SEAWEED - A WAY TO MITIGATE CARBON EMISSION

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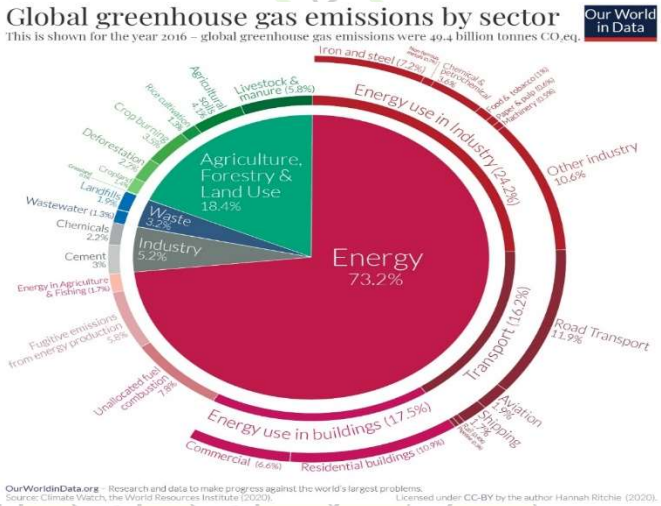
ABSTRACT

About 3.4 million square kilometres of our oceans are covered by seaweed. Seaweeds has the ability to grow up to 60cm each day. Mangroves and seagrass exist on rich soil and hence it contributes to carbon sequestration. When the plant die, a portion of their leaves, branches, roots, and stems were buried underwater in the soil, it remain for decades or longer before breaking down and releases carbon dioxide due to low oxygen concentrations in underwater. Hence, the carbon in the seaweed is safely hidden away for hundreds of years after it is submerged in deep waters or buried in sediments. As a consequence, scientists have suggested that like seaweed, other blue carbon storage sites like mangroves and wetlands are considered as an instrument to fight against climate change.

CARBONDIOXIDE EMISSION AND ITS SOURCE

Carbon dioxide has been shown to be a large contributor to air pollution, as well as a significant contributor to the greenhouse effect. The world emits around 50 billion tonnes of greenhouse gases each year *[measured in carbon dioxide equivalents (CO2eq)]*[1].The International Energy Agency has reported that the amount of Carbon dioxide has increased to a level of 36.3 billion tonnes, after a recovery from COVID-19 in 2021. The primary source of carbon dioxide emission to environment are through decomposition, respiration, weathering of carbonate rocks, burning of forests and fossil fuels. The carbon dioxide emitted from industries are Forestry, agriculture, Transportation has leads to an intensive effect on environment such as climate change, and respiratory diseases in humans and other living organisms.



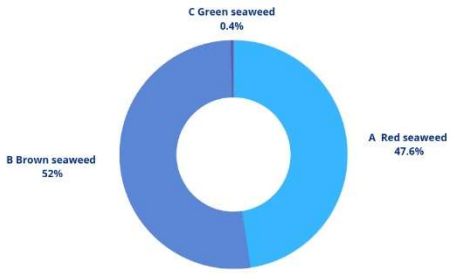
Source: https://ourworldindata.org/emissions-by-sector

SEAWEEDS AND ITS OCCURANCE: -

Seaweed is a group of marine plants and algae found in the ocean, rivers, lakes and other bodies of water. Photosynthesis is used by seaweed to convert carbon dioxide into seaweed biomass, just like terrestrial plants. It is expected to store roughly around 175 million tonnes of carbon per year in other words 10%of all global car emission. Once the carbon dioxide has been locked up in seaweed biomass, it can be either harvested for use or sink allowed to seafloor ,or

underground. Coastal ecosystems stores a surprising amount of carbon, upto 20 times than that of per acre of land forests .Seaweeds are broadly classified into three taxonomic groups: Brown seaweeds (around 2 000 species under Phaeophyceae), Red seaweeds (over 7 200 species under Rhodophyta) and Green seaweeds (more than 1 800 macroalgae species under Chlorophyta).

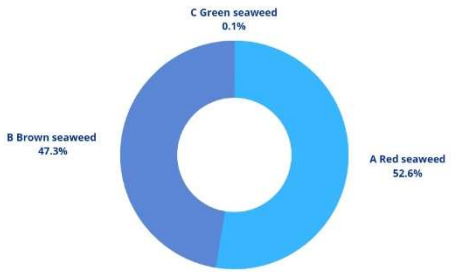
In 1969, 2.2 million tonnes of world seaweed production was evenly divided between wild collection and cultivation. A half century later, i.e in 2019, the wild collection remained at 1.1 million tonnes and cultivation has increased to 35.8 million tonnes which accounted for 97%of the world seaweed production. Seaweed shares a strong regional imbalance in its production. In 2019, the production from Asia was around 99.1 percent from cultivation which contributes 97.4 percent of total world production. It ranks seventh of the top ten seaweed producing countries. Whereas America and Europe contributed around 1.4 percent and 0.8 percent respectively. Seaweed production in these two regions was primarily fulfilled from wild collection (4.7%) and through cultivation (3.8%) respectively. In 2019, brown seaweeds accounted for 47.3 percent of total world seaweed cultivation in terms of tonnage and 52 percent in terms of value. In Brown seaweed, cultivation is concentrated on two main cold-water genera: namely *Laminaria/Saccharina* (also known as kelp) and *Undaria* (also known as wakame. Red seaweeds accounted for 52.6 percent of the total world seaweed cultivation in terms of tonnage and 47.6 percent in terms of value. In Red seaweed, cultivation is concentrated on two warm-water genera such as (*Kappaphycus*/ *Eucheuma and Gracilaria)* and one cold-water genus (*Porphyra*, also known as nori) and the remaining percentage was contributed by green seaweeds.



