Seaweed Fights Climate Change for Blue Carbon

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Introduction

When we think of climate heroes, our minds often go to trees. Forests get all the credit for absorbing carbon dioxide and cleaning our air. But there's an unsung climate warrior beneath the waves that's quietly soaking up carbon while doing a whole lot more **Seaweed**.

Yes, that slippery green stuff clinging to rocks at the beach or floating in your miso soup might just help save the planet.

What Is Blue Carbon?

We all know that plants on land absorb carbon dioxide (CO_2), but what's lesser known is that marine ecosystems also store carbon and often more efficiently. This is called blue carbon, and it includes carbon captured by oceanic habitats like mangroves, seagrasses, and seaweeds. Unlike trees, which store carbon for decades, seaweed can absorb carbon in just a matter of weeks. Some species of macroalgae grow up to half a meter per day, rapidly pulling CO_2 from the atmosphere through photosynthesis.

Farming the Future

Seaweeds are members of the kingdom *Thallophyta* and are ancient autotrophic organisms with a several kinds of life forms. They are multicellular or macro-algae that play a very important ecological roles in many aquatic communities and categorized into three types based on their pigment profile and characteristics: Chlorophyceae (green algae), Phaeophyceae (brown algae), and Rhodophyceae (red algae).

Globally, seaweed farming is booming. Countries like South Korea, Indonesia, and China have been cultivating seaweed for food, cosmetics, and industry for decades. Now, a growing number of startups and researchers are exploring seaweed farming as a carbon offset strategy.

Some projects aim to scale up seaweed farms to capture CO_2 and sink biomass into the deep ocean a concept still being studied for its long-term effectiveness and ecological impact.

Seaweed's Superpowers

Here's how seaweed earns its title as a blue carbon hero:

Rapid CO_2 Absorption : Seaweed acts like a sponge for atmospheric carbon. It grows fast and sequesters carbon at rates that rival or even exceed terrestrial forests.

Carbon Export: Some of the carbon captured by seaweed sinks to the ocean floor when the plant dies, potentially storing it for hundreds or even thousands of years.

No Need for Fertilizer or Fresh Water: Unlike land-based crops, seaweed doesn't need arable land, irrigation, or chemical fertilizers making it one of the most sustainable crops on Earth.

Ocean Cleanup: Seaweed also absorbs excess nutrients, such as nitrogen and phosphorus, helping reduce ocean dead zones and improving water quality.

Seaweed's Role in Livestock Methane Reduction

One unexpected benefit? Seaweed could cut methane emissions from livestock. When certain red seaweeds are added to cattle feed, studies have shown a reduction of methane emissions by over 80% a major breakthrough, since methane is 25 times more potent than CO_2 as a greenhouse gas.

Methane Emissions from Livestock:

Ruminant animals like cows and sheep produce methane during digestion through a process called enteric fermentation. This methane is released primarily through belching and is a potent greenhouse gas, significantly contributing to global warming.

Seaweed as a Feed Supplement :

Incorporating certain types of seaweed into livestock feed has emerged as a promising strategy to mitigate methane emissions. The red seaweed *Asparagopsis taxiformis* has been identified as particularly effective. Studies have

Rhodophyceae	Chlorophyceae	Phaeophyceae
Kappaphycus alvarezii	*Ulva reticulata*	*Ascophyllum nodosum*
Gracilaria edulis	*Ulva armoricana*	*Sargassum spp.*
Gelidium serrulatum	*Ulva Lactuca*	*Laminaria digitata*
Porphyra perforate	*Codium Liyengarii*	*Fucus vesiculosus*
Cyanidium caldarium	*Codium tomentosum*	*Durvillea antarctica*
Macrocystis pyrifera	*Caulerpa paspaloides*	*Ralfsia spp*
Nereocystis spp.	*Caulerpa sertularioides*	*Ecklonia maxima*
Acanthophora spicifera	*Enteromorpha prolifera*	*Hydroclathrus spp.*

Table 1. List of some important Seaweed species

demonstrated that adding small amounts of this seaweed to cattle feed can lead to substantial reductions in methane production.

So What's the Catch?

While seaweed shows massive promise, scaling it up isn't without challenges

Regulatory Uncertainty :

Many coastal areas lack policies or permits for ocean farming.

Environmental Impact:

Large-scale seaweed farms need careful management to avoid disrupting marine ecosystems.

Carbon Accounting :

It's still tricky to quantify and verify exactly how much carbon seaweed captures and stores long term.

A Green Wave Worth Watching

Still, seaweed is gaining serious momentum in the climate conversation. It's fast-growing, sustainable, versatile, and seriously underrated. From climate-smart farming to reducing methane burps from cows, seaweed is one of nature's most promising tools in the fight against climate change.

So next time you slurp some seaweed noodles or enjoy a sushi roll, take a moment to appreciate the blue carbon hero on your plate. The future of the planet might just be a little greener and a lot more marine.

