

FINAL REPORT
2023/2024 Joint Innovation Project

“Testing Four Approaches to Small-Scale Primary Seaweed Stabilization & Matching Methods to Markets”

Lead Entity: Saltwater Inc.

Category: Innovations in processing: Primary stabilization of seaweed

Project Location: Homer, AK

Project Start Date: August 1, 2023

Project End Date: January 31, 2025

Award Amount: \$99,240

Project Team & Partners: Kathryn Carovano, Saltwater Inc., Evie Witten, Regeneration North LLC, Jeff Hetrick, Director, Alutiiq Pride Marine Institute/CRRC, Briana Murphy, Mariculture Liasson, CRRC

PROJECT OVERVIEW

Problem Statement: To be cost effective, the Alaska seaweed mariculture industry needs to develop different methods of primary stabilization at different scales that are energy and labor efficient, capable of processing large volumes during the very short harvest season, and that prepare seaweed for a variety of secondary processing steps, products and markets.

Background/Context: Primary stabilization is a critical step in seaweed processing, and the “best” approach will vary depending on both scale and markets. With the goal of promoting the growth of the seaweed mariculture sector in the region, our team began working to address the challenge of identify energy, labor, and cost-efficient method(s) for stabilizing kelp at the community hub/small-medium farm collective scale in 2022 at the Kachemak Kelp Hub in Homer, AK. Our initial focus was on solar drying in a standard high tunnel (with support from a NOAA-SK grant) and bringing dried kelp products to market. That experience led us to research improvements to the high tunnel design and additional stabilization methods which provided the foundation for this project, aimed at diversifying stabilization approaches and aligning those methods with markets. The project also sought to engage with people in the lower Cook Inlet Alaska Native communities of Port Graham and Nanwalek who are establishing a seaweed farm, to and identify seaweed processing that could be implemented in the communities with initial minimal investment in equipment and infrastructure.

Proposed Solution

Our solution focused on matching methods for primary stabilization with markets for farmed kelp products. These two factors are related, as the methods used to stabilize kelp need to result in kelp product with qualities matching the specifications for each market. We proposed testing four different methods of primary kelp stabilization—improved solar drying, infra-red (IR) drying, fermentation and salting. For each method we proposed tracking energy and labor inputs, time to stabilization, and volume processed per ‘batch’. We also planned to measure product quality through nutritional analyses, shelf/refrigerator-stability testing, moisture content and flake quality of dried kelp, taste and appearance. Finally, we proposed testing the suitability of the different processing methods for different secondary processing steps, end products, and markets.

Project Objectives

The broad project objective was to test different methods of stabilizing two species (*Alaria marginata*—ribbon kelp, *Saccharina latissima*—sugar kelp) of farm-grown kelp to determine which methods are most effective in terms of quality of product, cost of stabilization (energy and labor inputs), energy efficiency, and alignment with specific and viable markets. Specific objectives included:

- Identify energy, labor, and cost-efficient method(s) for stabilizing kelp at the community hub/small farm collective scale.
- Identify nested primary processing steps that can be used in place of or in addition to blast freezing as an intermediate post-harvest step.
- Engage farm collectives and communities to identify methods best suited to their local infrastructure and potential markets and/or products.
- Align methods with markets by matching the suitability of stabilization method(s) to secondary processing steps, end products, and markets.
- Identify and use existing resources and coastal infrastructure that can be seasonally shared with other industries and sectors.
- Build on and add to learning from our 2022 and 2023 processing seasons.
- Leverage current S-K funding, including our existing high-tunnels, processing equipment and rental agreement at 4501 Ice Dock Rd, the former fish processing plant owned by Salmon Sisters, adjacent to the Homer Public Dock.

Tasks

Receiving & Tracking

All kelp was delivered by local kelp farmers from Ebb Tide and Spinnaker Farms in brailer bags (provided by us) to our processing facility at Ice Dock Road within 2 hours of harvest. The kelp was weighed at the time of delivery and weights recorded in a spreadsheet. Fresh kelp was stored in insulated totes filled with fresh saltwater from a saltwater well and equipped with a bubbler to oxygenate the water and a pool thermometer to monitor temperature. All kelp was processed in its fresh state within 2-3 days of harvest, or frozen in a blast freezer, and later thawed for drying or other processing.

