CONCLUDING REMARKS

Overview of Findings

Wide-scale cultivation of seaweed locally could reduce the environmental concerns of imported seaweed products.

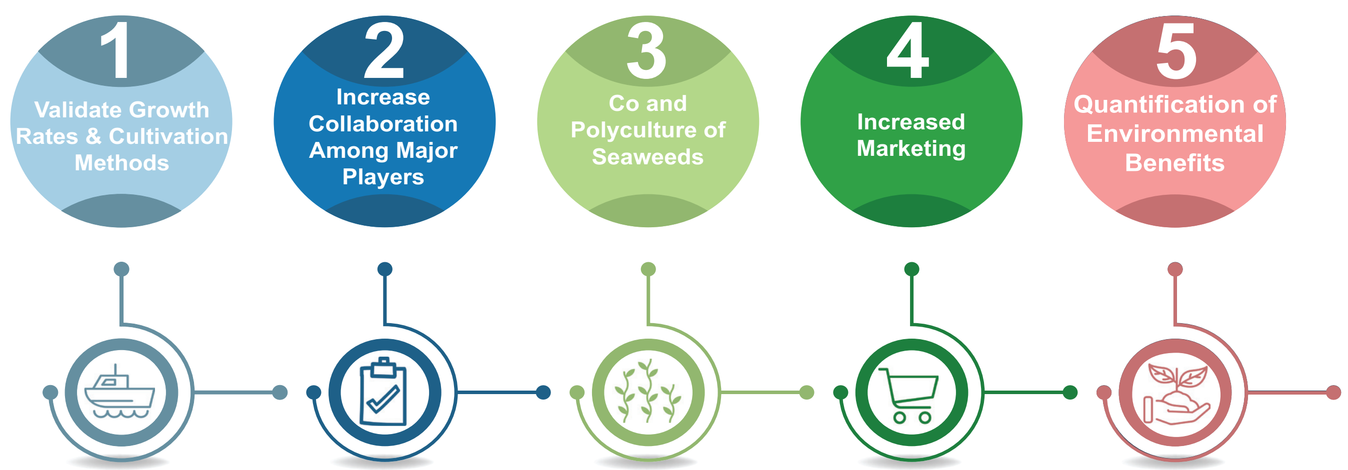
We identified four local seaweed species with promising cultivation potential in the Southern CA Bight: **ogo, kombu, nori, and sea lettuce**.

Offshore feasibility will depend primariliy on productivity and risk of storms. **Onshore feasibility** will depend on operating and structural costs.

Local seaweed can be profitable if sold at **specialty or value-added market prices,** with two caveats:

- Demand for local seaweed continues to grow or is greater than supply
- Procedure for bulk sale of fresh, local seaweed must be streamlined

Recommendations for Next Steps



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For more information please visit sbmussels.weebly.com

TESTING THE ECONOMIC FEASIBILITY OF SEAWEED AQUACULTURE IN SOUTHERN CALIFORNIA

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Project Brief, Spring 2018

OVERVIEW OF SEAWEED AQUACULTURE

Over half our seafood is produced by farming aquatic plants or animals, known as aquaculture. **Seaweed aquaculture** produces a staggering 23.8 million tons per year with a global net worth of $6.4 billion, with most of this used for human consumption. Demand for edible seaweed products in the US grew 65% from 1999 to 2008, overwhelmingly supplied by Asian imports. Domestic seaweed production is small and largely limited to wild harvesters. As demand continues to grow, our increasing reliance on imported products has potential environmental consequences.

Santa Barbara Mariculture Company farm. Photo: Marco Mazza.

Importing more seaweed could increase the carbon footprint of seaweed consumption due to the large energy use during storage, packaging, and transportation operations. Lower aquaculture environmental standards in Asia can lead to negative benthic impacts and increased water pollution through the addition of fertilizers.

