshadweep have shown extraordinary results **of up to 15X**. These areas, benefiting from favourable environmental conditions for at least seven months a year, are set to become key hubs for seaweed cultivation, unlocking substantial economic opportunities and promoting sustainable livelihoods, especially for coastal rural communities.

However, the market growth does face challenges – both from perspective of farmers and buyers. Buyers have concerns around seed quality, logistics, contract farming uncertainties, etc. Farmers on the other hand have low awareness of the possibilities, and suffer from poor market linkage.

The Government must establish a concrete roadmap in the coming years, focussing on three key areas: infrastructure development, policy support, and market access to achieve a strong seaweed value chain. This will not only help the economy grow in a sustainable manner, but also empower coastal communities, driving job creation.

Infrastructure Support should involve establishing **onshore and offshore seed banks.** These can prevent seasonal losses, while dedicated research facilities and innovations like suspended seaweed cultivation will ensure a steady supply of raw material. A **micropropagation facility** can safeguard early-stage growth, mitigate environmental stressors, and scale production to meet commercial demand.

Policy Support around **contract farming** is critical. This can formalise agreements between farmers and buyers, ensuring stable incomes, reliable supply chains, and fair pricing.

Expanding **Market Access** requires active engagement with both buyers and investors. Encouraging private investment through fiscal incentives and Public-Private Partnerships (PPPs) will strengthen infrastructure, enhance processing capabilities, and improve competitiveness. Some of the buyers may also want to get involved in these investments. Furthermore, promoting **value-added seaweed products** such as hydrocolloids, fertilizers, and cosmetics, for India's distinct seaweed varieties, will position the country as a global industry leader.

01

What is the Current Scenario of Seaweed Farming in India?

Seaweed, encompassing thousands of species of red, green, and brown marine algae, is fundamental to marine ecosystems. It acts as a carbon sink, reducing atmospheric CO_2 levels, and provides habitat for diverse marine life.

Beyond its ecological contributions, seaweed is a versatile resource with applications in various industries. Rich in essential nutrients, it is incorporated into superfoods, animal feed, and organic fertilizers amongst others.

In India, with its extensive coastline and rich marine biodiversity, seaweed cultivation is gaining momentum. The Hon'ble Prime Minister has emphasized developing the seaweed value chain, recognizing its potential to offer alternative livelihoods for fishermen and significantly contribute to India's GDP through processing, marketing and exports.

1.1

Who are the buyers of Seaweed? What are the high-demand applications across industries?

India's leading seaweed buyers include large multinational corporations across the food, pharmaceutical, agriculture (bio-stimulants), and cosmetics industries, as well as small businesses focused on sustainable packaging, biofuels, and agriculture. Additionally, companies specializing in extracting agar, agarose, and carrageenan from red algae purchase significant quantities for use as thickeners and emulsifiers in the food industry.

Some of the prominent companies in India across various sectors that use seaweed in their products or processes include **Britannia, Nestle, Amul, Cipla, Zydus Cadila, Hindustan Unilever, The Body Shop, Tata Chemicals, UPL, Godrej Agrovet and BASF India** amongst many others. The growing demand for sustainable, plant-based alternatives and the health benefits of seaweed are likely to fuel even more companies and sectors adopting seaweed-based products in the coming years.

India's Seaweed buyer's market is segmented based on type, method of cultivation, form, and application.

By type, it includes brown, red, and green seaweed, each with distinct uses and benefits.

Cultivation methods vary, with systems such as the single rope floating raft method, fixed off bottom long line method, and integrated multi-trophic aquaculture offering different approaches to sustainable farming.

In terms of processing, seaweed is available as liquid extract or raw dried seaweed (RDS), catering to diverse industrial needs.

Lastly, **based on application,** the market is segmented into human consumption and non-human consumption, reflecting its wide-ranging utility across food, pharmaceuticals, cosmetics, and agriculture industries:

Agriculture (Bio-Stimulants)

Seaweed is used in agriculture / bio-stimulants as a natural extract, rich in bioactive compounds like hormones, amino acids, etc. This can stimulate plant growth, improve nutrient uptake, enhance stress tolerance, and boost crop yield when applied to plants in small quantities. This makes it a valuable, organic, alternative to chemical fertilizers.

Food Industry

Seaweed has a high nutritional value as it contains different types of **vitamins, essential amino acids, minerals, and fibres**. It is commonly incorporated into various products such as **soups, salads, smoothies, low-calorie diet foods, and dietary supplements**.

