

REIMAGINING THE TROPICAL SEAPLANT INDUSTRY

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INTRODUCTION & BACKGROUND



I will use "seaplant" in this presentation as "weed" has a negative connotation that usurps the positive branding message for this amazing regenerative and sustainable biomass.

My seaplant journey started when I was the Principal Investigator for Catalina Sea Ranch's contract with the ARPA-E \$25 million MARINER Program.

Last year, while retained as a consultant by the Inter-American Development Bank to develop a marketing and distribution strategy for seaplant exports from Belize, I discovered that the \$10 billion tropical seaplant industry has remained artisanal for the past 30 years.

99.5% OF GLOBAL SEAPLANTS PRODUCED IN ASIA

SEAPLANT MARICULTURE PRODUCTION

| | |
|--|--------------------|
| China | 18.5 (57.1) |
| Indonesia | 9.3 (28.8) |
| Republic of Korea | 1.7 (5.3) |
| Philippines | 1.5 (4.6) |
| Democratic People's Republic of Korea | 0.5 (1.7) |
| Japan | 0.4 (1.2) |
| Malaysia | 0.2 (0.5) |
| Taiwan | 0.1 (0.2) |
| Vietnam | 0.0 (0.1) |
| Total Asian Seaplant Production | 32.2 (99.5) |
| Zanzibar, United Republic of Tanzania | 0.1 (0.3) |
| Chile | 0.0 (0.1) |
| Other producers in the world | 0.1 (0.1) |
| Total World Seaplant Production | 32.4 (100) |

Numbers are in million metric tons live weight (FAO 2020)
numbers in brackets are percentages.

INDUSTRY RIPE FOR INNOVATION

KZO Sea Farms, Inc. has developed a Submersible Seaplant Structure (SSS) farming system for protecting seaplant crops from hurricanes, producing higher yields, quality control and capable of scaling the seaplant industry with secure and transparent traceability.

Indonesia is the global leader followed by the Philippines for producing over 80% of the world's carrageenan having a market value of \$1 billion. Other countries include South Korea, North Korea, Japan, Malaysia, and India.

In all these countries seaplants are cultivated using traditional methodologies including the fixed, off-bottom line method, the floating raft method, and basket method. Remarkably, the massive seaplant industry has remained artisanal despite explosive growth.

