Popular Article

Trends in Agriculutre Science ISSN:2583-7850

Vol.2 Issue 7 July 2023, Page: 593-600

Seaweed in India: Serving as A Boon for Ecosystem and Fishermen

Bhooleshwari[*1], Shivakumar M.[1], Narendra Kumar Maurya[1] and Dikeshwar Prasad[2]

College of Fisheries, Mangalore, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka (575002), India
ICAR- Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar, Odisha (751002), India
https://doi.org/10.5281/zenodo.8200150

Abstract

Growing seaweed has become a realistic option for India's low-income coastal villages to improve their economic situation. Gujarat is currently expanding its commercial production of *Kappaphycus alvarezii*, which has already reached six coastal districts in Tamil Nadu. The CMFRI has effectively standardized the practice of Integrated Multi-trophic Aquaculture (IMTA) which permits cage farming or bivalve farming combined with seaweed farming in coastal waters. Due to their global distribution, ability to regenerate and variety of uses, seaweeds have recently gained significant importance. Seaweeds exhibit highest photosynthesis efficiency due to moist conditions. They contribute to about 50% of all photosynthesis in the world.

Introduction

More than half of the oxygen in the planet is produced by the ocean, which also absorbs 50 times more carbon dioxide than our atmosphere. The ocean, which makes up 70% of the surface of the planet, carries heat from the equator to the poles and hence controls our temperature and weather patterns. We may engage in a wide range of interesting activities on the ocean, including fishing, boating, kayaking and whale watching. Other than seafood, the ocean is a source of components for surprise foods such corals, fish, oysters, sea grass and sea weeds. Ocean-derived chemicals are used in many pharmaceutical treatments, including those that treat heart disease, cancer, arthritis and Alzheimer's disease. Seaweeds play a major role in marine ecosystems. As the first organism in marine food chains, they provide nutrients and energy for animals – either directly when fronds (The leaf or leaf like part of fern or similar plant) are eaten or indirectly when decomposing parts break down into fine particles and are taken up by filter-feeding animals. Beds of seaweed provide shelter

and habitat for scores of coastal animals for all or part of their lives. They are important nurseries for many commercial species such as the rock lobster, abalone and green-lipped mussel. Until recently seaweeds were described as simple plants that grew in the sea, but scientists now consider that the structure and chemistry of seaweeds is so distinctive that they warrant their own classification. They are simple in structure, usually consisting of a hold-fast that anchors them to a surface, and a blade which may be divided into fronds. Some of the larger seaweeds have a flexible stalk or stipe connecting the blade to the hold-fast. Unlike plants, seaweeds do not have roots or internal tissues to conduct water. They absorb minerals and gases directly from sea water through the surface of their blades.

Diversity of Seaweeds

In 2020, 178 million tonnes of aquatic animals were produced, along with 36 million tonnes (wet weight) of algae, 97 percent of which came from aquaculture. Between the years 2000 and 2010, the production of algae increased dramatically, from 12 million tonnes to 21 million tonnes. However, compared to 2019, it only increased by 2% in 2020. With a share of 97% of the world's algae output, Asian nations confirmed their status as leading producers. China was the world's top producer in 2020, contributing 58% of the total, followed by Indonesia (27%) and the Republic of Korea (5%) (FAO-SOFIA, 2022). India is one of the world's 12 mega-biodiversity nations. India has a 2.02 million km2 Exclusive Economic Zone (EEZ). India has a coastline of 8,100 kilometers and has reported 844 seaweed species. The inter-tidal and sub-tidal zones of the West Coast, particularly in Gujarat, are rich in resources. The growth of seaweed-based enterprises in India has a lot of promise because to these resources. Seaweed is abundant in Tamil Nadu, Gujarat's beaches, Lakshadweep and the Andaman and Nicobar Islands. At Tamil Nadu, rich seaweed beds can be found in Mumbai, Ratnagiri, Goa, Karwar, Varkala, Vizhinjam, and Pulicat, and in Orissa, Chilka. There are about 240 different types of seaweed in the Gulf of Mannar, with at least 185 of them being edible.