Solar Drying

Solar drying was the primary focus on our processing efforts during 2022/2023 seasons using two high tunnels set up in Homer outside 4501 Ice Dock Rd, a former fish processing plant and warehouse now owned by Salmon Sisters, LLC. During those two seasons we had found solar drying to be effective and energy efficient for producing a quality, whole-leaf and milled food product, but too labor-intensive and limited by foul weather to be cost effective and time efficient. Modifications to the high tunnel in 2023 led to improvements and data to support ideas for further refinement.

We proposed to:

- Re-engineer air flow systems in a high tunnel, implementing recommendations from MEP/UAA study: Add heat pumps and dehumidifiers, remove 1 of 2 exhaust fans, reduce the size of air intake vents. Continue engagement with Alaska MEP and UAA Department of Engineering to these refine designs.
- Add a large-scale tray drying rack on a pulley system, building on 2023 small tray drying experiments, to more efficiently dry small/broken kelp, reduce waste, and create additional layers to make better use of high tunnel space.

Implementation of this task varied little from what we proposed, and included:

Re-engineering the solar dryer/high tunnel design based on recommendation from the UAA Department of Engineering (through the MEP).¹We set up a 20' x 24' Rimol double wall high tunnel (12' high at peak), equipped with two different systems that included a combination of one 20"x 48" screened vent and one 30"

¹ Grant funds from NOAA-SK were used to engage UAA/MEP to provide recommendations to improve air flow in the high tunnel.

mechanical vent on the northeast end, and two 20” exhaust fans on the southwest end, and three 20” recirculating fans hung from the ceiling. We also installed an air-to-air heat pump and jobsite dehumidifier to pull moisture from the air. The mechanical vent, exhaust fans and circulating fans were wired to a temperature and humidity controller. Sensor Push units were also used to measure ambient and internal high tunnel air temperature and % moisture content which team members could use to adjust vents, fans and heat as needed. Energy use was tracked using a ‘Smart’ outlet meter.

After working on a design for a large-scale tray drying rack on a pulley system, we instead installed 9 rows of heavier gauge braided nylon rope looped on pullies, laundry line style, and suspended from opposite ends of the high tunnel at a height of 9 feet. These lines on pullies were installed above existing kelp drying lines of fine nylon net-mending cord tied on opposite sides of the high tunnel at a height of 5 feet and in rows spaced 24” apart.

For each batch dried in the high tunnel, we also tracked initial wet weight, labor (person hours), total elapsed time from filling the tunnel to reaching the desired water activity level (0.85 aw and/or 10% moisture or lower), and dry kelp weights.

Alternative Dryer

In February 2023, we worked with the Alaska Fish Nutrition Company (AFNC), then located in Washington state, to test dry approximately 40 lbs. of sugar kelp in their infrared (IR) dryer. Test conditions and results (kelp dried at variable/220F + temperatures, variable/ 220F +, was dark green, translucent, friable and <3% moisture content) were not to our specifications, but indicated that with modified methods the IR dryer could potentially produce food grade dried kelp, for flaking and products and markets requiring ground kelp.

Under our original proposal we planned:

- Collaborating with AFNC and Salmon Sisters on relocation of IR dryer to Homer processing facility.
- Initial “at scale” test drying of 150 lbs. each Ribbon, Sugar and Native Conservancy- brown Bull kelp in IR dryer, both pre- ground and whole leaf kelp.
- Applying lessons from 2023 initial test to large batch runs in 2024 ((+/-1,000 lbs./day).
- Monitoring energy and labor inputs and identifying any potential efficiencies.
- Assessing and determining economic pros/cons of IR machine as a seasonally shared community resource, via continued communication and coordinated machine/product testing with Peony Co-op, Native Conservancy, Salmon Sisters and others.

Unfortunately, we made considerable efforts to support AFNC’s relocation of the IR dryer to Alaska that were not successful. We therefore modified our approach.