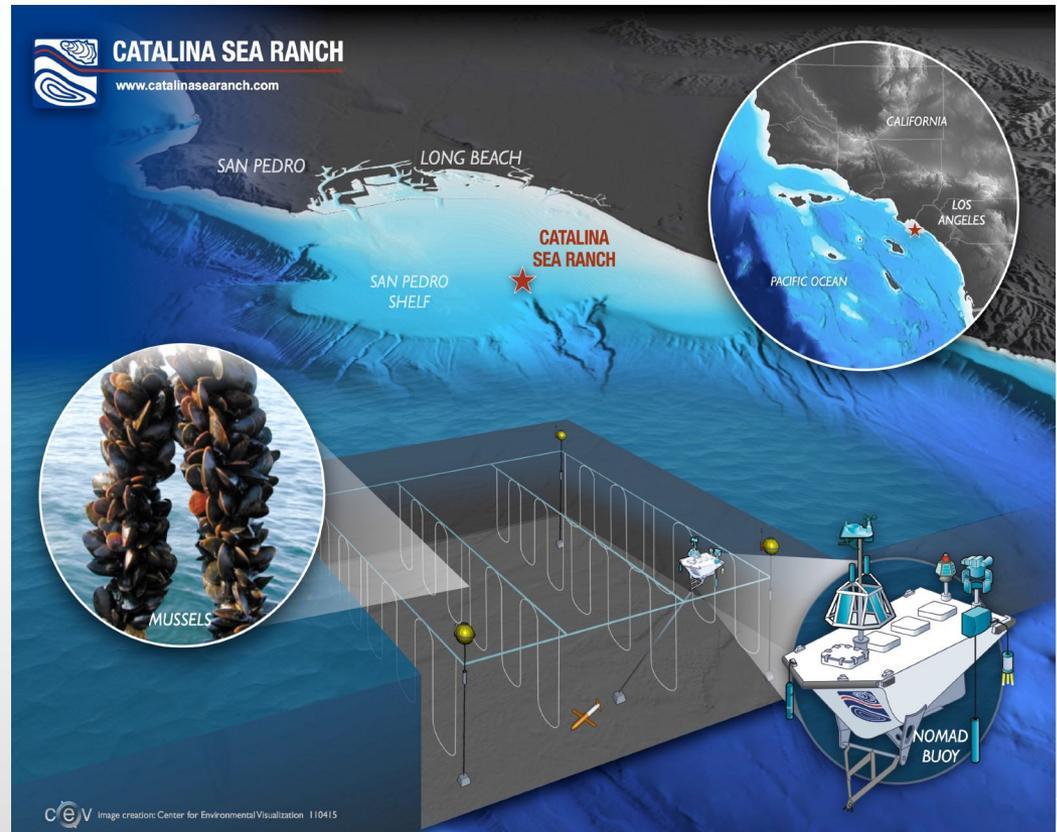


OFFSHORE SEAPLANT FARM OPERATIONS

KZO Sea Farms management has expertise and experience with open ocean mariculture having pioneered the concept in U.S. Federal waters offshore California.

Research and technologies developed for offshore seaplant mariculture were supported by the \$25 million *MARINER Program* funded by ARPA-E.

The technologies and lessons learned will be transferred for reimagining the the tropical seaplant industry.

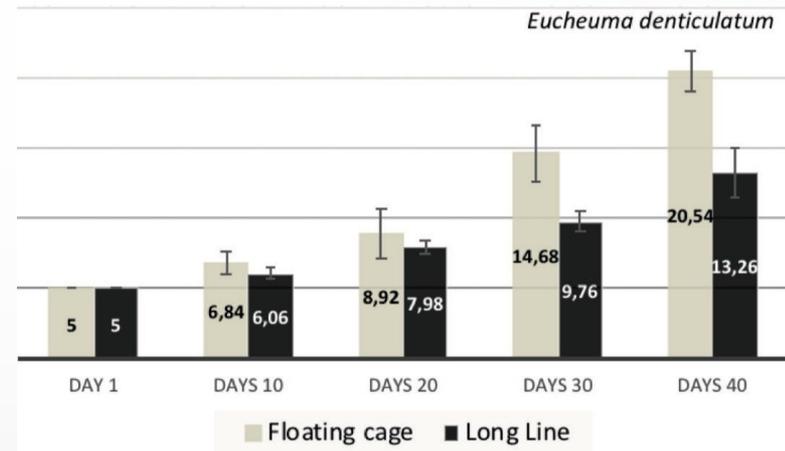


TRANSFORMING SEAPLANT MARICULTURE

Documented research data from Indonesia show submerged PVC cages with multifilament netting, produce a 54.9% increase in *Eucheuma* growth in 40 days as compared with traditional long line cultivation.

The specific growth rate increased to 6.4% per day using the floating cage method.

