AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 6, Issue 12
www.agriallis.com

Article Id
AL04413

SEAWEED FARMING: A POTENTIAL CLIMATE CHANGE SOLUTION IN TROPICAL COUNTRIES

Velmurugan A

Email
velmurugan13061999@gmail.com

Tamilnadu Dr. J. Jayalalithaa Fisheries University, Nagapattinam, Tamil Nadu, India

Seaweed is climate-smart macro algae and they act as ecological engineers on rocky coasts of the world's oceans. Seaweeds are also termed as the 'Medical Food of the 21st Century' as they are being used as laxatives, for making pharmaceutical capsules, in treatment of goiter, cancer, bone-replacement therapy and in cardiovascular surgeries. It plays a huge role in fighting climate change by absorbing carbon emissions; reduce ocean acidification, regenerating marine ecosystems, creating bio-fuel and renewable plastics as well as generating marine protein. In fact, macro algae have the potential to sequester 173 million metric tons of CO_2 in every year, with about 90% of sequestration occurring through export to the deep sea (Zhang Y, et al.2017). In terms of avoided the emission from fossil fuels, about 1500 tons of CO_2/km^2/year. This perspective tends to take an applied industrial view in which seaweeds offer valuable tools for mitigation and adaptation to climate change.

Seaweed Farming

Commercially important species- red algae (*Gelidella acerosa*, *Gracilaria edulis* is farmed for agar production) and brown algae (*Sargassum spp*, *Turbinaria spp*. is farmed for alginates and liquid seaweed fertilizer productions).

Site selection

- Area with stable and mild water currents is preferable.
- Sandy / rocky bottom with transparent water
- Salinity not less than 30 ppt is required
- The area should have minimum 1.0 m water depth during low tide.

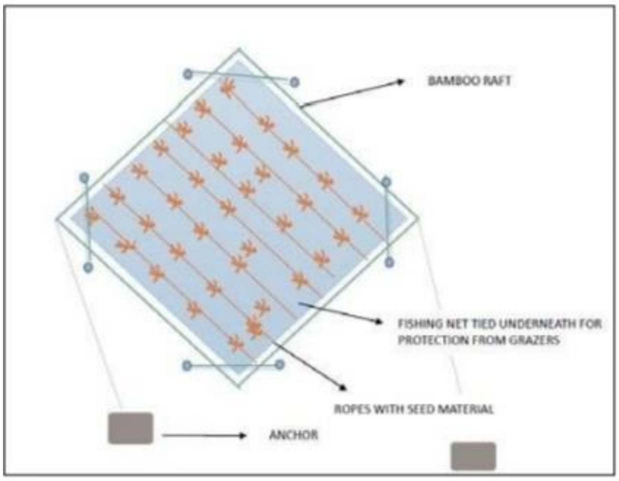
Raft preparations and installation

- Ideal raft size – 3 × 3 m (made bamboo poles having 7.5 to 10 cm diameter)
- Installations – rafts may be free floating or fixed.

Seed requirement – 50 - 60 kg/raft

Crop durations – 45 to 60 days

Yield – 250 kg/ raft



Tying Seedlings of Seaweed on a Bamboo Raft

Carbon Sequestration

83% of the global carbon cycle is circulated through the ocean. Coastal habitats cover less than 2% of the ocean area, but account for approximately half of the total carbon sequestered in the ocean sediments.

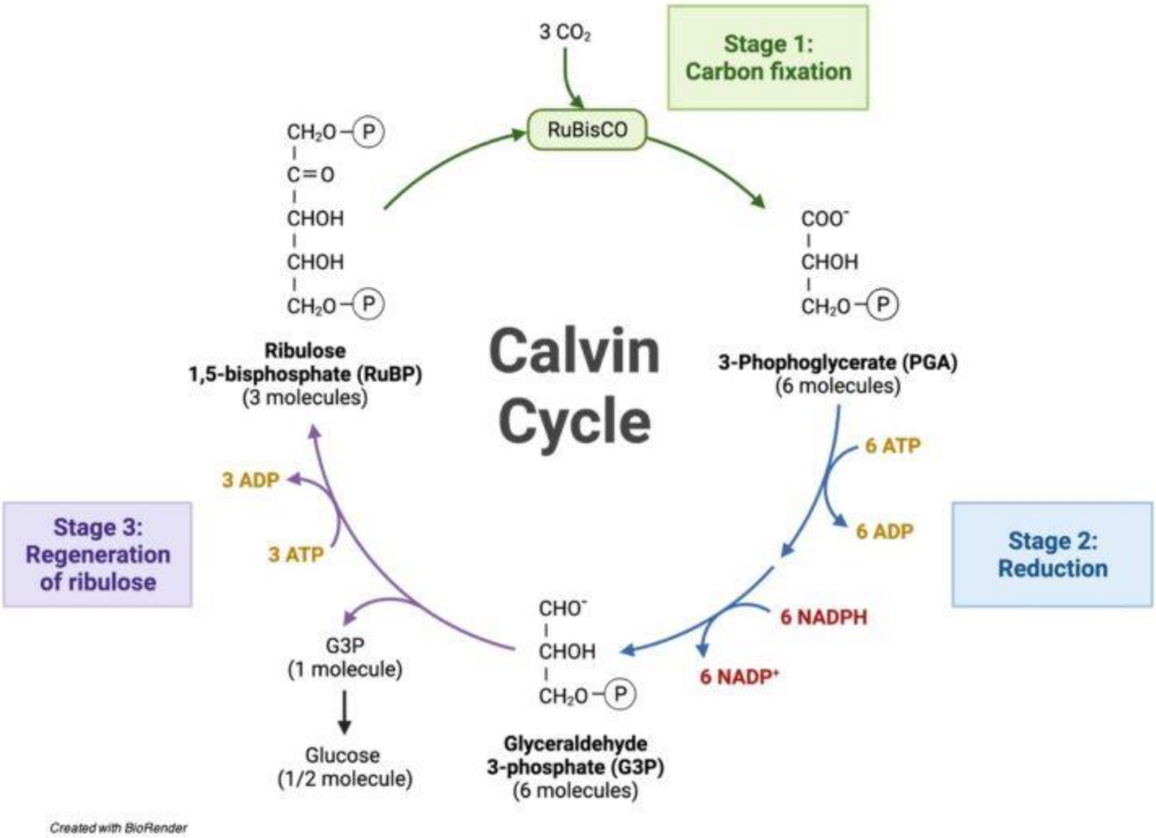
Efficiency of Carbon Sequestration by Seaweeds