Seaweed is considered a healthy food that can address various nutrient deficiencies in the Indian populations such as **Iodine, Calcium and Potassium**. As seaweed is cultivated without chemical fertilisers and pesticides, it can also be **considered as organic, or residue-free**.

Skincare & Cosmetics

Seaweed is one of the most versatile resources in the beauty industry, where it can be used as **a moisturizing agent, as an anti-aging product, and as an anti-inflammatory**. Due to its wide uses, it is applied as a raw material in various kinds of personal care products, including **creams, serums, shampoos, soaps, masks, and scrubs**.

As more people look for natural-based and multi-purpose cosmetics, seaweed has been rising in popularity within the increasing cosmetics market around the world.

Medicine

Seaweed-derived polysaccharides like **carra-geenan, agar and alginate** can be used to form protective coatings on pharmaceutical tablets, which help in controlling the release of the drug or protecting it from stomach acid. In the long run, they are **eco-friendly, bio-compatible and sustainable**.

Alginates have been used in many gastric reflux products such as Gaviscon to prevent stomach acid rising from the stomach. Carrageenan have been used as stabilizing fluid in inoculations. Alginates are also used in wound dressing to form a scaffolding to increase healing and prevent infections.

Industrial Applications

Agar, carrageenan, and alginate are used in a wide range of industrial applications, including food processing and the textile industry for thickening and stabilizing processes.

Biofuels & Energy Conservation

Seaweed is a promising feedstock for biofuels, especially for bioethanol and biogas production. Algae-based biofuels have the potential to reduce dependence on fossil fuels and help mitigate climate change.

1.2

What are the Buyers' Sourcing Preferences - Local vs. Imports?

The current landscape of India's seaweed market reveals a distinct preference among buyers for **imported seaweed** over **local procurement.**

This is largely driven by the inconsistency in supply quantities and quality within India. Unlike imported seaweed, which tends to offer more stable and predictable quality, locally sourced seaweed often suffers from significant variability in its **gelling properties, especially in agar derived from dura**. For buyers, this lack of uniformity is a major concern, as they require a reliable, high-quality product to meet their standards, whether for food, pharmaceuticals, or industrial applications.

One of the primary factors affecting the **quality** of seaweed is its **gelling strength**, which is directly linked to the **growing conditions** and handling during harvesting. Better-quality seaweed with higher gel strength commands a premium price. Currently, some seaweed produced in India is priced based on its **gelling properties**, but the variation in these properties makes it difficult for buyers to rely on a consistent local supply.

This has resulted in a growing reliance on imports from countries like the **Philippines** and **Indonesia** with Indian buyers procuring various types of seaweed, including **red, brown, and green varieties.**

1.3

What is the Current State of Seaweed Production in India?

Official reports state that India contributes **less than 1%** to global seaweed production. Some Industry experts go to the extent of saying it would be merely **0.1% of global output.** In 2022, the country earned approximately **₹200 crore** from seaweed. This includes species such as **Sargassum, Turbinaria, Caulerpa, Ulva, Gracilaria, Kappaphycus** and others. Clearly, in terms of **production volumes**, India's seaweed industry is still in its early stages.

> ***Lakshadweep has emerged as a key location. Typically, the final dry seaweed production per unit of seeds is ~5X; however, some regions in Lakshadweep have shown extraordinary results of up to 15X.***
>
> **Dr. Stefan Kraan**
>
> CSO of
> TSC-Purple Pvt. Ltd,
> Tuticorin, Tamil
> Nadu

Experts estimate that there are approximately 40,000+ farmer families involved in seaweed farming across the country. India's diverse coastal regions, including Tamil Nadu, Gujarat, Maharashtra, Orissa, Goa, Lakshadweep, and the Andaman & Nicobar Islands, present untapped potential for large-scale seaweed farming.

Lakshadweep's coastal and lagoon ecosystems are ideal for seaweed farming during certain months of the year when temperatures are very suitable. Typically, the final dry seaweed production per unit of seeds is ~5X; however, some regions in Lakshadweep shown extraordinary results **of up to 15X.** These areas, benefiting from favourable environmental conditions for at least seven months a year, are set to become key hubs for seaweed cultivation, unlocking substantial economic opportunities and promoting sustainable livelihoods, especially for coastal rural communities. The commonly grown indigenous species are *Gracilaria edulis* and *Acanthophora spicifera*.