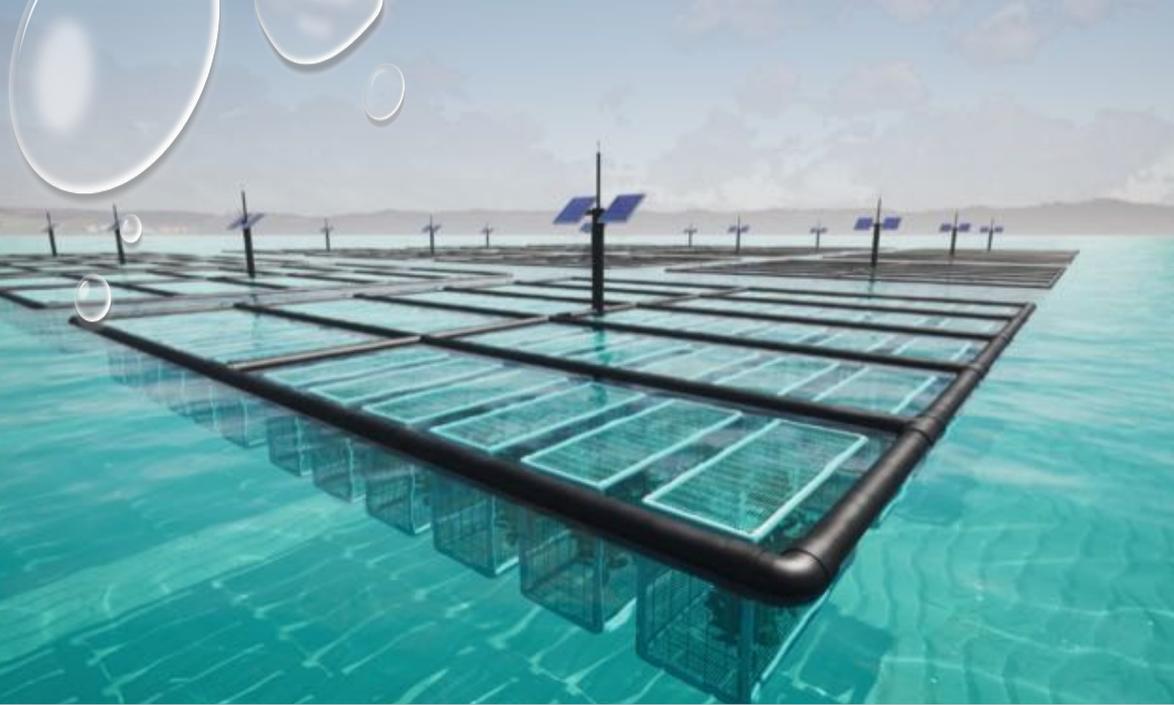
40-day day harvests with more efficient cage culture for seeding and harvesting could produce nine annual harvests ($360/40 = 9$) and submergibility of the cages could increase yield from favorable abiotic factors.



SUBMERSIBLE SEAPLANT STRUCTURES

KZO Sea Farm's team of engineers and consultants has designed a Submersible Seaplant Structure (SSS) constructed with High Density Polyethylene (HDPE) pipes providing four transformative benefits for seaplant mariculture:

- 1) The buoyant HDPE pipes can be filled with seawater by opening valves submerging the structure for protection from storms and hurricanes.
- 2) The submersible capability allows the SSS to be positioned in the ocean water vertical column having optimum cultivation characteristics for producing significantly higher crop yields.
- 3) The SSS employs cage culture for protecting seaplant crops from losses due to pest predation, epiphyte attachments, and storm shocks.
- 4) A SSS farming system is traceable to the cage where a seaplant was grown and the day it was harvested for transparently meeting certification standards and quality control.



GREATER PRODUCTIVITY WITH TRACEABILITY

Research shows that ocean depth significantly affects abiotic factors of temperature, sunlight, salinity, and nutrients which are critical factors for seaweed survivability and growth.

The SSS can be positioned in the vertical ocean water column for producing optimum abiotic factors.