- Rate of sequestrating dissolved CO2 @ 80.5mg/g wet wt./day.
- Rate of emission through respiration @ 10mg/g wet wt./day.
- Majority of brown and green seaweeds are capable of utilizing the respiratory emission of CO2 within the cells for photosynthesis.

Seaweed species	Efficiency to absorb CO2 (mg/g wet wt/ h)
***Gracilaria corticata* (red)**	1.60
***Sargassum polycystum* (brown)**	2.35
***Ulva lactuca* (green)**	4.10

Carbon Fixation in Seaweed Ecosystem

- Inorganic carbon is an essential nutrient for photosynthesis and in the ocean dissolved inorganic carbon (DIC) is available as carbon dioxide (CO_2) and bicarbonate (HCO_3).
- In natural seawater, at a pH of 8.0 (± 0.2) and 20°C, the concentration of HCO_3 - is ~2000 µM, and that of CO_2 is ~10 µM.
- With few exceptions, seaweeds utilize CO_2 for photosynthesis and a majority is additionally using HCO_3 - which is converted to CO_2 via at least three mechanisms.
- Within the seaweed cell, CO_2 is fixed by RuBisCO and used to build carbon-skeletons that form amino acids, polysaccharides, starch, reproductive material and cell walls.



Phases of Calvin Cycle

(i) Carboxylation: Atmospheric CO2 is fixed by a pentose sugar Ribulose – 1, 5 – Bisphosphate to form 2 molecules of 3 – Phosphoglycerate.

(ii) Reduction: The reaction involves the reduction of 3 – Phosphoglycerate is converted into Hexose sugar molecules when it enters gluconeogenesis.

(iii) Regeneration: The involved Ribulose – 1, 5 – Bisphosphate to regenerate which can be used for many products.

Mitigation And Adaptation of Climate Change

- Both wild and farmed seaweeds can contribute as carbon sinks by removing carbon directly from the water column and keeping it in their tissues. With this ability to store carbon for a longer term, seaweeds help to preserve climate change.
- Seaweed also helps lower the Green House Gases (GHGs) emissions from agriculture by increasing soil quality through replacement of synthetic fertilizer and also by lowering methane emissions from cattle when it is included in cattle feed.
- It also helps in climate change adaptation by breaking wave energy, defending shorelines and by increasing pH and providing oxygen to the waters, thus lowering the effects of the ocean acidification and de-oxygenation.

Socio-Economic Benefits of Coastal Communities

- Create employment opportunities in many coastal peoples.
- Generating additional income for fisherman's in the coastal areas.
- Relatively small investment and short harvesting period.
- High demand for local industries and export commodity.

Conclusion

Seaweeds are a vital part of coastal ecosystems, which offer indispensable ecosystem services as well as socio-economic value. However, to increase the seaweed aquaculture areas in the country by interested farmers and coastal communities, to sequester the carbon emission and mitigate climate change.

References

Bhuyan, M., Abid Husain, S., Chowdhury, E. and Bat, L., (2022) Assessment of Carbon Sequestration Capacity of Seaweed in Climate Change Mitigation. *Journal of Climate Change*, *8*(1), pp.1-8.

Rameshkumar, S. and Rajaram, R., (2019) Impact of seaweed farming on socio-economic development of a fishing community in Palk Bay, Southeast Coast of India. In *Coastal zone management* (pp. 501-513). Elsevier.

YANG, Y., LUO, H., WANG, Q., HE, Z. and LONG, A., (2021) Large-scale Cultivation of Seaweed is Effective Approach to Increase Marine Carbon Sequestration and Solve Coastal Environmental Problems. *Bulletin of Chinese Academy of Sciences (Chinese Version)*, *36*(3), pp.259-269.

Zacharia, P.U., Kaladharan, P. and Rojith, G., (2015) Seaweed farming as a climate resilient strategy for Indian coastal waters.

Zhang, Y., Zhang, J., Liang, Y., Li, H., Li, G., Chen, X., Zhao, P., Jiang, Z., Zou, D., Liu, X. and Liu, J., (2017) Carbon sequestration processes and mechanisms in coastal mariculture environments in China. *Science China Earth Sciences*, *60*, pp.2097-2107.

Zheng, Y., Jin, R., Zhang, X., Wang, Q. and Wu, J., (2019) The considerable environmental benefits of seaweed aquaculture in China. *Stochastic Environmental Research and Risk Assessment*, *33*(4), pp.1203-1221.