

## SEAWEED PRODUCTION AND PRICE ADMINISTRATION OF SEAWEED CULTIVATORS IN TAMIL NADU

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### **Abstract**

This study aims to examine the role of price and production administration in seaweed production in Tamil Nadu. Seaweed production with rich availability of coastal nature. Seaweed not only give the production significance but also it is provide the livelihood source for many fisher folk community in India and Tamil Nadu. It is also provide alternative income during the fishery closure period and to meet the growing industrial demand. Seaweed is considered a priority part of the fisheries sector in India. For the purpose of analyse, we collected data of 357 and analysed with the help of simple descriptive tables, percentage analyses were employed to assess the economic feasibility and livelihood status of seaweed farming farmers in Tamil Nadu. The findings discourses the majority of the seaweed cultivators were well-informed about the welfare initiatives introduced by the Central and state Governments. Moreover, most of the respondents were availed the loan subsidies. The study suggested that policy supports, financial incentives, infrastructure development, changes in environment regulations, market development, capacity building and training for seaweed cultivators have been highly needed for promoting seaweed cultivation in India and specific in Tamil Nadu because of her rich potential in seaweed recourses. Seaweeds are regarded as an essential part of the current global food security due to their extra functions in the mitigation of climate change and the empowerment of women. Due to its straightforward culture method, outstanding nutritional profile, and contribution to global climate change mitigation and adaptation measures, some recent study suggests seaweed farming as an alternative to terrestrial agriculture.

**Key Words:** Seaweed, Price, Production, livelihood

### **Introduction**

The fishery sector plays a significant role in the Indian economy, it contributes nearly one percent of gross value added and 5.37 per cent of gross value added from the farming sector. This sector is also a principal source of exports, food, and nutritional security and it makes in employment

generation and livelihood for a large sector of the economically underprivileged population of the country, especially in the coastal areas, as per the 2011 census more than one crore family members engaged in fisheries activities (Handbook on Fisheries Statistics, 2018). The country is well on its way to reach the potential of fisheries can be seen from the fact that fish production increased from the level of 0.75 million metric tonnes (MMT) in 1950-51 to 12.59 MMT in 2017-18 from a long coastline of about 8,118 km and 2.02 million sq. km of EEZ (Exclusive Economic Zone), both marine and inland indicative of the immersive growth and potential of the sector.

Sustainable development provides a coherent approach to address pressing global challenges such as climate change, environmental degradation, and resource depletion. However, when shifting from a fossil-based economy to a bio-based economy, it is important to adhere to the fundamentals of recycling in order for it to be a viable solution. When considering the possibilities of new feedstocks, the bio-based economy's acceptable capacity should be kept open because the downward strategy would increase value creation. Seaweed, a bio-product, can replace fossil products because of its distinct chemical features, quick germination rate, and other advantages outside food.

Handling naturally exposed bunches of seaweed is the most basic way to cultivate seaweed. Additionally, in the most innovative method, the ranchers take complete control of the algae's life cycle. There are three methods for growing seaweed. First is the Central Salt and Marine Chemical Research Institute's (CSMCRI) single rope floating raft (SRFR) approach. It is appropriate for growing seaweeds at greater depths and across a larger region. The second is the synthetic seaweed manufactured using the fixed bottom long thread technique. The third method is Integrated Multi-Trophic Aquaculture (IMTA), which is similar to polyculture in that it involves the synchronised growth of two or more species. To increase production, decrease waste, and support ecosystem services like bioremediation, IMTA produces a variety of marine organisms from various trophic levels.

India has a lot of potential for growing seaweed. India has an exclusive economic zone (EEZ) that spans 2.15 million square kilometres and is one of the world's 12 megabiodiversity countries. The nation's coastline and its numerous water surrounding ecosystems support the prolific growth of several seaweed cultures, each of which has a considerable economic worth. The country, which has a 7500 km coastline, is home to about 844 different types of seaweed. There are plenty of resources in the intertidal and subtidal zone on the West Coast, especially in Gujarat. The development of industries based on seaweed has tremendous potential thanks to these resources. Seaweed is widely available in Tamil Nadu, Gujrat coasts, Lakshadweep, Andaman, and the Nicobar Islands. Mumbai, Ratnagiri, Goa, Karwar, Varkala, Vizhinjam, and Pulicat in Tamil Nadu, as well as Chilka in Orissa, are other locations with rich seaweed beds.