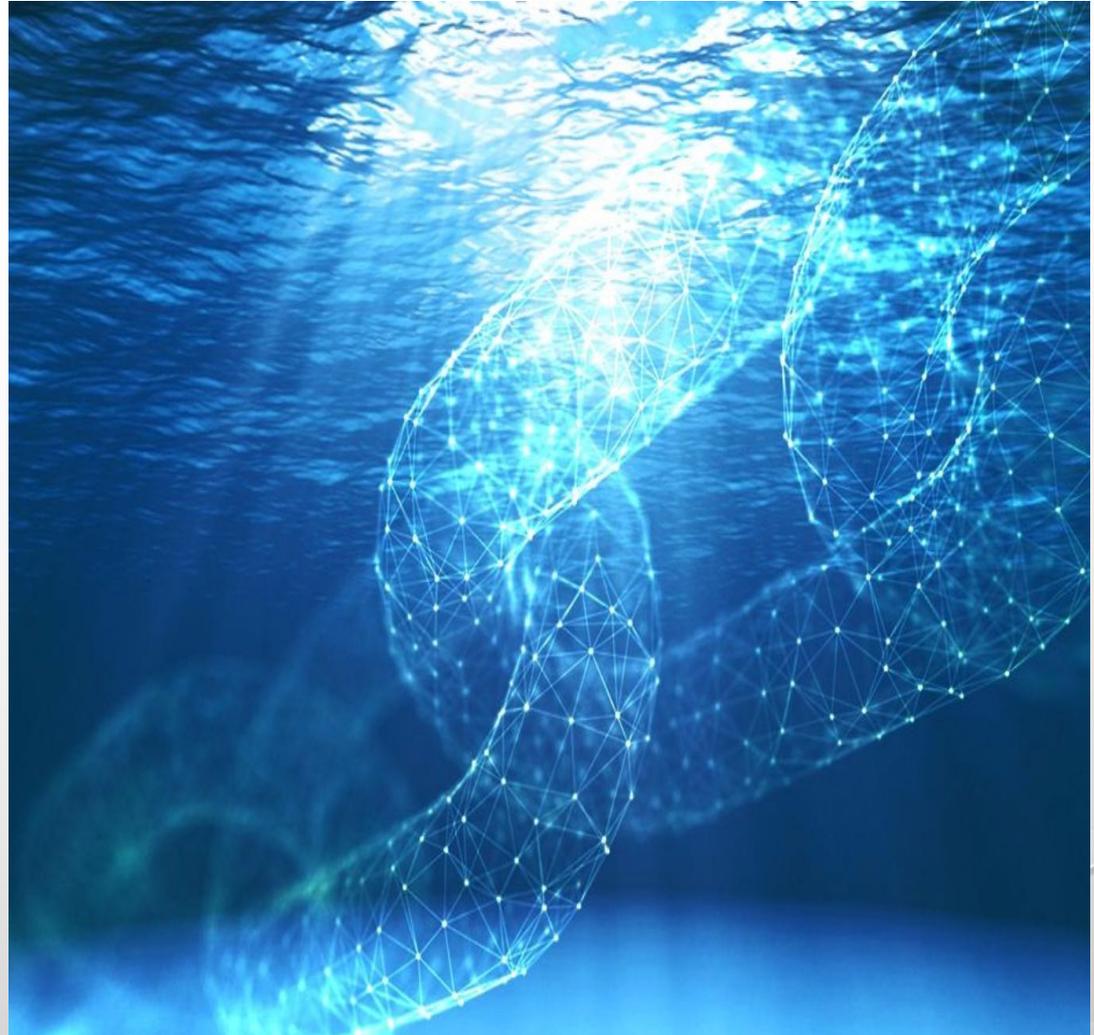
The SSS also provides traceability data on when and where the seaplant crops were harvested for meeting future sustainability standards and farm management quality control.



SECURE CHAIN OF CUSTODY

Currently, there is a lack of regulation requiring labels with information about the quality and content of seaplant products including heavy metals, microplastics and pathogens.

