# GROWING SEAWEED | *Testing the Economic Feasibility of Seaweed Aquaculture in Southern California*

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BRENSCHOOL UC SANTA BARBARA

## Overview of Seaweed Aquaculture

***Farmed seaweed*** comprises a quarter of all aquaculture produced annually by weight. This is a $6 billion industry, with the majority of seaweed used for human consumption. Demand for seaweed products in the US has increased by 65% from 1999 to 2008. In the US, seaweed production is limited largely to wild harvesters meaning domestic production is small.

***Wide-scale cultivation of seaweed domestically could reduce the environmental and health concerns of imported seaweed products.***

***Increasing imports*** comes with a few concerns:

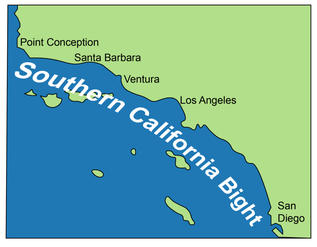
**Increased carbon footprint** due to transportation, electricity use for storage, packaging, and operations

**Lower environmental standards** for cultivation (ie. managing fertilizer input) leading to benthic damage and water pollution

## Our Approach

***Why Southern California?***

1. **The Southern California Bight** has been identified as a suitable region for seaweed cultivation due to the nutrient-rich waters from upwelling every spring.
2. **The environmental and health-conscious food market** in southern California also make local seaweed an untapped product with large potential.




***Why is it not happening?***

There is limited experience and knowledge of costs for seaweed cultivation of native California species. Our research aims to remove knowledge gaps on suitable local species, cultivation, production potential, as well as total costs for operating a seaweed farm.

Below are the steps we took:

### Select candidate seaweed species and growing method

***Candidate Criteria***
- Has existing food market
- Native throughout Bight
- Commercially cultivated

***Data Collected***
- Food use
- Species cultivation
- Optimal growing period

### Create a bioeconomic model to assess each species-farm system

Estimate farm costs and seaweed production to calculate net-present value of farm operations and the break-even price ($/kg) required for a 5-year payback period.

### Identify factors influencing economic feasibility & available markets

Investigate which farm costs have the highest contribution to model outcomes for both onshore and offshore systems and explore available markets for each species-farm system.

## Four candidate seaweed species

### Sea Lettuce

*Ulva Lactuca*

**Food Use**
Soup, seaweed salad

**Cultivation**
Offshore nets, onshore tanks

**Optimal Growing Period**
Spring to Fall

### Nori

*Pyropia perforata*

**Food Use**
Sushi, snack food, soup, noodles, sauces

**Cultivation**
Offshore nets, onshore tanks

**Optimal Growing Period**
Winter to Spring

### Kombu

*Laminaria setchellii*

**Food Use**
Soup, sushi, pickles, rice seasoning

**Cultivation**
Offshore longlines, onshore tanks

**Optimal Growing Period**
Fall to Spring

### Ogo

*Gracilaria pacifica*

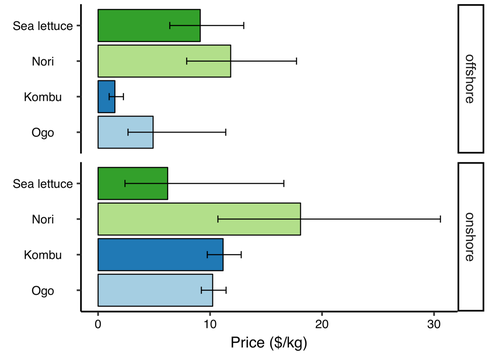
**Food Use**
Poke bowl topping, seaweed salad

**Cultivation**
Offshore longlines, onshore tanks

**Optimal Growing Period**
Spring to Summer

## At what price do you break even?

Break-even prices were determined from estimates of cost ($), production (tons), and market price ($/kg) for each species-farm scenario. Some average production values (e.g. nori) were derived from a wide range of reported growth rates and farm yield. Offshore seaweed production was indirectly related to the break-even price with kombu and ogo having the highest mean annual yields – 180 and 52 tons respectively. To produce the same annual yield in an onshore farm, break-even costs have to be significantly higher, except in the case of sea lettuce.

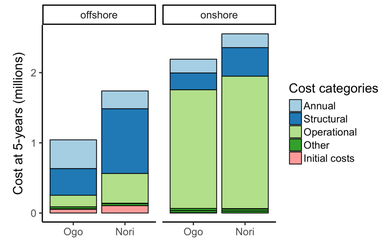



***Offshore systems on average were more feasible, but riskier due to storms. Onshore systems had higher capital requirements, but are easier to control.***

***Key Takeaways***

1. **Offshore system:** Seaweed production had the greatest impact on break-even price.
2. **Onshore system:** Cost, growth rate, and cultivation period influenced variability.
3. **Onshore versus offshore:** the mean break-even price is lower for offshore ($6.84/kg) than onshore ($11.42/kg).

## Cost contribution & market accessibility

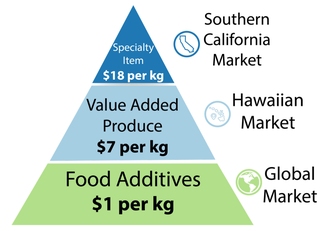



**Operational costs** include labor, gas, electricity fees from pumping water onshore, and transportation of product. **Structural costs** vary based on the farm size and includes upfront structural costs of longlines & nets, buoys, and tanks.

***Operational costs and structural farm costs had the largest contribution for both onshore and offshore farms.***

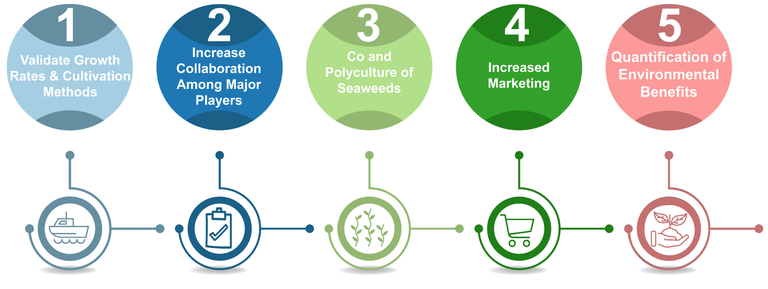
**Exploring Available Markets**

Current prices for three different edible seaweed markets were estimated from California, Hawaii, and global data. The estimated break-even price range of $6-12/kg from our model indicates that local seaweed should be sold as a specialty or value-added product.




## Next Steps

**Overview of Findings**
- Candidate species: ogo, kombu, nori, and sea lettuce
- Feasibility for onshore and offshore systems depend on productivity, risk, and operating or capital costs
- Local seaweed should target the value-added produce market, which averages $7/kg

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**For further information see** sbmussels.weebly.com

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