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1s4 Towards circular marine food production | Sustainable mariculture

SUITABILITY OF WORLD SEAS AND OCEANS FOR SEAWEED CULTIVATION

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70% Of Earth's surface is covered with oceans. Their contribution to world food production is limited. Seaweeds currently contribute less than marginally to world food production. Much uncertainty and speculation exists on whether food production by seaweeds can be boosted to future significant levels. Here we present a quantitative exploration of production potential for seaweed cultivation. The model runs at a global scale, monthly timestep, with 1o (100x100km) spatial resolution. Biophysical site suitability is modelled taking into account environmental variables: ocean temperature, salinity, irradiation, nitrate concentration, phosphate concentration and wave height. Monthly site suitability is modelled on a scale from 0 to 1 (unsuitable to perfectly suitable). Presuming a minimum site suitability of 0.5 during a period of at least 6 months of the year we present maps of global site suitability.

Seaweeds use the same nutrient resources as phytoplankton, the base of the marine food web. A potential ecological concern with future large scale seaweed cultivation is that if competition is too strong, reductions in phytoplankton growth could lead to collapse of the marine ecosystem. To accommodate these concerns, potential production calculations were constrained, allowing only the sites with high nutrient concentrations to be cultivated and allowing only 1% of each gridcell (pixel) area to be cultivated.

Economic concerns limit potential sites to sites not too far offshore, but also not too close to the shore. Sites too far of shore are unprofitable because production costs (for harvesting and planting operations) increase with distance from shore. Too close to shore one finds the coastal zone is often also used intensively by other sectors (tourism, transport, fisheries). Biophysical potential was mapped for the whole world, and subsequently calculations of production potential were limited to the Exclusive Economic Zone (EEZ), a zone of 200 nautical miles (360km) out of shore. Sites close to shore are automatically excluded because the dataset provides poor coverage of these sites.

We explicitly consider the pathway from the current state to a possible future state of the seaweed sector. Agriculture on land is more than 10000 years old. Seaweed cultivation is currently still in it's infancy. Expecting production increases at rates higher than witnessed on land during the green revolution also seems unrealistic. A more realistic

approach is extrapolating from historical seaweed production trends. We present scenarios of what could maximally be produced in the year 2050.

Keywords: Seaweed, site suitability, production, model, world ocean atlas