MARINE CONSERVATION SOCIETY

MCS Position on UK Seaweed (Macro Algae) Aquaculture and Harvest

Dawn Purchase
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Overview

In 2020, 36 million tonnes of seaweed (macro algae) were produced globally, with 97% produced from aquaculture, predominantly marine.[1] This is an impressive growth trend, as total production in the year 2000 was just 12 million tonnes. Asia produces 97% of algae, with China dominating at 58% of production, followed by Indonesia (27%).

In Europe, most seaweed is from wild harvest (98% in 2016[2]). However, interest and investment in seaweed aquaculture is growing, as markets and opportunities emerge in the areas of animal feeds; human consumption; aquaculture diets; biochemical use and bioenergy, as well as regenerative aquaculture.

In the UK, the totals for harvesting, locations, scale, and extent of seaweed production are currently unknown.[3] It is thought that methods of seaweed production across the UK comprise 69% from wild harvest, 10% from aquaculture, 3% from a combination of wild harvest and aquaculture, and 18% was not specified.[4] However in 2013, it is estimated that 2000-3000 dry tonnes (equivalent to 25,000–40,000 t wet weight) of seaweed are harvested per year in the UK to produce food and feed products as well as speciality chemicals and fertilisers.[5]

Contents

Opportunities for seaweed aquaculture development in the UK

There is an opportunity for UK seaweed aquaculture development. However, to unlock its potential there are a number of barriers to be overcome. **An enabling regulatory framework, licensing and a planning system is required before development can be considered. This must ensure surrounding biodiversity is protected and safeguarded.** In addition, infrastructure, processing facilities and market development are all required if this sector is to be established.

Expansion of seaweed farming could have positive impacts on food security goals, socio economics, ecosystem management and climate change mitigation. Seaweed farming is gaining increasing attention to be promoted and monitored for climate and environmentally friendly bio economy development.[6]

There are a growing number of commercial farms in the UK, in addition to pilot farms for research and development. Several seaweed companies are also currently applying for marine licences to begin commercial seaweed farming in the UK or shifting from wild harvesting to farming.[7]

A recent study carried out for Crown Estate Scotland[8] included two scenarios for seaweed aquaculture in Scotland– one for business as usual, the other for high growth in the seaweed sector. The high growth scenario illustrated a seaweed cultivation industry worth £4 million by 2040 with associated employment opportunities in remote areas.

