



Oceanic Harvest: Cultivating Waves of sustainability with Seaweed Farming

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ABSTRACT

Seaweed farming, also known as mariculture or seaweed aquaculture, has emerged as a sustainable and versatile industry with immense potential to address pressing global challenges. This article provides an overview of seaweed farming, highlighting its benefits and applications. Seaweed cultivation offers significant environmental advantages, serving as a carbon sink, enhancing biodiversity, and mitigating nutrient pollution. Its applications span from food and biodegradable packaging to cosmetics, pharmaceuticals, and biofuels. Different farming methods, including offshore and nearshore approaches, as well as Integrated Multi-Trophic Aquaculture (IMTA), are discussed. Seaweed farming holds promise for a more sustainable future, although it faces scaling and regulatory challenges.

KEYWORDS

Mariculture, Sustainability, Food Security, Biodiversity, Pharmaceutical, Biofuels.

Introduction

Seaweed farming, a centuries-old practice rooted in coastal communities across the globe, is gaining renewed attention as a sustainable and versatile industry that holds the promise of addressing a myriad of pressing environmental, nutritional, and economic challenges. The cultivation of marine macroalgae, commonly referred to as seaweed, within controlled aquatic environments, represents a harmonious union between humanity and the ocean—a union with the potential to transform the way we interact with the vast blue expanse that covers over 70% of our planet. The resurgence of interest in seaweed farming is not arbitrary; it is driven by a convergence of urgent global issues. The first and most pressing concern is the need for sustainable food sources in the face of a rapidly growing global population. Seaweed offers a nutritious and protein-rich food source that is also environmentally friendly. Simultaneously, seaweed is a potent tool in mitigating climate change due to its capacity to absorb and store carbon dioxide, a greenhouse gas responsible for global warming. Beyond its culinary potential, seaweed boasts a wide array of applications, including the development of biodegradable packaging materials, cosmetics, and biofuels. Its growth in these areas aligns with a growing global consciousness regarding the harmful impact of single-use plastics and the need for eco-friendly alternatives.

The Future of Seaweed Farming

Seaweed farming is poised to play a significant role in addressing global food security and environmental challenges. As the world seeks more sustainable solutions, seaweed is gaining recognition as a versatile and eco-friendly resource. However, challenges remain, such as scaling up production, addressing regulatory hurdles, and expanding markets for seaweed products. Seaweed farming contributes to the

development of the blue economy by creating jobs, fostering innovation, and generating economic opportunities in coastal communities. The cultivation of multiple seaweed species for diverse applications adds to the versatility of this industry. In summary, the future of seaweed farming is a dynamic landscape where sustainable agriculture meets environmental stewardship, offering solutions to global challenges across food security, climate change, and the quest for eco-friendly alternatives.

Seaweed Farming Methods

Seaweed farming methods can vary depending on the type of seaweed species being cultivated and the specific environmental conditions of the farming site. Some common seaweed farming methods are:

Longline or Vertical Line Cultivation: This method involves the use of long, suspended lines or ropes that are anchored to the seafloor. Seaweed spores or young plants are attached to the lines, allowing them to grow submerged in the water column. This method is often used for species like kelp, which grow vertically.



Raft or Buoy Systems: In this method, seaweed is grown on floating structures like rafts or buoys, typically in sheltered coastal areas. Lines or nets are suspended from the rafts, and seaweed is attached to them. Raft systems are commonly used for the cultivation of species like nori.



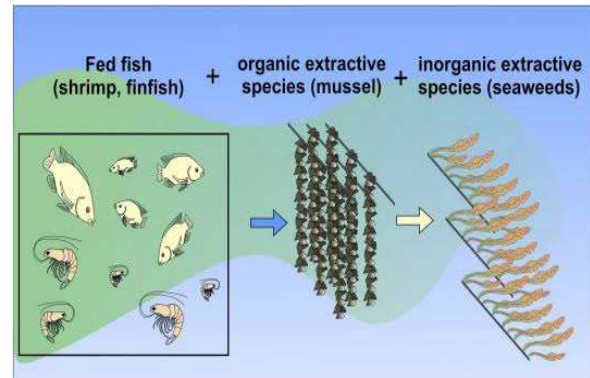
Fixed Bottom Structures: Seaweed can be grown on fixed structures on the seafloor, such as frames, grids, or trays. This method is well-suited for species that attach to solid surfaces, like dulse or red seaweed.



Submerged Nets or Cages: Seaweed can also be cultivated in submerged nets or cages. These are placed on the seafloor, and the seaweed grows within the protective enclosure. This method can help protect the seaweed from herbivores and strong wave action.