Region of India cultivates more Seaweed:

Tamil Nadu

The southeast Indian state of Tamil Nadu has 1,076km coastline with the convergence of the Bay of Bengal, Arabian Sea and the Indian Ocean. The southern Gulf of Mannar's rocky inter-tidal and lower intertidal regions maintain rich populations of several seaweed species. Seaweed diversity from 42 Indian coastal stations and 14 Gulf of Mannar islands showed a total of 282 seaweed species.

trendsinagriculturescience.com
trendsinagriculturescience@gmail.com
Published: 28 July 2023

Among these, 80 species were *Chlorophyta*, 56 species were *Phaeophyceae* and 146 species were Rhodophyta. The genus *Caulerpa* was represented by the highest number of species (24) among the green algae.

Gujarat

The Gujarat coast, more than 1600 km long, is located in northwest India. seaweed diversity of the Gujarat coast revealed 198 species representing all three major groups of seaweed; Rhodophyta 109 species from 62 genera; Chlorophyta 54 species from 23 genera; Phaeophyceae 35 species from 16 genera. Seaweed diversity is rich in the Gulf of Kachchh islands totaling 130 species from Dani, Dhabdhaba, Kalubhar, Manmarodi, and Narara Islands. Species collected ranged from 93 species from Kalubhar Island to a minimum number of 14 species collected from Narara Island.

Types of Seaweeds

They generally grow in the shallow waters in the tidal zone**.** Some seaweeds are microscopic, such as the phytoplankton that live suspended in the water column. Some are enormous, like the giant kelp that grow in abundant "forests" from their roots at the bottom. Seaweeds can be grouped into three types, based on color – green, red or brown. Seaweeds or marine algae refer to three taxonomic groups that have different pigment composition:

I. Chlorophyta (Green algae),
II. Rhodophyta (Red algae),
III. Ochrophyta/ Pheophyta (Brown algae).

Life cycle of seaweed

Many seaweeds only survive for a single season; others, especially the large kelps, grow ear-round and may live for many years. Seaweeds have complex life cycles involving both sexual and asexual stages. Their appearance may change conspicuously between these stages. Red seaweeds have the most intricated life cycle. One edible species, karengo (*Porphyra* species), includes a phase that bores into the surface of shellfish and rocks. Suitable sites for seaweed cultivation will be selected based on the following criteria: Stable seawater with not less than 30 ppt salinity Sandy/ rocky bottom with transparent water ideal temperature 26-30˚C. The area should have minimum 1.0 m water depth during low tide. Area with mild water currents are preferred.

Why seaweed farming is important?

- ❖ It is providing occupation for the coastal people.
- ❖ Seaweeds are provided continues supply of raw material for seaweed-based industry.

trendsinagriculturescience.com
trendsinagriculturescience@gmail.com
Published: 28 July 2023

- ❖ Seaweed farming is eco-friendly.
- ❖ It is a major tool to treat coastal pollution in the sea & reduce CO_2 in global warming.
- ❖ Sometimes it acts as a remedy for non-availability of required quantity of seaweeds for various uses.
- ❖ It can provide seaweeds of uniform quality for use in industry.
- ❖ It conserves natural populations of concerned seaweeds.

Techniques for Growing Seaweed

1) Single Rope Floating Raft method (Coir Rope & Nylon Rope).
2) Fixed Bottom long line method (Coir Rope & Nylon Rope).
3) Integrated Multi Trophic Aquaculture (IMTA) method.

Indian Seaweed Harvesting Restrictions

1. Labour shortages during the paddy harvesting & transplanting season.
2. Lack of livelihood security due to low wages & during bad weather.
3. Lack of technology to improve processed products.
4. Lack of information on new & alternative sources of raw material.
5. Risky as they must be collected from depths of more than 25 to 30 feet to collect seaweed.
6. Over-exploitation: While India has a rich source of seaweed varieties, we have **focused only on harvesting, not cultivation** thus leading to over-exploitation.
7. Lack of awareness about health benefits acts as a hindrance to nutrition transition among the population.
8. Less market demands.
9. Lack of support from the government.

Demerits of Collection of Seaweeds

I. The forest department is carrying out manual removal of the seaweed annually since 2014 to protect the coral reefs.
II. Fisher folk, mostly women, collect tonnes of seaweeds daily around the islands. And while doing so, they break the corals.
III. Mechanical dredging causes damage to the kelp forests formed by large seaweeds.
IV. Indiscriminate collection of seaweed also causes severe damage to the useful algaes.