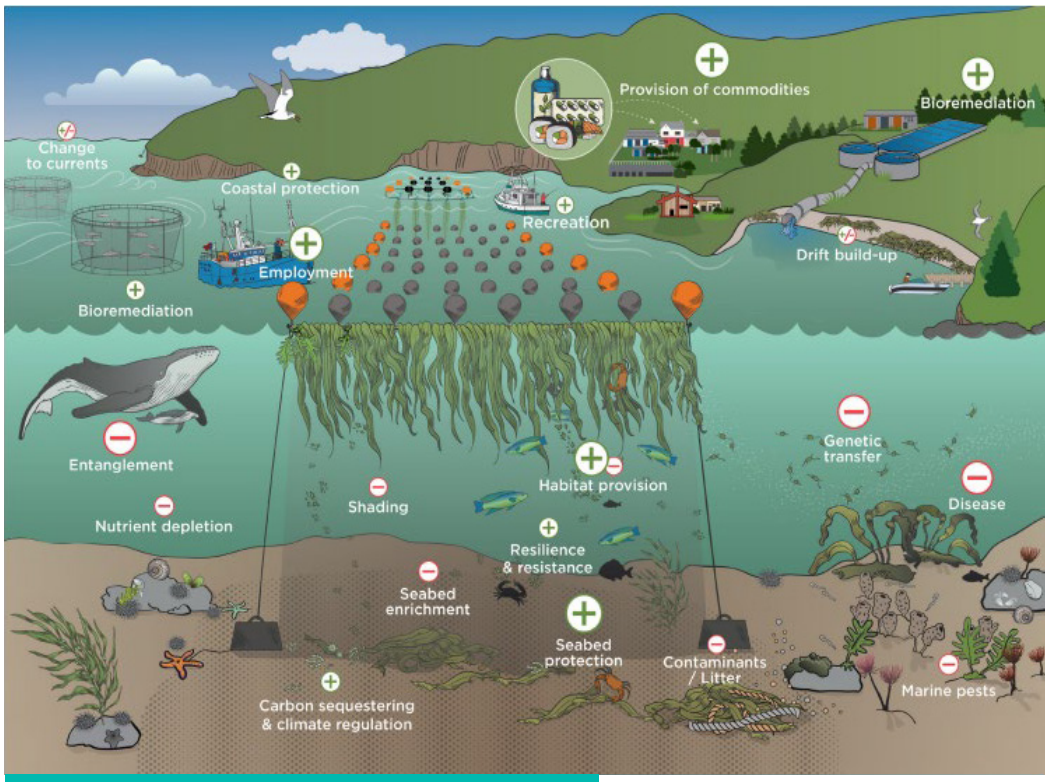

Figure 1 The positive and negative impacts of a seaweed cultivation system. Yong, et al 2022[9]

Integrated Multi-Tropic Aquaculture (IMTA)

IMTA refers to the practice of growing different species, such as finfish, shellfish and seaweed next to each other. It is a more ecosystem-based approach to aquaculture than the single species system, as the combination of finfish (source of nutrients and waste), and shellfish (organic extractive species) and seaweed (inorganic extractive species) are complementary.

Although theoretically possible, it has never really gotten underway in the UK. More research is needed to identify suitable species and space for this type of system. It is also worth noting the volume of seaweed required to offset the nutrient load:

> *In terms of sequestering 10% (as a nominal value) of the nitrogen from a 1,000-tonne salmon farm, this would require approximately 10 to 13 ha of seaweed cultivation.*[10]

Rewilding aquaculture

Rewilding or restorative aquaculture refers to the practice of farming species for purpose of providing ecosystem services rather than as an economic venture. An example of this would be the Sussex Kelp Restoration Project which aims to restore 200 km2 of the once-abundant kelp forest along the Sussex coastline using kelp farming techniques. If successful, the project could:

- increase seabed diversity,
- create new habitat and nursery grounds particularly of bass, black seabream, and cuttlefish,
- potentially help with the regeneration of natural oyster beds,
- help create a better food web structure,
- offer increased protection, and
- sequester carbon[11]

Carbon Sequestration

The potential for cultivated seaweed to be used as a mechanism for sequestering carbon has yet to be fully understood and quantified. Although seaweed can sequester carbon through the burial of detritus, which is stored within certain areas of the seabed called blue carbon pools, the quantity and effectiveness of this is unknown. The carbon filled seaweed detritus needs to be transported to soft sediment for burial and subsequent carbon storage. The process of cultivating seaweed offshore for the purposes of carbon sequestration is called "ocean afforestation". In theory, ocean afforestation could provide a large contribution to carbon sequestration[12], but concerns regarding the ethics and science behind this method cast doubts.[13]