Integrated Multi-Trophic Aquaculture (IMTA): IMTA is an innovative approach that combines seaweed cultivation with other forms of marine aquaculture, such as fish or shellfish farming. The idea is to create a mutually beneficial relationship where the seaweed absorbs excess nutrients and provides habitat and food for the associated species. This approach

enhances overall sustainability and nutrient cycling.



Offshore Farming: Some seaweed farming operations are conducted further from the coast in offshore areas. These farms are often larger and exposed to more wave action. Offshore farming allows to produce significant quantities of seaweed, especially species like giant kelp.



Nearshore Farming: Nearshore farms are situated closer to the coast, in more sheltered areas. They are suitable for certain types of seaweed and offer easier access for maintenance and harvesting. This method is well-suited for species like sugar kelp.



Rocky Intertidal Zones: In areas with suitable intertidal zones, seaweed can be cultivated directly on rocky substrates. Species like dulse and Irish moss are well-suited to this method.

Benefits of Seaweed

Seaweed farming offers a wide range of benefits, making it a sustainable and versatile industry with the potential to address various environmental, economic, and nutritional challenges. Some of the key benefits of seaweed farming include:

Environmental Sustainability:

- 1. Carbon Sequestration:** Seaweed acts as a natural carbon sink, absorbing and storing carbon dioxide (CO₂) from the atmosphere. This helps mitigate climate change by reducing CO₂ levels.
- 2. No Freshwater Requirement:** Seaweed cultivation does not require freshwater resources, reducing the strain on already limited freshwater supplies.
- 3. No Pesticides or Fertilizers:** Unlike land-based agriculture, seaweed farming does not rely on pesticides or synthetic fertilizers, reducing the environmental impact and potential water pollution.

Biodiversity Enhancement:

Seaweed farms create artificial underwater ecosystems that provide habitat and food for various marine species, enhancing biodiversity and promoting ecosystem health.

Nutrient Uptake:

Seaweed is efficient at absorbing excess nutrients, such as nitrogen and phosphorus, from the water. This helps mitigate the effects of nutrient pollution, which can lead to harmful algal blooms and dead zones in coastal areas.

Renewable Resource:

Seaweed is a highly renewable resource that can be harvested multiple times a year, depending on the species and local conditions, making it a reliable source of biomass.

Food and Nutrition:

Seaweed is a rich source of essential nutrients, including vitamins, minerals, and antioxidants. It provides a sustainable and nutritious food source for both humans and livestock.

Biodegradable Packaging:

Seaweed-based materials can be used to create eco-friendly packaging alternatives. These materials are biodegradable and help reduce plastic pollution.

Cosmetics and Pharmaceuticals:

Seaweed extracts are used in cosmetics and skincare products for their hydrating and nourishing properties. Some species of seaweed have potential pharmaceutical applications due to their bioactive compounds.

Biofuels and Energy:

Seaweed can be processed into biofuels, such as bioethanol and biodiesel, offering a sustainable source of energy that doesn't compete with food crops.

Mitigating Ocean Acidification:

Seaweed can help counteract the effects of ocean acidification by absorbing CO₂ and releasing alkaline compounds during photosynthesis.

Job Creation and Economic Development:

Seaweed farming can stimulate local economies by creating jobs in coastal communities and supporting small-scale enterprises.

Reduction of Overfishing Pressure:

Seaweed farming can reduce the pressure on wild fish populations by providing alternative seafood

products, such as kelp-based alternatives to fishmeal in aquaculture.

Conclusion

Seaweed farming is a remarkable testament to nature's ability to offer solutions to some of the most critical issues of our time. It is an environmental champion, acting as a carbon sink, enhancing biodiversity, and curbing nutrient pollution. In a world grappling with climate change, seaweed's potential as a natural carbon sequestration tool is especially noteworthy. Moreover, seaweed offers a wealth of nutritional benefits, providing a sustainable food source that can bolster global food security. Its applications in biodegradable packaging, cosmetics, pharmaceuticals, and renewable energy production underscore its versatility and the vast potential to reduce our reliance on resource-intensive and polluting industries. As the seaweed farming industry continues to evolve, challenges remain, including scaling up production, navigating regulatory complexities, and expanding markets. However, the path forward is clear, and the benefits are undeniable. Seaweed farming represents a shift towards more sustainable, regenerative, and ecologically harmonious practices, a vision for a brighter and more prosperous future for both our planet and its inhabitants.

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