There are 14,500 miles of open rivers in India. India can benefit much from seaweed cultivation if these natural resources are used. First, freshwater, arable land, or dietary inputs are not required for the cultivation of seaweed. This is critical since the nation is facing a serious water scarcity. Second, it is possible to gather seaweed and utilise it to make biofuels, the usage of which is being advocated in India. The potential for carbon sequestration might be greatly enhanced and the reliance on fossil fuels could be decreased by switching to seaweed-based electricity. Preliminary research results from a University of California study indicate that adding a modest amount of seaweed to cattle feed can lower methane emissions from the cattle industry. India has a significant population of cattle, thus since these conditions are present there as well, they would be felt there. Fourth, fish population cultivation and ocean acidification reversal can be supported by seaweed farming. This would support the livelihood and revenue production of the numerous riverside inhabitants who also work in traditional agriculture.

With the help of the Council of Scientific and Industrial Research (CSIR) and CSMRI and their connections to the industry, India is moving towards knowledge-intensive seaweed production rather of relying solely on collecting seaweed from untouched regions of the ocean.

By 2025, India hopes to increase seaweed output to at least 1 million tonnes annually with an investment of roughly \$86.8 million. The investment is a component of the Blue Revolution programme under India's Pradhan Mantri Matsya Sampada Yojana (PMMSY). The programme, which was approved by the government in May 2020, aims to "bring about a Blue Revolution through sustainable and responsible development of the fisheries sector in India." Seaweed seed banks, nurseries, tissue culture units, processing and marketing facilities, as well as skill training and business development, will all be funded by the funding. Additionally, the number of jobs and wages available to individuals will increase because to these investments. The government is also luring big investors to this industry by approving 100% FDI through automatic methods in the fisheries and aquaculture industries.

An emerging and promising area of a global circular economy is led by startups. For employing seaweed to help rescue the planet, the Indian startup Sea6 Energy has won praise from all over the world. The goal of this business is to assess the size and level of automation of tropical seaweed farming. It produces sustainable raw materials for enterprises involved in the production of agri-foods, health supplements, cosmetics, bio plastics, and polymers, as well as biomass for use as fuel. For the whole value chain, patents have been obtained. It has created the "Sea Combine," a tractor-like vehicle that is currently being used in India and Indonesia to distribute seeds and collect tropical sea plants offshore.

### **Seaweed demand globally**

- ❖ Demand for red seaweeds is estimated to grow at the highest rate due to its functional qualities.
- ❖ More than 80 per cent of the demand for commercial seaweed in 2015 was from Asia.

### Seaweeds Resource in India

Pacific and the region is forecasted to witness the highest growth of more than 9 per cent during 2015-24. Seaweeds Resource in India In India seaweed production potential is estimated 1,000,000 tonnes distributed in six states-Gujarat, Tamil Nadu, Kerala, Andhra Pradesh, Maharashtra and Andaman & Nicobar Islands. In 2016 the Tamil Nadu governments introduced a scheme for seaweed cultivation to fishermen community for livelihood support and ensure means of income generation of costal area community. The coastal area of Tamil Nadu and Gujarat makes the significant contributing to the production of seaweed of the country. These resources have great potential for the development of seaweed-based industries in India. As many as 1000 varieties of seaweed are in existence in India out of which, 300 varieties are in the Gulf of Mannar (south Tamil Nadu) with rich in algal flora. The latest projection shows that in 2020 the production capacity of seaweed reached to 26,000 tonnes. At the same time the ministry was target that the incremental production from 0.56 Lt. in 2020-21 to 11.2Lt, in 2024-25. In the year 2016 the government of Tamil Nadu has introduced a scheme for seaweed cultivation to the fishermen community for livelihood support and ensures the means of income generation of the coastal community.