The cultivation of seaweed, such as the commercially valuable species Kappaphycus alvarezii, has shown strong profitability, with **farmers earning between ₹16 per kg for fresh seaweed to ₹70 per kg** for dried products. This is proving to be an attractive avenue for farmers, with the potential to boost both local economies and the country's export capabilities.

02

What is the Future Potential of Seaweed Farming in India?

When the potential of seaweed cultivation is fully tapped, the total farmer families that could benefit, would be approximately 4,00,000. Assuming an average family size of 4, **1.6 mn lives** can be positively impacted by seaweed farming.

In addition, the revenue growth will be driven by the cultivation of Kappaphycus alvarezii and Gracilaria edulis. In the case of Kappaphycus alvarezii, the net revenue a seaweed farmer can generate from one hectare can be ₹13.28 lakh a year. Similarly, Gracilaria edulis can generate net revenue from one hectare about ₹12.48 lakh a year. The ICAR-CMFRI has identified 333 sites and 51 sites were identified by CSIR-CSMCRI across a total area of 24,707 hectares suitable for seaweed farming. Together, this comes to a total market potential of ₹3,277 crore. If the right support is provided, this potential can be achieved in the next 10 years.

03

What are the current Government Initiatives to support Seaweed Farming?

The government's focus on **doubling fishers' incomes** under Prime Minister Narendra Modi's vision has driven multiple initiatives:

Budget Allocation

The government has allotted **₹640 crore** to promote seaweed cultivation.

Pradhan Mantri Matsya Sampada Yojana (PMMSY)

Under initiatives like the **Pradhan Mantri Matsya Sampada Yojana (PMMSY),** seaweed cultivation is recognized as a promising area to diversify income sources for coastal communities.

Kisan Credit Cards (KCC) and Mudra Loans

This would help small and medium-scale farmers, as well as fishers, to borrow money for seaweed farming, which will increase their involvement in the sector.

CSIR Integrated Skill Initiative

This initiative plays a role in training stakeholders - such as coastal communities, entrepreneurs, and researchers - in areas like seaweed cultivation, processing, and value-added product development. By equipping individuals with the necessary skills, the program helps promote sustainable seaweed farming, innovation, and commercialization, contributing to India's blue economy and marine resource management. The collaboration by ICAR with private companies like TSC-Purple Turtle company has thus facilitated pilot projects on a commercial scale.

National Fisheries Development Board (NFDB) Seaweed Cultivation Scheme

This initiative focuses on the cultivation of high-value seaweed species, such as Kappaphycus and Gracilaria, to boost production, generate employment, and promote sustainable farming practices. It provides financial support, technical training, and infrastructure development, including seaweed nurseries and processing facilities, to enhance the seaweed sector.

04

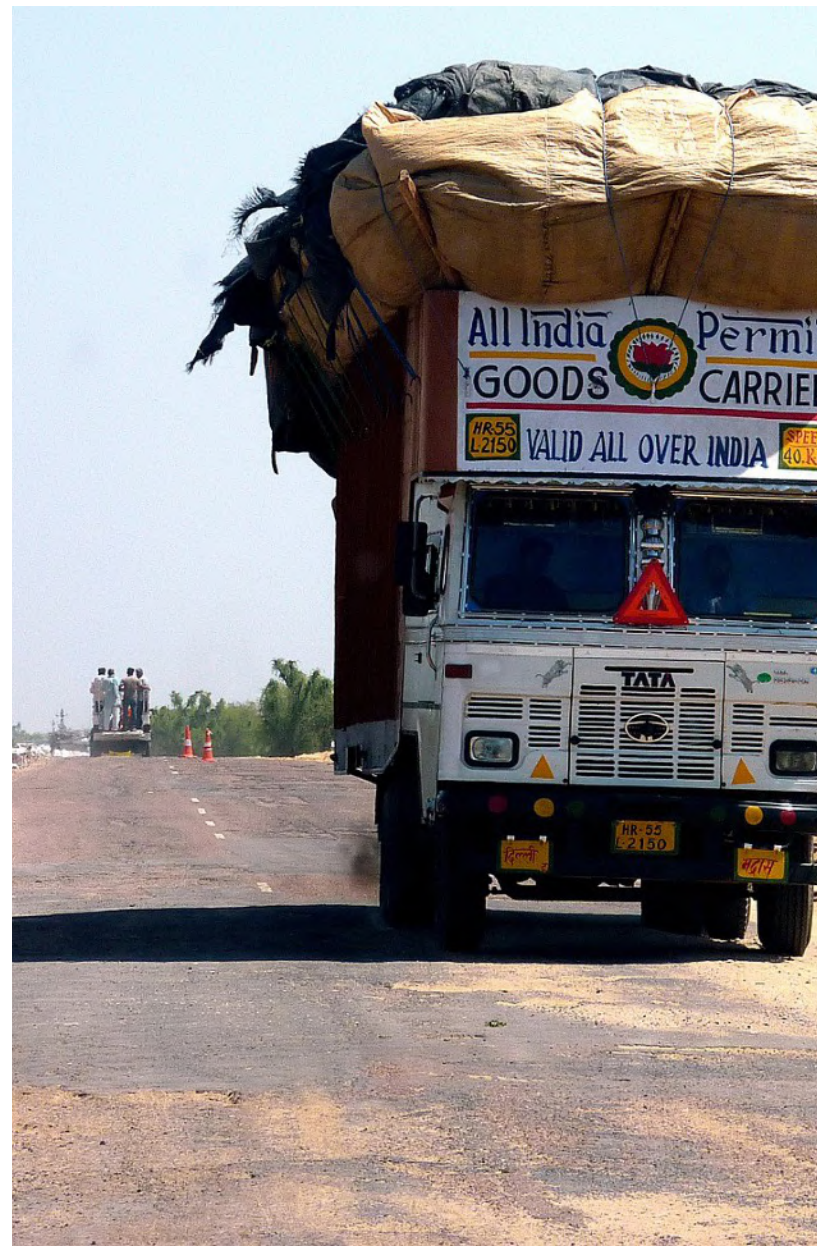
What are the Challenges faced by Buyers of Seaweed?