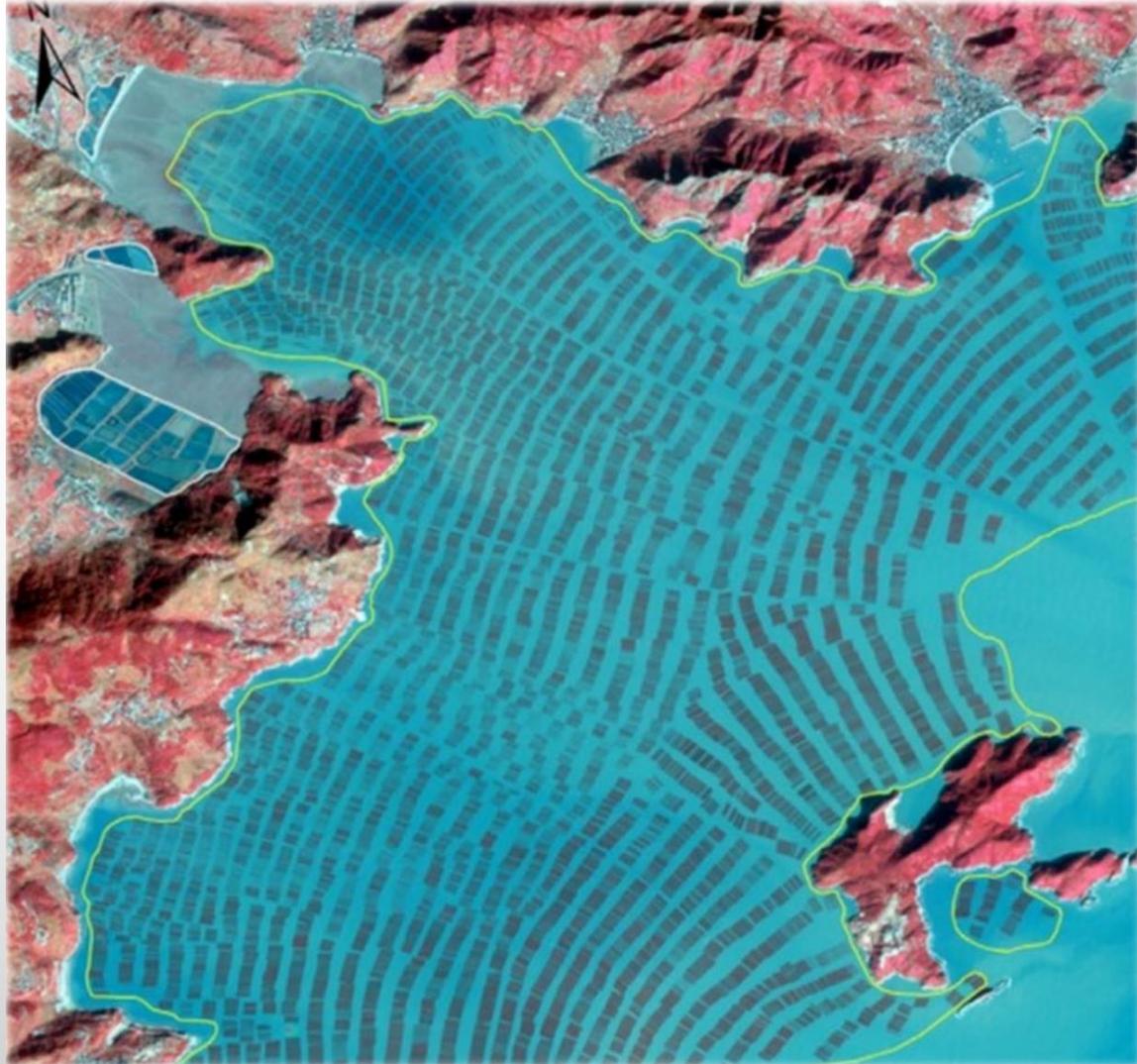
In the future, traceable and transparent supply chains will be required for the extraction, production, and processing of seaplant products for certifying them as safe for human consumption.