Updated Alternative Drying Methods

In late summer 2023, when it became clear the IR dryer was not being moved to Alaska until at least spring of 2024, we shipped approximately 180 lbs. of frozen sugar kelp to AFNC in Washington in for the initial test drying in the IR dryer. We attended 2.5 days of testing via video conference and measured:

- Dryer temperature
- The number of minutes for one row of wet kelp to travel the full 40 ft. of the dryer.
- The number of lbs./oz of kelp that can be dried in one hour
- The energy use per hour of drying the kelp
- Moisture content and other characteristics of the dried kelp.

In spring 2024 there were continued delays with the IR dryer set up, therefore we explored other dryer options and decided to run tests with Beltomatic, an Indiana-based company that manufactures a mid-sized conveyor food dryer. They were optimistic that the Beltomatic would be able to efficiently dry ground or shredded kelp

and offered test batch processing for a nominal fee. We shipped frozen, shredded samples to their headquarters and they ran tests in late June 2024

Fermenting

Fermenting kelp is known to be a reliable primary processing method for both food grade and soil amendment grade products and is a lower energy, lower cost, and lower labor option than drying. We proposed to test this stabilization method for a variety of applications, including as:

- An intermediate holding step - in totes after delivery, pre-drying.
- A low-input, community-level primary stabilization option.
- A subsequently dried food product
- A refrigerator-stable food product
- A soil amendment product, using primarily scrap kelp left after food grade sorting.

Updated Fermenting Methods

Implementation of this task varied little from what we proposed, however based on initial tests and due to limitations in our drying equipment, we emphasized work to develop a stabilized kelp slurry primarily for application as soil amendment/plant biostimulants product. We also emphasized fermenting as a potential low-input stabilization option for Port Graham, Nanawalek and other remote communities. Specifically:

- We determined that fermenting kelp as an intermediate holding step before drying - and/or as a dried food product, meant that we would be drying a kelp slurry which would require a more powerful dryer than our modified high tunnel.
- We made 6 test batches of a fermented kelp slurry using ground and not ground kelp, with added sugar or molasses, and with or without added lactobacillus bacteria.
- Each batch was filtered using a mesh screen, and pH and other general characteristics were monitored and recorded for 23 -30+ days,

Two representative batches were sent for lab analyses.

- In collaboration with APMI, we introduced the process to community members during workshops at the Kelp Hub in Homer and in Port Graham.
- While lab analyses indicate the fermented slurry could be developed as a refrigerator-stable food product, we were not able to find ready markets for such a product, and therefore did not further test this method for that purpose.

Salting

Salting is an ancient and widespread method of preserving foods, including kelp. Our small-scale preliminary tests in 2023 yielded a shelf-stable (water activity = 0.7585, below the 0.85 threshold) food grade product that could be soaked to remove excess salt and rehydrated for soups, salads or other culinary uses.

We proposed testing commercial scale salting methods at the processing facility in Homer, and community processing in Port Graham and/or Nanwalek. Specifically, this included:

- Testing salt mixing in a large compost tumbler.
- Assessing potential to be adapted for Alaska coastal community conditions and scale.
- Identifying culinary markets or value add products for salted kelp.

Updated Salting Methods

Implementation of this task varied little from what we proposed. Exceptions and additions to proposed methods included:

- Instead of testing salt mixing in a large compost tumbler we used well-vented totes that could drain naturally and a large, plastic garbage can with drilled rain holes, and we hand tossed the kelp to

“tumble” it. We tested two processing methods: “Greg’s Method” (provided by an established food and fish processor) and the “Simple Method”. Both methods involved salting layered kelp heavily with coarse salt in well-vented totes that could drained naturally. The approaches varied in the follow-up, with the first involving removing and replacing the salt every 24 hours, and the second simply adding more salt as needed each day. The weight of the kelp and amount of salt used at the start of the process were recorded and water activity, added salt and kelp weights were recorded daily until the desired water activity of 0.75 was achieved.

- We led a hands-on kelp salting workshop in Port Graham
- We had salted kelp lab tested for food safety, shelf stability, and nutritional analysis.
- We did not sell the salted kelp, instead we offered free product to a nationally prominent and several local chefs who tested it in their kitchens, and on their menus with customers.