Seaweed production (In terms of value)

Source:-Food and Agriculture Organization of the United Nations ,2018.

The main five genera accounted for more than 95% of world seaweed production



Seaweed production(In terms of tonnage)

includes *Laminaria/saccharina* (35.4%), *Kappaphycus Euchema* (33.5%), *Gracilaria* (10.5%), *Porphyra/pyropia* (8.6%) and *Undaria* (7.4%). Macroalgae provides various environmental benefits and ecosystem services, such as control over Eutrophication, Mitigation, Carbon capture, Ocean acidification,

Amelioration, Habitat provision and Shoreline protection.

CARBON SEQUESTRATION: -

It is a method of absorbing and storing atmospheric carbon dioxide. . It is one of the way to lowering carbon dioxide level in the atmosphere thereby it reduces global warming. The main goal is to prevent carbon from warming the atmosphere by stabilising it in both solid and dissolved forms. This method has a great potential in lowering the "carbon footprint" of the people. Geological and biological sequestration are the two basic methods of carbon sequestration.

Biological sequestration

In biological sequestration carbon dioxide is stored in vegetation, such as grasslands, forests as well as in soil and ocean.

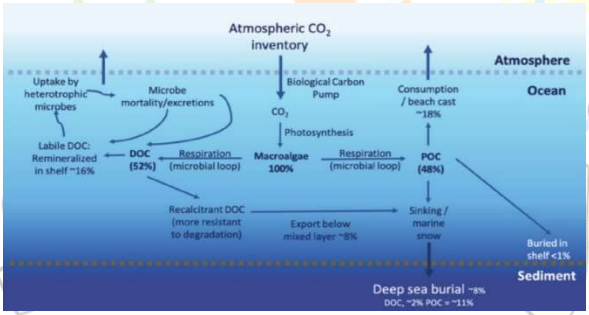
Geological sequestration

It is a process of burying carbon dioxide in subsurface geologic formations, such as rocks. Typically, carbon dioxide is extracted from an energy-related source, such as a power plant or a natural gas processing facility, or an industrial source, such as the production of steel or cement, and then injected into porous rocks for long-term storage. Until a new energy source is widely adopted, carbon capture and storage can enable the usage of fossil fuels.

ROLE OF SEAWEED IN CARBON SEQUESTRATION

Most carbon in the oceans exists in inorganic forms (>2000 µmol/kg seawater), with organic carbon constituting 35–150 µmol/kg of seawater. The biological carbon pump fixes carbon into biomass through photosynthesis, which is turn transferred by sinking through the water column to deep ocean. Organic carbon sequesters once it passed the 'sequestration flux' at a depth of 1000 m. In contrast, much of the labile fraction of the DOC is rapidly remineralised to Carbon dioxide through net respiratory metabolism within the microbial loop and is ultimately returned to the atmospheric carbon inventory; however, a proportion is repackaged as microbial biomass and eventually exported to depth as microbial POC (Particulate organic carbon). The more recalcitrant DOC (Dissolved organic carbon) fraction, is used by microbial mixotrophs and heterotrophs, and it is exported to depth. The efficiency of the ocean biological carbon pump is based on a balance between carbon fixation and remineralisation. When remineralisation occurs at a faster rate, POC is being transported in fewer amounts to the depth and thus less being buried for a long-term storage. As the oceans warm, the remineralisation depth is predicted to increase (thereby the sequestration flux depth will increase), which will reduce the overall sequestration capacity; indeed, a deepening in the order of only a few tens of meters can account for ~10–30 ppm changes in the atmospheric Carbondioxide concentrations. Where these detrital carbon sources are exported to depth (and ultimately assimilated within stable sedimentarystores), this is deemed to constitute long-term carbon storage as remineralisation rates are considerably reduced due to the lower temperatures and oxygen levels. Recent work had estimated that 153 Tg C yr−1 (0.153 Gt) of macroalgae carbon is sequestered in deep sea sediments, with 14 Tg C yr−1 (0.014 Gt) buried in shelf sediments and a further 6.2 Tg C yr−1 (0.0062 Gt) buried from macroalgae growing in soft sediments. These

estimates exceed the combined total carbon burial of seagrasses, mangroves and salt marshes although there are significant variations between species and regions; thus, global estimates are difficult to quantify and must be treated conservatively. Tomeet the 1.5ºC limit of global temperature rise, it has been estimated that we need to remove between 640 and 950GtCO2 from the atmosphere by 2100 (approximating to8–12 GtCO2 per annum). The capacity for macroalgae to help enable this (0.1732 Gt yr−1, or between 1.44% and2.17% of the annualised target) should not be dismissed, for example due to growing attached to rock rather than in sediment, or indeed our capacity to scale up biomass production through aquaculture; equally, nor should it be flippantly overblown.



Source: - The potential of seaweed for carbon capture, 2022.

CONCLUSION

Seaweed provides a variety of functions and are considered as an important part of our coastal communities. Seaweed aquaculture has the ability to mitigate the negative effects of climate change in local level by absorbing the carbon, reducing the agricultural greenhouse gas emission and protects the coastal lines from erosion. These impacts will last as per the usage of farmed and wild seaweed

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