In contrast, **locally grown seaweed** may provide added benefits to our marine environment, by acting as a localized acidification buffer or habitat restoration tool. Wide-scale cultivation of seaweed locally could reduce the environmental concerns of imported seaweed products and may provide ecosystem services.

OUR APPROACH

The Southern California Bight is a highly suitable region for seaweed aquaculture because of annual upwelling, providing nutrients essential to seaweed growth. The strong **environmental and health-conscious food market** in southern California also provides market opportunities for local seaweed products.

Despite great potential, comprehensive studies and industry knowledge of seaweed aquaculture are limited. Our research begins addressing the two gaps by identifying suitable species, cultivation methods, and assessing the costs of seaweed aquaculture.

Below are the steps we took to tackle this problem:

Select a Candidate Seaweed Species and Growing Methods

Candidate Criteria

- Has existing food market
- Native throughout the bight
- Commercially cultivated

Data Collected

- Growth requirements
- Cultivation methods & period
- Farm costs & market price

Create a Bioeconomic Model to Assess Feasibility of Species-Farm Systems

Estimate farm costs, annual seaweed production, and market information to calculate the break-even price ($/kg) required for a 5-year payback period.

Identify Key Factors Influencing Economic Feasibility for Farm Systems

Investigate key farm costs that effect model outcomes and identify the target market for each species-farm system.

KEY FINDINGS: CANDIDATE SEAWEED SPECIES

Sea Lettuce *Ulva lactuca*

Sea lettuce is grown in aquaculture systems around the world and often consumed in soups. This species is generally grown on nets offshore or tanks onshore. The predicted offshore growing period for our region is spring to fall.

Nori *Pyropia perforata*

The genus *Pyropia* is usually used for sushi and has a large, high-value global food market. It is most often grown on nets offshore and tanks onshore. In northern California, *P. perforata* is hand harvested, dried, and then sold by commercial harvesters. The cultivation period is winter to spring.

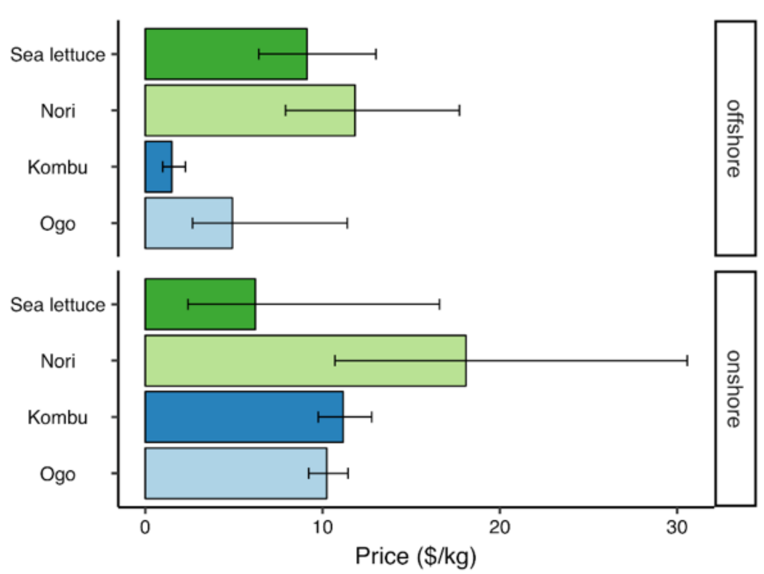
Kombu *Laminaria setchellii*

We chose to consider *Laminaria setchellii* as a native representative of the genus *Laminaria spp*, which are widely cultivated in aquaculture systems for soup or pickled appetizers. Kombu is grown on longlines offshore and in tanks onshore. The best growing period in the Southern California Bight is likely fall to spring.