Measures Of Success

The project achieved all of the proposed/initially stated measures of success, including:

- *Identification of efficient and effective primary stabilization method(s) at the community hub/small farm collective scale (10-30 acres)*
- *Data and information to share about all four methods tested.*
- *Matching stabilization methods to diverse market requirements.*
- *Engagement with APMI and the communities of Port Graham and Nanwalek throughout the project timeline.*

Project Outcomes

We successfully set up and tested four distinct primary stabilization strategies and processed 3,000+ pounds of farmed seaweed. This included using a modified high tunnel for drying, testing an infrared and commercial electric drier, salting for food preservation, and fermenting to produce a plant biostimulant. We monitored and tracked inputs and results from all processing methods. We sent samples of the dried, salted and fermented kelp to professional labs for nutrition, composition, and food and farm safety testing. We worked closely with APMI to share learning with local Alaska Native communities through site tours and demonstration workshops. We were able to sell all of our bulk dried, milled kelp and expand local sales of value-added whole-leaf and spice mixes using dried kelp. We collaborated closely with the Salmon Sisters to market our products in their Homer store and e-commerce site and with a local Homer chef who incorporated salted kelp into his regular menu. We successfully produced a kelp-based plant biostimulant using fermentation that initial lab analysis indicates contains commercially important bioactive compounds.

Solar Drying General Outcomes

- Tests drying small blades of Alaria and ground sugar kelp on bakery racks were labor intensive and yielded mixed results, with brittle, over dried whole leaf the ground kelp drying only if spread in very thin layers.
- Samples of the dried sugar kelp and Alaria were analyzed at Midwest Labs for nutrition, composition and food safety. Quality met US and European food grade standards. (See Data Appendix for results).
- We also smoked two high tunnel batches using a small maze smoker and alder pellets for test marketing a smoked condiment. We also experimented with drying small blades of Alaria and some ground kelp on mesh trays in bakery racks in the high tunnel.
- Initial tests of drying a fermented kelp slurry on trays in the high tunnel were not successful, with results of > 50-70% moisture after 4 days. We concluded that drying a kelp slurry requires a more

powerful dryer than our modified high tunnel.

Re-Engineered High Tunnel Outcomes

- The mechanical and screened vent were both necessary in terms of surface area and air flow, and both styles were useful under different conditions, however the mechanical shutter was more labor efficient and require less monitoring because it was linked to the temperature and humidity controller.
- The temperature and humidity controller were not as sensitive to subtle shifts and differences as would have been ideal. Consequently, during the day we choose to monitor the sensor push and adjust the fans and heat pump manually to achieve the most moisture reduction in the least amount of time. At night we used the temperature and humidity controller or set the heat pump and fans at a steady rate, depending on what part of the drying cycle.
- The air source heat pump significantly increased temperature and decreased humidity in the high tunnel and resulted in much faster drying times relative to similar weather conditions in the 2023 and 2022 processing seasons.
- The jobsite/commercial grade dehumidifier pumped out an average of approximately 5 gallons of water/high tunnel batch.
- Under most weather conditions, the two exhaust fans installed in the west wall of the tunnel were too powerful when used together, resulting in too much air draw and loss of temperature. We therefore mostly used only one at a time.
- The addition of the 9 additional upper-level rows of kelp hanging line in the high tunnel peak increased total volume of kelp/batch by approximately 20%, and did not appear to significantly slow drying time.
- Total kelp volume/weight capacity of the high tunnel varied depending on the length and species of kelp. Full batches of long, broad sugar kelp were 180-200 lbs. in total, while full batches of shorter, narrower Alaria were in the 120-140 lb. range.
- Under conditions with relatively low outside air moisture content, this high tunnel system dried kelp in an average of 24 hrs., even under fully cloudy conditions; when outside air moisture content was high it took an average of 36 hrs. for the kelp to dry. This overall result was a significant change from the 2022 and 2023 processing seasons when a lack of sun and high outside air moisture resulted in multi-day drying/batch.