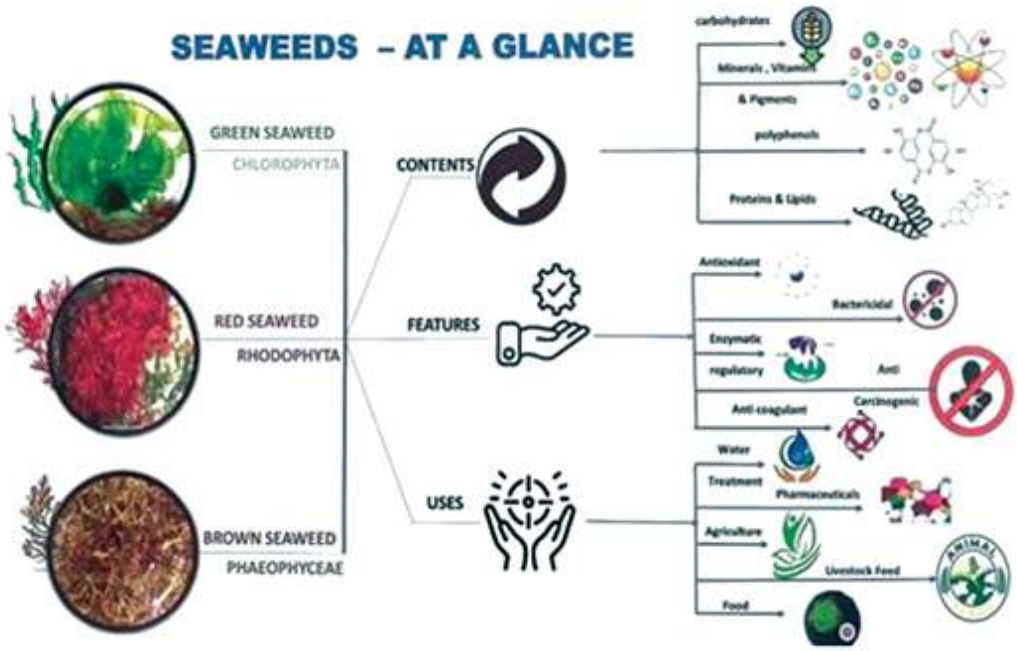


Fig. 1. Flow diagram of seaweeds at a glance

Seaweed research and training in India

The below central government institutions collectively advance seaweed research and cultivation in India, contributing to economic development, environmental sustainability, and the enhancement of coastal livelihoods.

Central Marine Fisheries Research Institute (CMFRI):

In September 2024, ICAR-CMFRI's Mandapam Regional Centre in Tamil Nadu was designated as a Centre of Excellence for seaweed cultivation. The centre aims to promote sustainable seaweed farming practices, address cultivation challenges, and enhance India's role in the global seaweed industry.

Central Salt and Marine Chemicals Research Institute (CSMCRI):

CSIR - CSMCRI's Marine Algal Research Station in Mandapam, Tamil Nadu, has been pivotal in developing seaweed cultivation techniques. The station has trained locals including many women, in modern seaweed farming techniques, significantly improving their livelihoods.

Central Institute of Fisheries Technology (CIFT):

ICAR-CIFT provides technological support for seaweed processing, contributing to the development of value-added seaweed products.

Centre for Marine Living Resources & Ecology (CMLRE):

Seaweed Research : CMLRE conducts studies on marine biodiversity, including seaweed ecosystems, and manages research vessels for extensive marine studies.

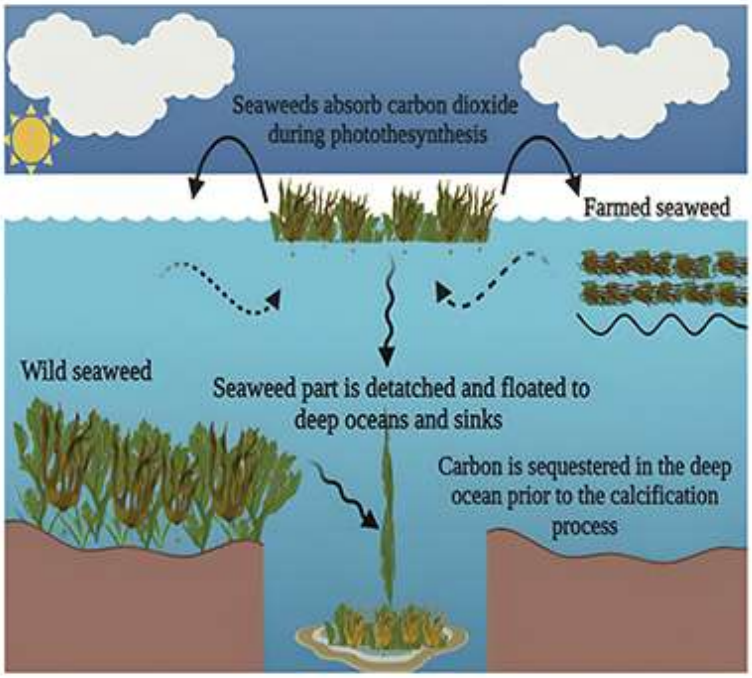
Central Institute of Brackishwater Aquaculture (CIBA):

ICAR-CIBA explores the potential of seaweed cultivation in brackishwater systems, aiming to enhance aquaculture sustainability.

Conclusion

In the global fight against climate change, solutions often seem complex, costly, or far off in the future. But seaweed offers something rare a natural, scalable, and surprisingly simple tool that's available right now. Whether it's drawing carbon from the atmosphere, cleaning our oceans, or slashing methane emissions from livestock, seaweed is proving to be more than just a fringe food trend.

Ongoing research and development are essential to address cultivation, economic, and regulatory challenges, aiming to make this solution both environmentally and commercially viable of course, no single solution will solve



the climate crisis. But when we stack powerful innovations like seaweed farming alongside renewable energy, reforestation, and sustainable agriculture, we get closer to a truly resilient planet.

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