The study of Food and Agricultural Organisation has (Table 2) pointed that, as of 2019 that the aggregate potential of seaweed resources of the Indian coast are 22,044 tonnes in Tamil Nadu, 20,000 and 8000 tonnes in Gujarat and Maharashtra respectively, 2,000 tonnes in Lakshadweep, and 1,000 tonnes in the Andaman and Nicobar Islands.

### Why seaweed farming in India

- ❖ Remedy for non-availability of required quantity of seaweeds for various uses.
- ❖ Provide occupation for the coastal people.
- ❖ Provide continuous supply of raw material for seaweed-based industry and reduce CO2 in global warming.

**Table 1: Seaweed Production target**

<b>(Lakh ton) in wet Weight</b>							
<b>State/UTs</b>	<b>2020-21 (5%)</b>	<b>2021-22 (10%)</b>	<b>2022-23 (25%)</b>	<b>2023-24 (30%)</b>	<b>2024-25 (30%)</b>	<b>Total (100%)</b>	<b>Rank</b>
Gujarat	0.1	0.2	0.5	0.6	0.6	2	2
Maharashtra	0.05	0.1	0.25	0.3	0.3	1	4
Goa	0.01	0.02	0.05	0.06	0.06	0.2	6
Kerala	0.025	0.05	0.0125	0.15	0.15	0.5	5
<b>Tamil Nadu</b>	<b>0.15</b>	<b>0.3</b>	<b>0.75</b>	<b>0.9</b>	<b>0.9</b>	<b>3</b>	<b>1</b>
Andhra Pradesh	0.075	0.15	0.375	0.45	0.45	1.5	3

Odisha	0.05	0.1	0.25	0.3	0.3	1	4
West Bengal	0.05	0.1	0.25	0.3	0.3	1	4
Karnataka	0.025	0.05	0.125	0.15	0.15	0.5	5
Pondicherry	0.01	0.02	0.05	0.06	0.06	0.2	6
Lakshadweep	0.005	0.01	0.025	0.03	0.03	0.1	7
Andaman & Nicobar Islands	0.005	0.01	0.025	0.03	0.03	0.1	7
Daman & Diu	0.005	0.01	0.025	0.03	0.03	0.1	7
<b>Total</b>	<b>0.56</b>	<b>1.12</b>	<b>2.8</b>	<b>3.36</b>	<b>3.36</b>	<b>11.2</b>	

Source: Adopted from Ministry of Fisheries, GoI. 2021.

Note: UTs: Union Territories' of India

**Table 2:** Seaweed resources in Indian coasts

State/UTs	Annual Yield in tonnes (fresh wt.)
Tamil Nadu	22,044
Gujarat	20,000
Maharashtra	20,000
Lakshadweep islands	8,000
Goa	2,000
Kerala	1,000
Andaman and Nicobar Islands	120

Source: Adopted from food and agriculture organisation, Status of seaweed culture in India (2019).

Note: UTs: Union Territories' of India

### Administration Capacity by the Farmers

Seaweed farmers have no control over the price of their product, which is established by the private institutions. The government should build and empower farmers with price and product administrative skills to deal with price-fixing resistance. The utilization of seaweed need a large support from the state and central governments so that the seaweed in regency can be developed in the commercial direction. In order for it to be able to be exported and traded as raw resources for the creation of kappaphycus alvarezii cultivation in coastal Tamil Nadu districts.

### Recent Literatures on Seaweed

Nupur Bapuly and Nikhil Sharma (2023) have mentioned that seaweed has huge positional in promoting socio and economic conditions of the coastal farmers.

Maiken Bjørkan and Suzannah-Lynn Billing (2022) discourse in their study on commercial of seaweed cultivation in Scotland and social pillar of sustainability, they motioned that the government of Scottish has establish the seaweed cultivation for industrial promotion and to the blue economy for the potential for rural, island and coastal communities.