Importance of Culture of Seaweeds

- ❖ Seaweeds has the light-absorbing pigment chlorophyll that is necessary for photosynthesis. Brown and red seaweeds have additional pigments that enable them to photosynthesis at depths

trendsinagriculturescience.com
trendsinagriculturescience@gmail.com
Published: 28 July 2023

where little light penetrates. These extra pigments cover up the green color of chlorophyll. Brown seaweeds can be yellow-brown to dark olive. Red seaweeds have the greatest range of tone – pink to purple, red and brown to nearly black.

- Dense forests in the underwater known as kelp forests, which act as underwater nurseries for fish, snails and sea urchins. The herbivorous marine animals also feed on its Thallus. They releases oxygen through every part of their bodies.
- Seaweeds, found mostly in the inter tidal region, in shallow and deep waters of the sea and also in estuaries and backwaters, absorb the excess nutrients and balance out the ecosystem.
- They also act as a bio-indicator, when waste from agriculture, industries, aquaculture and households are let into the ocean, it causes nutrient imbalance leading to algal blooming, the sign of marine chemical damage.
- These aquatic organisms heavily refers to the iron for photosynthesis. When quantity of this mineral exceeds healthy levels and becomes dangerous to marine life, seaweeds trap it and prevent damage. Similarly, most heavy metals found in marine ecosystems are trapped and removed by seaweeds.
- They also supply organic nutrients, which they are capable of producing, to other marine lifeforms. Seaweed has a significant role in mitigating climate change. By afforesting 9 per cent of the ocean with seaweed, it is possible to sequester 53 billion tons of carbon dioxide annually. Hence, there is a proposal termed as 'ocean afforestation' for farming seaweed to remove carbon.
- The importance of seaweed in agriculture and animal husbandry is noteworthy. They can be used as fertilizers and to increase fish production. Also, when livestock is fed with seaweed, methane emission from cattle may be reduced substantially. Additionally, they may be buried in beach dunes to combat beach erosion. It is used as an ingredient in preparing toothpaste, cosmetics and paints.

Under the PMMSY (Pradhan Mantri Matsya Sampada Yojana)

The IUCN has not yet assessed the status of seaweed conservation. Given the ecological importance of seaweeds, it is crucial for the federal and state governments to take swift, scientific action to manage seaweeds sustainably and protect them for future generations. The Pradhan Mantri Matsya Sampada Yojana (PMMSY) was introduced by the Indian government under the leadership of Hon'ble Prime Minister Shri Narendra Modi at a significant investment of Rs. 20,050 Crores for

trendsinagriculturescience.com
trendsinagriculturescience@gmail.com
Published: 28 July 2023

the comprehensive development of Fisheries in the nation. It offers potential for seaweed producers to boost their income.

Objectives of the PMMSY

1. To enhance production and productivity in the seaweed aquaculture in the country for harnessing the potential of the coastal waters and reduce reliance on wild harvest.
2. To improve the seaweed value chain and industrial product diversification to meet domestic demand and thus reduce dependence on imports.
3. To promote seaweed cultivation as a viable and sustainable livelihood amongst rural communities, especially for women.
4. To establish an institutional mechanism in Research and development in the seaweed farming and value chain and mechanism for effective Transfer of Technology.

Broad Strategies for Seaweed cultivation

- ✧ Area expansion
- ✧ Ensuring quality seed supply
- ✧ Enhancing Research and Development in seaweed farming and value chain
- ✧ Institutional development for market promotion
- ✧ Increasing Capital investment in small scale seaweed processing
- ✧ Utilization of the existing labour and skill development
- ✧ Integrated and cluster-based approaches
- ✧ Technological upgradation

Commercial Significance of Seaweeds

Out of the global seaweed production of 32 million tons fresh weight valued around 12 billion US dollars, China produces 57%, Indonesia 28% followed by South Korea, whereas **India is having a more share of 0.01-0.02%.** Despite several advantages, commercial seaweeds cultivation has not taken place in the country at an appropriate scale, as being practiced in South-East Asian countries.

- ✧ Seaweed is **full of vitamins, minerals & fiber.**
- ✧ Many seaweeds contain anti-inflammatory & anti-microbial agents.
- ✧ They are known to process significant medicinal effects.
- ✧ Certain seaweeds possess powerful **cancer-fighting agents**.
- ✧ They are effective binding agents (emulsifiers) & are used commercial goods as toothpaste & fruit jelly, & popular softeners (emollients) in organic cosmetics & skin-care products.