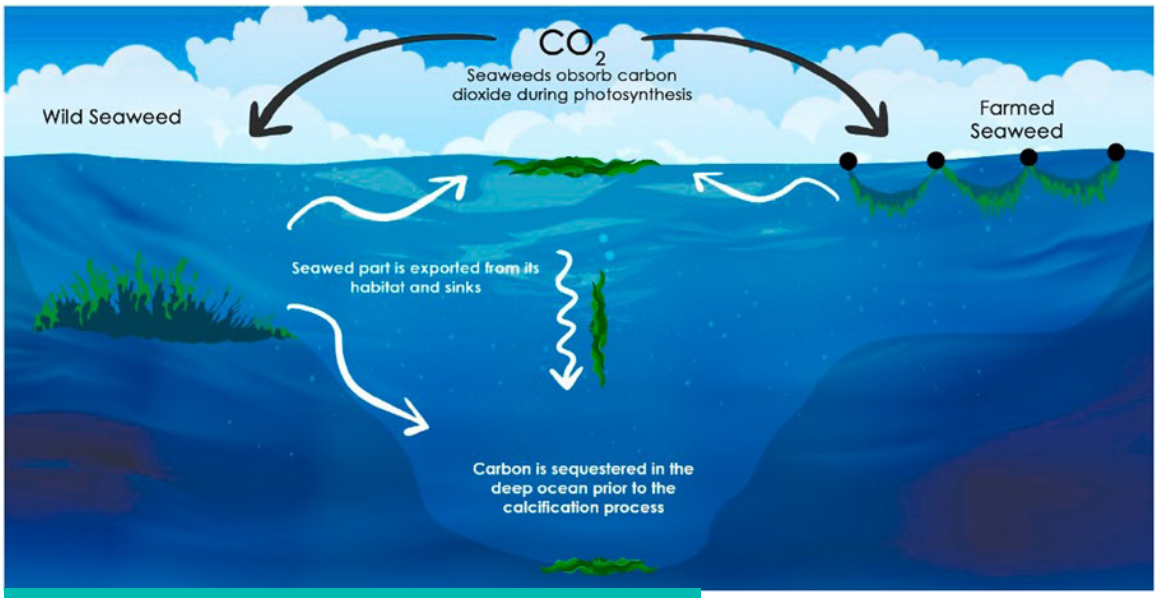

Figure 2 The role of wild and farmed seaweed in carbon sequestration and storage in deep ocean surfaces[14]

Nutrient Sequestration

Seaweeds can play an important role in removing nutrients from the water column. Nutrients such as ammonia, nitrate, phosphorus and nitrogen, found in agricultural, industrial and sewage water discharge, can all be utilised by seaweed. Seaweed culture could be used as a bioremediation tool to assist with preventing eutrophication and subsequent harmful algal blooms, as well as improving water quality.[15,16]

Colocation

The 2050 target for the UK is to achieve net zero emissions. In an October 2020 press release[17], the UK Government confirmed offshore wind would produce more than enough electricity to power every home in the country by 2030, based on current electricity usage. This would boost the government's previous 30GW target to 40GW. This could contribute to a reduction in carbon emissions, combating climate change and helping to secure the UK energy supply. One of the opportunities for offshore aquaculture is the colocation with existing structures such as offshore wind turbines, as this could ease the competition for space experienced in coastal waters. Seaweed is one species that could be grown in conjunction with offshore wind farms.

Environmental Impact of Seaweed Culture

Despite seaweed aquaculture being viewed as an environmentally friendly form of aquaculture, there are a number of environmental concerns that need to be addressed before this sector can grow and develop.

Equipment loss

As with other forms of aquaculture (finfish and shellfish) the loss or discarding of equipment, such as ropes, lines and floats, can increase the amount of marine debris in our seas and contribute to plastic pollution.

Habitat impacts

Mooring structures could impact the seabed, particularly in sensitive habitats. Benthic shading, particularly over shading sensitive species such as maerl and seagrass should be identified and avoided during the planning and licensing stage of the application.

Nutrient depletion

Whilst seaweeds can carry out valuable nutrient sequestration as an ecosystem service in areas of high anthropogenic activity, there is a risk that local nutrient depletion may occur in other areas. This could impact the area's natural productivity, therefore the carrying capacity of the local area should always be considered.

Entanglement and Obstacles

Entanglement of cetaceans in subsurface mooring lines and fishing gears is a concern in a number of aquaculture installations (see figure 1).

Large scale installations, both inshore and offshore can act as an obstacle to migratory species, such as minke whales, porpoises and other cetaceans, seals, and marine fish.[18]

Genetic diversity and Non-native species

Genetic integrity of wild stocks should be ensured when undertaking seaweed cultivation. Seed stock should be collected from locally occurring wild stock as opposed to cultivated stock.[19] Non-native species should not be cultivated, as to do so risks the introduction of an invasive species into the area, leading to ecological damage, biodiversity impacts and economic loss.

Planning and Development

EIA

An Environmental Impact Assessment (EIA) should be carried out prior to development to ensure that adverse impacts on sensitive habitats and species are avoided. This should include a benthic survey to ensure that impacts of seaweed culture, such as shading and altered hydrodynamics are mitigated.

Code of Practice

An audited code of practice should be in place to ensure the industry develops and operates in a responsible way. This code should ensure that correct location and planning are in place, and include, but not be limited to, environmental, social, health and safety, reporting and food safety.