According to Diego Valderrama (2013), seaweed farming has generated substantial socio-economic benefits to marginalized coastal communities in developing countries. La Ode Muhammad Aslan (2018) analyze the income of seaweed farming households and seaweed farming has the highest contribution to a household income of all activities. Seaweed is one of the world's main aquaculture products as 70 percent of the seaweed production is exported as a raw material (dried seaweed), while the remaining (30 percent) is processed into carrageenan (Ferdouse et al. 2018). Seaweed culture provides financial benefits and creates employment opportunity for coastal inhabitants. This study was conducted to assess profitability and to determine the socioeconomic factors that affect the profitability of seaweed culture in the coastal region (TK Ghose & MI Hossain 2020)

Songwe, B. A. et al., (2016) clearly said the study assessed business management capacity; economic return; business model, and level of value addition initiatives on seaweed farming. The study found that farmers were significantly not realizing economic returns due to most of the production being below breakeven point (1,439 kgs of dry seaweed per cycle). Alam et al., (2003) has reviewed the study to adopt commercially viable large-scale culture technologies, and provide them with good marketing facilities. Buschmann H. Alejandro (2017): Ginigaddara, GAS and Lankapura, AIY (2018) seaweed farming is perceived as an important livelihood option for the coastal communities, and developing strategies to mitigate the impact of adverse environmental changes would promote seaweed cultivation.

Kwabena Appiah Agyarko (2017) The study has analyzed women are more patient to complete the cycle of planting, weeding, harvesting, and selling involved in the cultivation of seaweed. D. Valderrama et al., (2015) and Zamroni. An et al., (2011) study assessed the opportunities and constraints of seaweed farming projects with regard to sustainable coastal management in Indonesia.

Ganesan, M.; Trivedi, N.; Gupta, V. (2019): Johnson, B. and Gopakumar, G (2011) pointed out that the regions of Tamil Nadu and Gujarat have rich seaweed diversity in India.

Narayanakumar, R. and Krishnan, M. (2013),: Krishnana, M. and Narayanakumar, R (2010) in their study has examined the structure, conduct, and performance of the value chain in seaweed farming in India inquiring into the production, institutional, marketing, social and community relationships in small-scale seaweed farming. Irmayani et al., (2015), Tandel Kirtankumar V. et al., (2016) have studied seaweed cultivation and its potential to generate new opportunities for

revenue generation and the empowerment of fisherwomen, Radhika Rajasree SR and S Gayathri (2014). M. F. A. Pratama et al., (2021) have explored the study based on the SWOT analysis increasing production to meet seaweed demand, expanding the area for seaweed breeding, empowering local communities. Business performance indicators are critical for making decisions about investments, disinvestments, recruiting staff, expanding into new markets, and other activities. R. C. Ladino et al., (2023). Garima., (2023) investigated the significance of enhanced agricultural produce selling in the context of improving farmers' livelihoods and rural development in their study.

### **Theoretical Framework**

Fisheries and aquaculture are important economic activities in India and there is vast potential for sustainable exploitation of various domestic and marine fisheries resources in the country. Currently, there is an emphasis on culture-based catch fishing and semi-intensive aquaculture, as well as the fact that fishermen are interested in sponge farming. The sector offers a wide range of opportunities for rural development, nutrition protection, job creation, gender equality, and export earnings.

India is one of the potential countries for seaweed availability and cultivable land. seaweed is considered a priority part of the fisheries sector in India. The model of using self-help groups, mainly women, is an innovative model that has not been implemented anywhere in the world, especially as an alternative livelihood for fishing women to provide alternative income during the fishery closure period and to meet the growing industrial demand. Providing a fixed predetermined price to provide predictable returns has also been implemented for the first time, as the market risk faced by farmers in other countries is a major barrier. This model removes farmers from risk in India. And is the raw material for the piccoloid industry. Natural reserves cannot meet the demand of these industries, so large-scale cultivation is inevitable to increase seaweed production in the country.

Globally, seaweed production is dominated by countries such as China, Japan, and Korea. India has 7516.6 km [6100 km of mainland coastline + 1197 Indian Islands coastline] with a coastline of 13 States and Union Territories (UTs). Of which Tamil Nadu is 906.9 km. M has a beach area. There are 13 coastal districts in Tamil Nadu of which Ramanathapuram district is 236.8 km. In the first place, it has a long coastline.