Economic Status of Seaweed

trendsinagriculturescience.com
trendsinagriculturescience@gmail.com
Published: 28 July 2023

1. Sanctioned proposals from States/UTs (Centrally sponsored Scheme CSS) : Tamil Nadu (Phase-1), Maharashtra (Establishment of seaweed culture rafts and monoline including inputs). Total cost of Rs. 331.48 Lakhs (INR 3.314 Million) .
2. Proposals under Consideration from States/UTs : Andhra Pradesh, Tamil Nadu (Phase-2), Karnataka, Dadra Nagar Haveli, Daman & Diu, Kerala (Establishment of seaweed culture rafts and monoline including inputs, Establishment of Brood banks for seaweed). Total cost of Rs. 4553.54 Lakhs (INR 455.3 Million).
3. Proposal from Research Institutes/UTs (Central Sector Scheme- CS) : CSIR- Central Salt and Marine Chemicals Research Institute, Andman & Nicobar Administration (Identification of Potential Location across pan India, Seed plant production of *Kappaphycus alvarezii* along Tamil Nadu coast, Pre feasibility studies and pilot scale farming in Andman coast). Total cost of Rs. 923.58 Lakhs (INR 9.23 Million).
4. Rs. 640.00 crore investment by Government in seaweed sector.
5. 8 lakh Employment Direct and Indirect in seaweed sector.
6. Socio-economic Employment of Coastal Fishers, especially fisher-women.
7. Supports infrastructure and activities to mitigate business Risks.

Financial support by Govt. by way of:

A. Central Sector Component (100%) -

I. Genetic Improvement Programme and Nucleus Breeding Centre.

II. Innovative project on Seaweed Business under Central Sector Component.

B. Centrally Sponsored Component (40% Subsidy for General Category and 60% for SC/ST/Women) -

I. Establishment of Seaweed culture Rafts, including inputs.

II. Establishment of seaweed culture with Mono line /Tube-net method, including inputs.

III. Establishment of Seed Bank for Seaweeds.

Conclusion-

They provide shelter, food and nurseries in these conditions for a very wide variety of associated organisms, such as other marine life, invertebrates, crustaceans, echinoderms and a variety of fish species. The majority of seaweeds are utilized to make phycocolloids. There are 25 agar and 21 alginate-based phycocolloids businesses in India. The potential of the Indian seaweed sector is constrained by the lack of superior germplasm and sophisticated growth techniques. Despite this, CSIR-CSMCRI has lately created unique technologies, one of which is the bio-prospecting of Indian

trendsinagriculturescience.com
trendsinagriculturescience@gmail.com
Published: 28 July 2023

agarophytes. Growing seaweed is a productive approach to supply a growing population with food that is incredibly nutritious. Seaweed grows quickly and doesn't need land, freshwater, pesticides or fertilizer like terrestrial crops do. In fact, some marine algae can be harvested in as little as six weeks. Seaweed farming has various advantages, including the ability to enhance water quality and give coastal communities a source of income. Seaweed, both wild and cultivated, provides a variety of ecosystem services, including habitat for other marine animals, bioremediation for coastal pollution, localized management of ocean acidification and climate change mitigation.

References

Anonymous, 2006 'Seaweed - What is seaweed?', Te Ara - the Encyclopedia of New Zealand, Available at: http://www.TeAra.govt.nz/en/seaweed/page-1. Accessed on: 12 March 2023.

Ganesan, M., Trivedi, N., Gupta, V., Madhav, S. V., Reddy, C. R., & Levine, I. A. (2019). Seaweed resources in India–current status of diversity and cultivation: prospects and challenges. *Botanica Marina*, **62**(5):463-482. DOI: https://doi.org/10.1515/bot-2018-0056.

Mantri, V. A., Kavale, M. G., & Kazi, M. A. (2020). Seaweed biodiversity of India: reviewing current knowledge to identify gaps, challenges and opportunities. *Diversity*, **12**(1): 13. DOI: **https://doi.org/10.3390/d12010013**.

CMFRI 2022. Annual Report 2021. Central Marine Fisher