Logistics Challenges

Moving seaweed and seedlings across states is hindered by poor road connectivity, particularly between coastal areas and mainland markets. Transporting seaweed from islands such as Lakshadweep to mainland adds more challenges.

Additionally, route-related issues, such as congestion, adverse weather conditions, and unreliable maritime transport, further complicate logistics.

The lack of dedicated transport infrastructure, including refrigerated vehicles, cold storage-equipped boats, and specialized cargo ships, significantly raises costs, making seaweed an expensive commodity to transport and market effectively.



Production Constraints and Limited Variety

The production in the seaweed industry in India is limited to a few species like Kappaphycus, Sargassum and Gracilaria. Industry wants to see more options to be able to increase its own usage and application areas.

Land Leasing and Contract Farming Policy Issues

Buyers who are interested to engage at the production level would like have clear 10-year-horizon lease, that can help them for long-term-planning. In addition, they would need assurance that the farmers they support provide the final output only to them. However, the lack of a clear leasing and contract farming policy for seaweed in India creates uncertainty and risk. The lack of a framework complicates long-term contractual agreements.

A revised and more transparent leasing approach, especially for zones identified by CMFRI and CSMCRI, is critical to ensure stable supply chains, foster business growth, and help buyers source dependable and sustainable seaweed.

Seed Access, Quality and Scaling Challenges

The availability of quality planting materials and seeds is a big challenge in the seaweed farming sector. This, in turn, leads to unreliable or inconsistent supply of seaweed – both in terms of quantity and quality.

Propagated seaweed faces a high risk of grazing by fish and sea urchins, which significantly reduces its survival rate. Thus, scaling laboratory-grown seaweed tissues to meet commercial demands remains a major hurdle.

Concerns around Kappaphycus

Kappaphycus is an important material for the buyers. However, the Forest Department considers Kappaphycus an exotic species and advises against its cultivation, citing potential ecological disturbances in coral reef areas.

Studies have proven that this concern is not valid, and industry has been pursuing for correcting the earlier directive. However, the official stand on Kappaphycus has not yet changed.

05

What are the Challenges faced by Seaweed Farmers?

Lack of Market Linkage

Uncertainty of who will buy the produce, or weak market linkage, make sales uncertain and prices volatile. These issues worry the farmers, and limit their adoption of seaweed farming.

Environmental Challenges

In Lakshadweep, increased populations of green turtles have led to intensive herbivory, resulting in the degradation of seagrass meadows. This over-grazing not only diminishes seagrass cover but also affects associated fish communities and subsistence fishing activities. Additionally, extreme weather events, such as cyclones and storms, pose substantial risks to seaweed farming operations. These events can damage farm structures, disrupt cultivation cycles, and lead to significant crop losses.

