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Targeted seaweed co-cultures to mitigate acidification

Policy Brief

Executive Summary

The ocean is becoming more acidic due to increasing levels of carbon dioxide in the environment cause by climate change. Acidic oceans have caused detrimental economic and productivity losses in calcifying aquaculture farms such as mussels, oysters, and clams [1]. Seaweed co-cultures involve planting seaweed beds near existing marine aquaculture and have been shown to raise the pH of surrounding seawater to create a haven for calcification for shellfish aquaculture. Real-life case studies are lacking; however, seaweed co-cultures may prove to be a viable solution to mitigating ocean acidification for aquaculture.

Mussel and seaweed co-culture in Chilé (Photo credit: Fernandez et al. 2019)

Why is ocean acidification a problem for marine aquaculture?

Baby oysters struggling to build their shell in acidic waters (Photo credit: Kuow. org/Ruby de Luna)

Ocean acidification is a threat to the sustainability of marine aquaculture. Due to climate change, the concentration of dissolved carbon in the ocean is rising. Carbon in the ocean reacts with seawater to lower ocean pH, making the ocean more acidic, and decreasing the amount of carbonate ions in the ocean. Acidification poses a risk to all marine animals, but the primary concern is calcifying organisms such as oysters, mussels, and corals, as they rely on carbonate to form their exterior shells. Ocean acidification has resulted in massive economic and productivity losses in shellfish aquaculture farms across the world [1].

How do seaweed co-cultures alleviate ocean acidification?

Seaweed co-cultures may be a possible solution to mitigate ocean acidification in shellfish aquaculture farms. A seaweed co-culture involves the planting of seaweed beds in close proximity to marine aquaculture. Through photosynthesis, seaweed beds are able to mitigate ocean acidification by converting excess carbon dioxide to oxygen, thereby buffering the pH and restoring the amount of carbonate ions in surrounding waters. For example, if this technique is applied to mussels, incoming acidic seawater would first pass through the photosynthetic seaweed and be buffered before reaching the shellfish, thereby alleviating the harmful effects of acidic seawater on the mussels. Research in the lab prove seaweed to be effective in raising ocean pH in surrounding waters as well as raising the concentration of available carbonate ions [2-4], thus creating a nursery ground for calcification for shellfish and coral. However, real-life application studies in aquaculture farms have not been performed.

Cost-Benefit Analysis

Benefits

- Raises the pH of local waters and alleviate the pressures of ocean acidification to increase productivity and revenue
- Help regulate other environmental stresses by storing carbon and excess nutrients from run-off
- A crop that has market value for food and pharmaceuticals
- Not expensive to implement and manage
- Not vulnerable to toxins, ocean acidification, or global warming

Costs

- Could compete with other crops for sunlight and nutrients
- Needs a substantial amount of space to grow
- Would occupy space otherwise could have been used for crops
- Can attract predators that want to feed on the seaweed
- Not all seaweed is suitable to mitigate ocean acidification

Aspects of a successful seaweed co-culture

Uses a variety of seaweed and kelp species

High biomass of seaweed

Uses non-calcifying seaweed

Recommendations

- Educate aquaculture farmers on the benefits and how to set up a successful seaweed co-culture
- Implement in farms that are most affected by ocean acidification
- Consistent monitoring of ocean pH to access the status of the farm and capability of seaweed co-cultures to mitigate ocean acidification.

Sources:

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[3] Krause-Jensen, D., Marbà, N., Sanz-Martin, M., Hendriks, I. E., Thyrring, J., Carstensen, J., ... & Duarte, C. M. (2016). Long photoperiods sustain high pH in Arctic kelp forests. Science Advances, 2(12), e1501938.

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