About 844 species of seaweed have been reported from the Indian Ocean, with an estimated reserve of about 58,715 tons (wet weight). India has 434 species of red algae, 194 species of brown algae, and 216 species of green algae out of the 844 species of seaweeds. Red algae such as *Gelidiella azirosa*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *Gracilaria edulis*, *G Compost*. The quantity of seaweed currently available is not sufficient to meet the raw material requirements of the Indian sponge factories.

*Grasileria edulis*, *Gelidella acerosa*, *Graceleria dura*, *Kappaphycus alvarezii* in Tamil Nadu People produce 4 species of seaweed cultivation. Vedalai, Valayarvadi in Ramanathapuram district under my study seaweed cultivators from 13 coastal villages of Munaikadu, Mandapam, Ariyankundu, Villundi, Chambai, Mankadu, Vadakadu, Olaikkuda, Chinna Ervadi Eranthurai cultivate the sponge species *kappaphycus alvarezii*.

This is why people have chosen this *kappaphycus Alvarezii* seaweed; the higher the return on investment, the higher the local and international markets, Can be harvested in 45 days under optimal conditions, Extra income for the eco-friendly system, small fishermen, and low-cost efforts.

Seaweed cultivators in Ramanathapuram district started as an alternative occupation for their income needs. They do not have to ask their husbands for their daily family needs but fulfill their needs. The monthly income is reported to be at least Rs 20000. They find high returns on low investment, producing and harvesting a maximum of 4 times a year. Carrying out the production of this seaweed cultivation has enhanced their status and livelihood.

### **Scope of the Study**

Farming of seaweeds is widespread, promising economic activity, and an important livelihood option in many tropical coastal households. Compared to other types of aquaculture activities, seaweed farming has little impact on the environment. The significant research works are carried out at the national and international levels. Most of the researchers have focused on the macro aspects of seaweed farming (Vaibhav, 2019; Sajid, I. Khan, and Satam, 2003; Kaplinsky, Raphael, and Morris, Mike, 2001) and some others have covered national aspects (Krishnan, and Narayanakumar, 2010; Ganesan, 2019) the limited studies focused on the micro-level impact on the economic feasibility and government intervention on promoting seaweed farming and create the socio-economic characteristics of the local population and their ability and willingness to work on the farms. These things are essential to consider for the sustainability of livelihood and income generation.

### **Objectives of the study**

- ❖ To study the economic significance of seaweed cultivation and its potential to generate new opportunity of revenue generation in India.
- ❖ To analyse the significance of schemes awareness and its involvement in promoting seaweed cultivation.
- ❖ To study the awareness on price and product administration of the seaweed cultivators.
- ❖ To suggest the suitable policy implications to promotion of seaweed cultivation and entrepreneurship in the study area.

### **Methodology and Data Collection**



This study is designed as a descriptive approach based on both primary and secondary data. Primary data were collected through a structured interview schedule. The schedule includes family size, age composition experience in fishing and seaweed farming, asset ownership, income, and employment status, indebtedness, and socio and economic status improvement associated with seaweed farming. The sample was drawn based on purposive sampling proportionate to size. For this purpose one district was identified namely Ramanathapuram district, Eleven villages are selected on the basis of the high-level proportion of seaweed farming, as the study area analyzes the structure, conduct, and performance of seaweed farming, as these districts are the center of seaweed farming in Tamil Nadu. Based on a detailed analysis of the existing literature and the gaps therein, the following hypotheses have been framed and to be tested. After the intervention of seaweed farming, household income was increased and there is a considerable diversification in livelihood and generation employment in general particularly to women in the coastal seaweed farming households.

### Data Analysis

The collected data of 357 were analysed with the help of simple descriptive tables, percentage analyses were employed to assess the economic feasibility and livelihood status of seaweed farming farmers in Tamil Nadu and selected district.