Limited Awareness of Seaweed Farming Techniques

The Indian government has introduced several initiatives to promote seaweed cultivation, such as the Pradhan Mantri Matsya Sampada Yojana (PMMSY), which allocates funds to coastal states and Union Territories for developing seaweed cultivation infrastructure. Despite these efforts, many coastal farmers remain unaware of these schemes, leading to limited access to technical knowledge and best practices. This lack of awareness results in inefficient farming techni-ques, which affect cultivation and sales, thereby reducing profitability.

06

What can the Government do to support Seaweed Farming?

Encourage Investments and Enhance Buyer Engagement

The Government needs to engage Buyers of Seaweed more effectively. They need to be brought into early conversations for market development as well as infrastructure investments.

The Government can explore fiscal incentives such as tax breaks, subsidies, and low-interest loans to encourage private investment in seaweed processing units, post-harvest handling facilities, cold storage, and dedicated supply chain infrastructure through Public-Private Partnership (PPP) models. Prioritizing the establishment of processing units near seaweed cultivation hubs would minimize post-harvest losses, preserve nutrient integrity, and improve efficiency in value-added production.

Additionally, developing dynamic data portals and decision support tools with geotagged maps of potential and actual seaweed farming sites would enable better planning, monitoring, and resource allocation.

While developing seaweed clusters, it is crucial to engage buyers from the outset so they can define their required quantities, preferred varieties, and product specifications. This alignment will help establish the right package of practices for cultivation while encouraging buyers to provide advance capital, technical training, and investments in infrastructure, thereby fostering a more sustainable and demand-driven seaweed industry. To support industry growth and global competitiveness, it is also essential to establish clear standards for different seaweed-derived products, including food, pharmaceuticals, and cosmetics, while implementing robust certification mechanisms to ensure quality assurance and boost export potential.

Strengthen and Build more Onshore & Offshore Seed Bank Facilities

During the monsoon season, mature seaweed is often washed away, leading to a significant drop in seed survival rates. To address this, it is crucial to establish seed banks in every state, preventing seed loss during transportation, as environmental changes often hinder their survival. Additionally, a dedicated research facility for seaweed studies should be set up to support scientific advancements in the field. To streamline seed distribution, a Section 8 company, including participation from private firms, should be established to manage seed banks on a non-profit basis, ensuring farmers receive seeds at fair prices and we promote sustainable seaweed farming.

Streamline Policy around Land Leasing and Contract Farming of Seaweed

To ensure a fair and transparent supply chain, it is essential to establish clear, standardized contract farming and leasing models that outline legal land use rights, pricing, delivery timelines, quality standards, and payment systems, thereby reducing disputes between seaweed farmers and buyers. Additionally, encouraging processors and exporters to engage in long-term contracts with farmers would provide stability, ensuring consistent incomes for cultivators while securing a reliable supply of raw materials for businesses. This structured approach would not only strengthen trust between stakeholders but also contribute to the sustainable growth of the seaweed industry.

Establish Seed Multiplication Centres (Hatcheries)

The establishment of seed multiplication centres (hatcheries), seedbanks and centres of excellence will ensure a stable supply of planting material of quality, hence improving production capacity, and providing better choices to both farmers and buyers.

Establish a Micropropagation Facility

Propagated seaweed faces a high risk of grazing by fish and sea urchins, which significantly reduces its survival rate. Establishing a controlled facility would help safeguard early-stage growth, ensuring better survival and yield. Additionally, seaweed tissues are highly sensitive to fluctuations in temperature, salinity, and light, making controlled growth a complex challenge. A dedicated micro-propagation facility can provide a stable environment, ensuring optimal and consistent growth conditions. Investing in a micropropagation facility would not only address these challenges but also support the development of scalable techniques for transitioning from lab-scale propagation to large-scale commercial production, ultimately strengthening the seaweed industry.

> ***Seaweed farming gives me a steady income and good profits with less investment.***
>
> ***It's a low-risk, high-reward opportunity..***

Thangam

A Seaweed Farmer from Lakshadweep

Resolve Concerns around Kappaphycus

It is important to formally close the open concern around Kappaphycus. This is a long-standing problem of the industry and needs to be urgently addressed.

> ***If the perception issue of Kappaphycus can be solved, seaweed farming can provide livelihood to a million lives.***

Mr. Abhiram Seth

Managing Director, Aquaagri Processing Pvt. Ltd.

Former Executive Director, PepsiCo India

Build Farmer Capacities - through FPOs

The farmers will need handholding and skilling in this new kind of crop cultivation. If communities are created – through FPOs, or otherwise – getting the communities trained will be more effective.

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