Seaweed Farming: A Promising Climate Restoration Solution

Restoring our climate will require pulling a trillion tons of legacy carbon dioxide from the atmosphere by 2050. Farming seaweed, mainly fast-growing kelp and sargassum, can help achieve climate restoration.

Seaweed takes up CO_2 through photosynthesis at breakneck speed. Giant kelp grows up to two feet a day; underwater kelp forests can pull 15% more CO_2 from the air per acre than a rainforest. When kelp sinks, it sequesters its biocarbon for centuries or millennia since it doesn't rot or burn like plants on land.

Due to high capital costs, though, seaweed farming is considered Plan C for climate restoration. Ocean iron fertilization (OIF), Plan A, is what nature uses to remove a trillion tons of CO_2 leading up to an ice ages: increased mineral dust blows off the land, fertilizing and restoring phytoplankton–the base of the marine food web– in ocean "pastures." Intentional OIF requires minimal investment and pays for itself through restored fisheries.

Seaweed cultivation is related to OIF but grows large seaweed species instead of single-celled phytoplankton. It can be seen as a climate restoration alternative in case political barriers related to OIF don't resolve.

Per ton of CO_2 removed, investment needed for kelp farming is 2,000 times higher than for OIF. Synthetic limestone, Plan B, requires an investment 100 times more than OIF.

Marine Permaculture®: The new seaweed mariculture

The Marine Permaculture Array, designed and implemented by the Climate Foundation, is designed to revive kelp forests at the coast and also grow them in the open ocean, where they can scale virtually without limit.

At the scale of a hectare, Marine Permaculture Arrays are expected to provide food and jobs for an entire community. Investment of $12 million could fund six hectare-sized permaculture arrays, with payback expected in 3-5 years. The vision is to process half the kelp into commercial products, perhaps in a floating bioprocessing plant, and sink the rest for long-term carbon sequestration.

Millions of these arrays could be built and launched in order to remove as much CO_2 per year as is needed.

For now, the path for fastest growth of this climate restoration pathway is to replace fossil fuel as a feedstock. Every ton of feedstock sold effectively replaces about a ton of fossil fuel

Sargassum: Getting it off the beaches and ranching it in open waters

While kelp is flagging in the wild, its relative sargassum is running riot from the Gulf of Mexico to West Africa, smothering wildlife under thick mats, clogging inlets, and coating beaches with methane-emitting rotting yellow seaweed. Some Caribbean islands report that tourism dropped up to 30% after sargassum ballooned in 2011.

Sargassum-based industry could revitalize stressed economies throughout the Caribbean and beyond. It can create jobs for collecting, processing, and shipping the seaweed, while also reviving local tourism. The lead company, CarbonWave, is planning a network of locally-owned franchises throughout coastal Mexico and the Caribbean.

Like kelp, sargassum can be processed into biofuel, bioplastics, and a wide range of consumer products including vegan leather. As the industry is established, some of the sargassum or its constituents would also be sunk for permanent carbon sequestration. To achieve gigaton carbon-removal scale, Carbonwave is partnering with startup Seafields.

The aim is to grow more sargassum, but in the open ocean –"ranching" it inside a floating pen far away from any shoreline.

Benefits and side-effects

The side-effects of seaweed-based climate restoration are the benefits. It can

- Revive fisheries
- Provide food and jobs
- Replace petroleum as a feedstock for bioplastic, biofuel, other products
- Produce methane-limiting feed for cows, reduce antibiotics for poultry
- Remove seaweed from beaches, restoring tourism. Most seaweed farming and ranching will take place on the open ocean, away from the shoreline. In case of unforeseen side-effects, it can be rapidly halted

What is needed now?

Mostly investment to grow the industry, especially its processing plants and distribution.

Reclaiming a Pre-Industrial Climate by 2050

Everyone wants to restore a safe climate, one that humans have actually survived and thrived in long-term, with CO2 levels below 300 ppm.

Reaching a safe climate will require pulling a trillion tons of legacy carbon from the atmosphere by 2050. We can do this by copying nature. Nature pulls massive amounts of CO2 from the atmosphere by two major pathways: Boosting photosynthesis, particularly in the ocean; and forming limestone from the calcium carbonate shells of sea animals.

Contact: Peter Fiekowsky, pfieko@gmail.com; Carole Douglis, cdouglis@gmail.com