### Results and Discussion

**Table 3:** Percentage of Awareness on Welfare Schemes Provided by the Central Government

S. No	Opinion	No. of the Respondents	Percent
1.	Yes	326	91.3
2.	No	31	8.7
<b>Total</b>		<b>357</b>	<b>100.0</b>

Source: Prepared by the authors

The above table 3 presents the awareness level of respondents regarding the welfare schemes of the Central Government. Among the total 357 respondents, a significant majority of 326 individuals (91.3% of the sample) were aware of the welfare schemes provided by the Central Government. Conversely, a small proportion of 31 respondents (8.7% of the sample) reported not being aware of these schemes.

The findings reported that the majority of the surveyed population is well-informed about the welfare initiatives introduced by the Central Government. However, it is essential to note that a minority still lacks awareness about these programmes. Addressing this lack of awareness among the smaller group could be an area of improvement for the government, ensuring that more citizens can benefit from the available welfare schemes.

**Table 4:**Percentage of Awareness on Welfare Schemes Provided by the State Government

S. No	Opinion	No. of the Respondents	Percent
1.	Yes	332	93.0
2.	No	25	7.0
<b>Total</b>		<b>357</b>	<b>100.0</b>

Source: Prepared by the authors

It was observed that a substantial majority of the participants, around 93.0%, were knowledgeable about the welfare schemes provided by the State Government. In contrast, a smaller minority of approximately 7.0% admitted to being unaware of these initiatives. These findings suggest a considerably high level of awareness among the respondents concerning the state government's social welfare programs.

**Table 5:** Price Administration Mechanism

S. No	Opinion	No. of the Respondents	Percent
1.	Yes	50	14.0
2.	No	307	86.0
<b>Total</b>		<b>357</b>	<b>100.0</b>

Source: Prepared by the authors

This table 5 explains that the Price administration mechanism. Maximum of the 86.0 percent respondents answered by the no and only few of the 14.0 percent of the respondents said yes. Private companies are usually in charge of pricing in this area. Farmers are not allowed to set their own prices for their produce; instead, they must pay the price set by private companies.

**Table 6:**Percentage of subsidies availed from the governments for seaweed cultivation

S. No	Opinion	No. of the Respondents	Percent
3.	Yes	291	81.5
4.	No	66	18.5
<b>Total</b>		<b>357</b>	<b>100.0</b>

Source: Prepared by the authors

According to the table 6 above, the respondents' views on government subsidies for seaweed cultivation are as follows: 81.5 percent, or 291 respondents, reported availing the subsidy, while 18.5 percent, or 66 respondents, stated that they did not receive any subsidy from the government.

**Table 7:**Percentage of nature of subsidy availed

S. No	Description	No. of the Respondents	Percent
1.	Loan	250	70.0
2.	Raft	57	16.0
3.	Seaweed	50	14.0
<b>Total</b>		<b>357</b>	<b>100.0</b>

Source: Prepared by the authors

The data provided in the table 7 above illustrates the types of subsidies utilized by the respondents. According to the study, 70.0% of the participants benefited from a loan subsidy, whereas 16.0% chose a raft assistance subsidy. Furthermore, 14.0% of the respondents took advantage of a seaweed-related subsidy.

**Table 8:** Percentage of bank loan available for seaweed cultivation

S. No	Opinion	No. of the Respondents	Percent
1.	Yes	276	77.3
2.	No	81	22.7
<b>Total</b>		<b>357</b>	<b>100.0</b>

Source: Prepared by the authors

According to the study findings, the respondents utilized a bank loan to support their seaweed cultivation endeavors. Among the participants, 276 individuals (77.3%) acknowledged having obtained the bank loan, while 81 respondents (22.7%) stated that they did not have access to this financial assistance.