Ogo *Gracilaria pacifica*

Currently, ogo is grown in onshore tank systems in southern California. However, it is most commonly grown offshore on longlines. The optimal offshore growing period is predicted to be spring to summer. This seaweed is most often found in poke bowls and seaweed salads

KEY FINDINGS: BREAK-EVEN PRICES



We modelled 8 species-farm scenarios. Kombu offshore had the lowest break-even price, and nori onshore the highest. Error bars show values for high and low break-even prices associated with estimated low and high growth rate scenarios, respectively. Annual yield inversely corresponded wtih break-even prices for species grown offshore.

Onshore & offshore: The species-specific market price needed to break-even after five years differed between growing locations.

3 of 4 Seaweeds have lower break-even values offshore

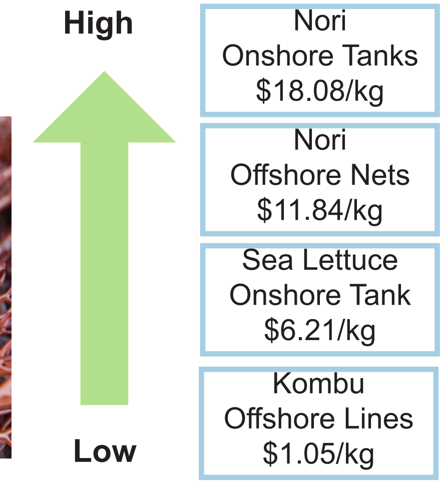
Species	Annual Yield
kombu	180 tons
ogo	52 tons
sea lettuce	38 tons
nori	36 tons

The mean values of the break-even price across all species were $6.84/kg for offshore and $11.42/kg for onshore

KEY FINDINGS: BREAK-EVEN PRICES (CONTINUED)

Species variation: There was strong inter-species variations of the break-even within the onshore and offshore cultivation type.

Ogo from The Cultured Abalone Farm. Photo: Marco Mazza.

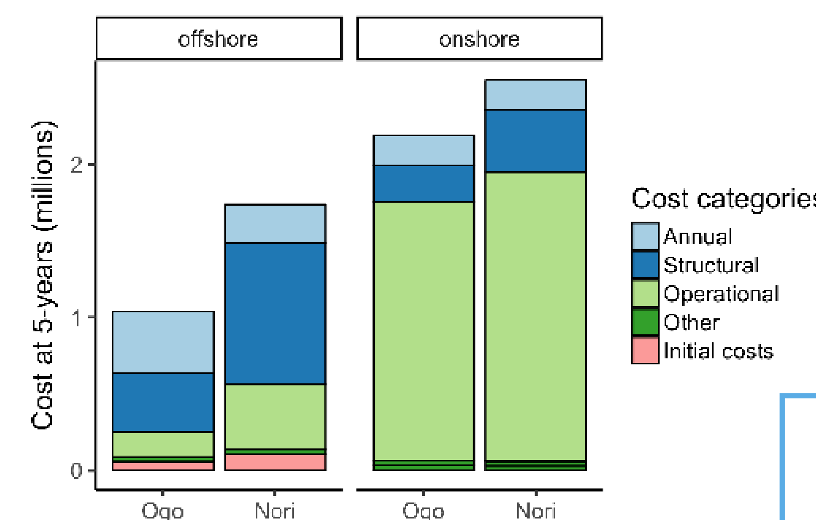


Major Takeways

- Feasibility **offshore** largely depends on annual farm yield
- **Higher productivity** allows a farmer to start profiting with lower break-even prices
- Estimated growth rates for **ogo** and **kombu** are less variable **onshore**
- Keeping costs low and taking advantage of ease of control can improve feasibility **onshore**

The range of growth rates used in our model reflects the variability of values obtained in literature under similar environmental conditions and highlights the need for field validated growth rates for native species.

KEY FINDINGS: COST CONTRIBUTION AND 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.

Local seaweed will need to be sold as a specialty or value-added product to be profitable

Explore Available Markets

The production capacity of our model 25-acre farm exceeds current demand for local seaweed in southern California. Comparing our break-even model prices against the markets would require selling seaweed as a specialty or value-added product for our model farm.