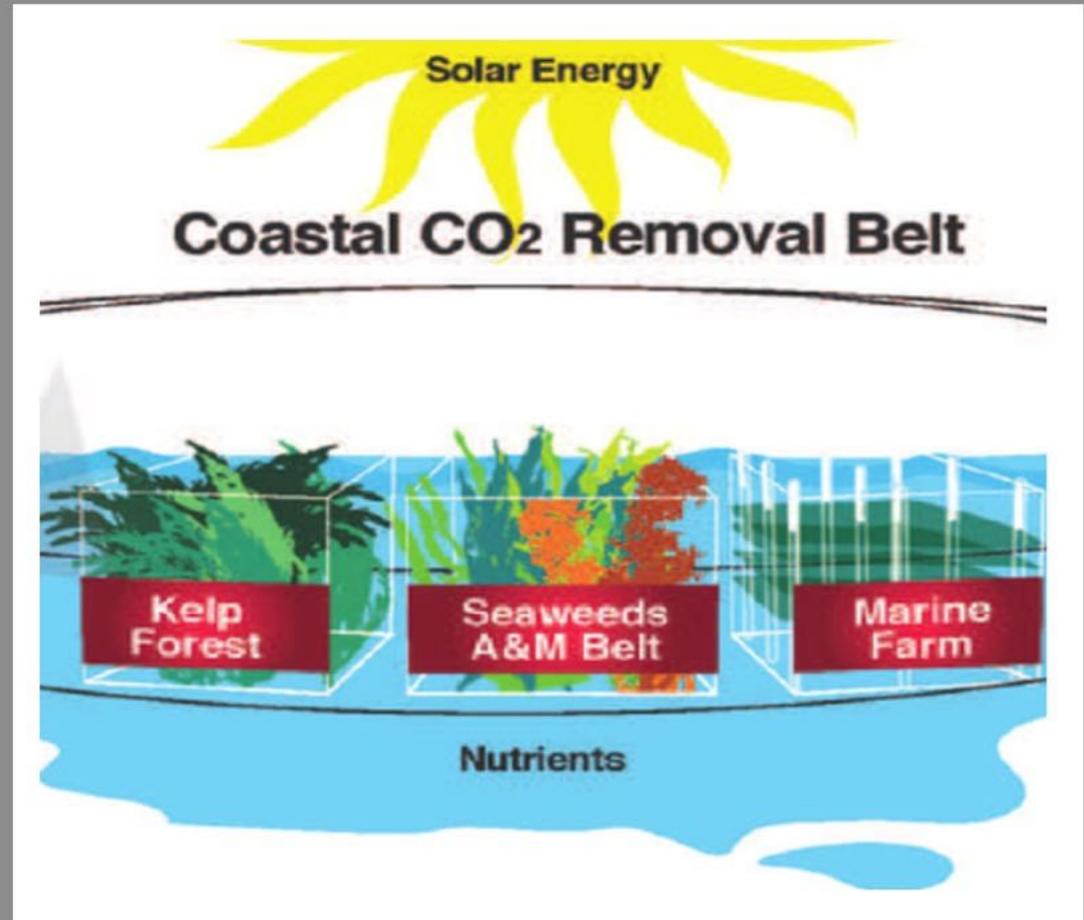
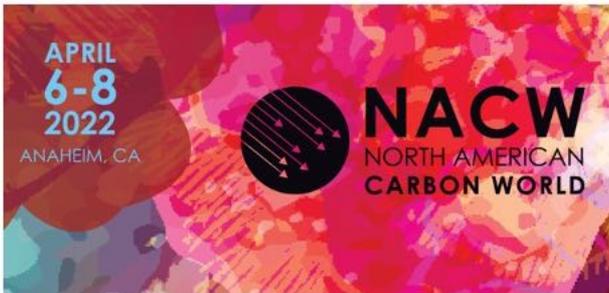
SUSTAINABLE OFFSHORE SEAPLANT MARICULTURE

KZO Sea Farms is developing innovative technologies for improving the productivity of traditional seaplant farming and for scaling the industry to deeper offshore waters.

An offshore seaplant industry, with a secure chain of custody, has the potential to scale globally for providing higher paying skilled jobs that are more eco-sustainable and appropriate for the emerging blue economy.



NET ZERO CARBON EMISSIONS



Seaplants are reputed to sequester up to 20 times more carbon per acre than land forests but there is no documented evidence. Scientists are now gearing up to verify and account for seaplant's carbon sequestration capability.

SEAPLANT BLUE CARBON CREDITS

Voluntary Carbon Markets (VCM) hit a record \$1 Billion in 2021 and mandatory protocols for certifying kelp and seaplants are underway.

The challenge will be documenting a secure chain of custody for quantifying the carbon sequestration capability to certify "Blue Carbon Credits" for the \$10 billion tropical seaplant industry.

Registration and verification must overcome the complexity of "Additionally" and Permanence" for the VCM expected to reach \$100 billion by 2030.



ADDITIONALITY means that the reductions in emissions achieved by the project must be "above business as usual" - they would not have happened unless the project was implemented.

PERMANENCE requires that emission reductions cannot be reversed. In other words, the carbon removed can't be reintroduced into the atmosphere