**Table 9:** Price Administration Mechanism by size

S. No	Opinion	No. of the Respondents	Percent
1.	Small	307	86.0
2.	Large	50	14.0
<b>Total</b>		<b>357</b>	<b>100.0</b>

Source: Prepared by the authors

The table 9 analysis indicates that Price Administration Mechanism by small size 86.0 percent of the respondents and 14.0 percent of the respondents said by large size cultivation of the seaweed farming. The seaweed cultivation farming in Tamil Nadu is mostly in the coastal communities. Along the coast of Ramanathapuram District, the people carry out *kappaphycus alvarezii* seaweed cultivation. This type of seaweed is more resistant to the weather and adjusts to the climate in Tamil Nadu, especially Ramanathapuram coastal Regency.

## **Policy Implications**

- **Policy Support:** Governments should create favorable policies and regulations that incentivize and support seaweed cultivation. This includes providing permits and licenses for seaweed farming operations, defining property rights and access to coastal areas, and establishing clear guidelines for sustainable practices.
- **Research and Development:** Governments should invest in research and development initiatives to improve seaweed farming techniques, optimize seaweed species for cultivation, and explore new applications for seaweed-based products. This can lead to increased productivity and efficiency in the industry.
- **Financial Incentives:** Governments should offer financial incentives, grants, and subsidies to encourage individuals and businesses to invest in seaweed cultivation. These incentives can help offset initial setup costs and stimulate growth in the industry.
- **Infrastructure Development:** Supporting the development of necessary infrastructure, such as seaweed processing facilities and transportation networks, can facilitate the growth of the seaweed sector and create a conducive environment for businesses to thrive.
- **Environmental Regulation:** Since seaweed cultivation takes place in marine environments, governments must set and enforce environmental regulations to ensure that farming practices do not harm marine ecosystems. Sustainable and responsible seaweed cultivation practices should be promoted to protect biodiversity and maintain the health of coastal ecosystems.
- **Market Development:** Governments can assist in the creation of markets for seaweed products by promoting awareness of seaweed's potential uses and benefits. Encouraging domestic consumption and facilitating international trade can boost the economic prospects of the seaweed industry.
- **Capacity Building and Training:** Supporting training programs and capacity building for seaweed farmers can help improve their skills and knowledge, leading to more efficient and sustainable cultivation practices.
- **Public-Private Partnerships:** Governments can collaborate with private companies, research institutions, and non-governmental organizations to promote seaweed cultivation. Public-private partnerships can leverage expertise, funding, and resources to accelerate the growth of the industry.
- **International Cooperation:** Seaweed cultivation often transcends national borders. Governments can engage in international collaborations to share knowledge, best practices, and technology related to seaweed farming for mutual benefits.
- **Climate Change Mitigation:** Seaweed has the ability to sequester carbon dioxide from the atmosphere, making it a valuable tool in climate change mitigation. Governments can support research and projects focused on utilizing seaweed to combat climate change.

## **Conclusion**

Seaweeds are regarded as an essential part of the current global food security due to their extra functions in the mitigation of climate change and the empowerment of women. Due to its

straightforward culture method, outstanding nutritional profile, and contribution to global climate change mitigation and adaptation measures, some recent study suggests seaweed farming as an alternative to terrestrial agriculture. The seaweed sector is expected to benefit the majority of farmers, particularly women, by increasing their purchasing power, fostering social empowerment, and aiding in efforts to fight poverty. Although seaweed farming technology has made considerable strides over the past few decades, there are still a number of barriers that need to be overcome before its sustainable production methods, varied uses, and societal acceptance can be fully realised. To achieve sustainable production at a reasonable cost with the greatest possible benefits, the initial phase in cultivation should involve careful selection of the proper species and adequate culture locations in the coastal waters. It's also essential to keep the market price at a level that encourages farmers to engage in the farming system. Establishing necessary rules is crucial to raising the calibre of seaweed species and the products developed from them for human use. Determining the daily intake of seaweed or seaweed products is also essential for a balanced diet. The collaboration and coordination between the nations and countries that produce and consume seaweed must be improved if the seaweed farming sector is to become sustainable. National and international organisations should develop and share best management practises for the seaweed farming technologies that are economically viable, environmentally benign, and socially acceptable among tropical and subtropical nations. To guarantee the contribution of these nourishing aquatic crops for a healthy earth and human populations, this should be done right away.

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