Knowledge and Research

Information on the potential environmental effects that seaweed farming could have in European waters is lacking. This issue could be solved by supporting pilot/demonstration facilities which would provide necessary data on ecological impacts, operation costs, and yields. This would provide valuable data to inform commercial seaweed farm development.

Seaweed Wild Harvesting

In 2022, seaweed harvesting in the UK was been roughly estimated to be is around 15 thousand tonnes per year (wet weight).[20] The majority of seaweed harvesting is small-scale, gathering by hand cutting or collecting beach cast. The only medium to large scale operation (2,000 tonnes to over 10,000 tonnes) is for the harvesting of rockweed/wrack (Ascophyllum nodosum), which is harvested either by hand or by using small, specialised cutting boats in the Outer Hebrides.[21] There are smaller operations in Scotland. For further information refer to Scottish Government's Seaweed Harvesting and Cultivation fact sheet - https://marine.gov.scot/sma/sites/default/files/sma2020_-_seaweed_harvesting_and_cultivation_-_production.pdf.

There has been a growth in kelp harvesting, with the alginates they contain used in food production, pharmaceuticals, textiles, paper and biotechnology. It is estimated that the kelp growing around the coast of Scotland alone covers 2,155 km2 and stores 1.73 million tonnes of carbon in its biomass, making it another, potentially significant, blue carbon store.[22]

Environmental Impacts

Stock Assessments

There is no stock assessment data for seaweed in the UK. There are estimations for commercial kelps[23] but no data which would allow for the sustainable harvest of seaweed within a quota system. As such, the concern is that overharvest and local depletion could occur.

Species Impacts

Large scale commercial harvest of seaweeds can have adverse impacts on vulnerable species. Removal of kelp forests affects fish abundance, such as small gadoids, and seabird foraging behaviour notably cormorants.[24,25]

Harvest methods

One of the major environmental concerns of seaweed harvesting is the method by which it done. Hand cutting from the foreshore can ensure that only fronds are harvested and leaves the holdfast for continued growth.

Gathering cast or drift seaweed from the shoreline, particularly when using mechanical methods, such as digger or tractor, removes valuable habitats for shoreline species like sandhoppers. This is mainly carried out for environmental or beach cleaning reasons.

Mechanical cutting uses boats to cut or mow floating seaweed stalks above the seabed.

Marine Conservation Society asks

UK and Devolved Government Administrations

Seaweed Aquaculture

- To develop seaweed specific regulation to ensure ecological interactions are understood, and development of this sector is consistent with an ecosystem based approach.
- Research the potential for seaweed aquaculture to provide ecosystem services, such as nutrient sequestration in areas of high anthropogenic run off and areas adjacent to finfish farms.
- Research the potential for seaweed aquaculture to mitigate coastal erosion by reducing inshore wave energy.
- Support investment in demonstration facilities to provide necessary data on ecological impacts, operation costs, and possible yields.
- Increase clarity in the licensing process.
- Ensure a comprehensive environmental impact assessment is undertaken before licenses are granted.
- Ensure that seaweed aquaculture is part of a fully integrated spatial planning regime.
- Research the potential of, and barriers to, seaweed produce in human and animal feeds, including finfish.

Seaweed Harvest

- To develop a stock assessment for wild seaweed used for commercial purposes, to inform harvest limits.
- To bring into regulation a Code of Best Practice for seaweed harvesting

UK Seaweed Aquaculture Sector

- Contribute data and experience to aid the development of a Code of Good Practice for Seaweed Aquaculture and Harvest.
- Adhere to the Code of Good Practice once developed.
- Share pre-competitive data regarding environmental interactions, operations, locations and performance to ensure the industry develops in an environmentally responsible way.

What Marine Conservation Society is doing

- We are working with UK Government and Devolved Administrations to advocate for best environmental practice and providing support for innovation and research into seaweed aquaculture development.
- We are working collaboratively to develop a Code of Good Environmental Practice for the development and operation of the seaweed culture and harvesting sectors.
- We are developing a risk assessment tool to identify best practice in seaweed procurement for the supply chain.

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