Matching Dried Kelp to Markets:

We sold a small amount (~14 lbs.) as a consumer whole leaf product and used ~85 lbs. in production of other value-added products that are sold under the Kachemak Kelp label.² We were able to sell all of the remaining bulk, milled product both the 2023 and 2024 season (~80 lbs.) to a mix of in-state and out of state buyers.

Alternative Dryer Outcomes

IR Dryer Outcomes

We shipped approximately 120 lbs. of frozen, whole leaf sugar kelp to ARNC to for test drying in the IR dryer. More than half the shipment spoiled on arrival due to a lack of adequate refrigeration and over estimation by the on-site drying team of the processing speed. Approximately 50 lbs. were dried in seven small test batches. Calibrating the machine to effectively dry kelp was difficult and became the focus of the test runs. Data collected indicated:

- The IR dryer produces relatively high temperatures in the drying kelp (avg. 239.5F, high 285F) and a product that has an average % moisture well below the target (1.5% vs 9.5%)

² Some of the dried kelp sold and used in our VA products was from 2023 season.

- The IR dryer is relatively energy intensive drying method, requiring an average of 0.15 kWh electric and 0.93 lbs. of propane per pound of wet kelp
- As currently configured, it is a relatively low volume drying method (dried an average of 8.2 lbs. and a maximum of 15 lbs. wet kelp/hr. and required two people to operate).
- Further testing should focus on lowering kelp drying temperatures (and increasing % moisture of the finished product) by turning off some of the burners and increasing the dryer belt speed.

Beltomatic Dryer Outcomes

We shipped 10 lbs. of frozen shredded kelp to Beltomatic. The company reported that handling and drying the kelp was too labor intensive for the operators and they were unable to successfully process the kelp to the targeted moisture content.

Fermentation Outcomes

We processed ~375 lbs. of sugar kelp in six test batches, producing ~30 gallons of a liquid biostimulants. We had two batches lab tested and results indicate it is a viable, bioactive product, indicating the method is successful and could be scaled up to reach the growing US and global markets for biostimulants.

Salting Outcomes

We salted approximately 250 lbs. of wet kelp using the two methods described above and reached a water activity level of 0.75 in approximately 6 days.³ The ratio of wet kelp to finished product was approximately 1.9:1. We vacuum packed 1 lb. packages and kept them refrigerated until distributed. We sent a sample of salted sugar kelp to Midwest Labs for nutrition, composition and food safety testing (See Data files for results) and to Brian Himelbloom, Kodiak Marine Science Center, for mold testing. He subdivided the one-pound of salted kelp into eight packages-- four were vacuum-packed and four were air-packed and then stored at 35 C (the elevated temp was to accelerate potential spoilage from mold). There was no mold detected and no significant change in water activity levels over three months, confirming the salted kelp as a shelf-stable product.

Early in the season we provided samples to the chef at Johnny's Corner in Homer. He incorporated it into his miso soup recipe which was awarded the First Place in the annual local culinary event, "Taste of Homer". Samples were also provided to the chef/owner of Superiority Burger, a leading vegetarian restaurant in New York City who plans to test it, and to lodge and home chefs known to our team. A NOAA rep shared samples with a seaweed company in Japan, and we also provided samples to a number of trade representatives from Asia at a WUSATA meet-up. We are still gathering feedback on product uses as well as packaging and pricing.

Successes & Challenges

Objective 1: Identify energy, labor, and cost-efficient method(s) for stabilizing kelp at the community hub/small farm collective scale.

- Successfully modified a standard high tunnel as a solar dryer to produce dried food grade kelp under all weather conditions.
 - We were only able to do limited testing of the IR dryer. Our initial results suggest the IR dryer as currently configured is neither an energy nor labor efficient tool, however discussions with the developer suggest improvements could be made. The second "alternative" dryer we tested was not effective at drying kelp.
- Successfully developed and tested two small-scale salting processes.

³ We were aiming for a water activity of 0.65 but could not achieve that without drying it in the greenhouse, which was not practical. The Kodiak lab confirmed that 0.75 was adequate.

- Successfully developed and tested four fermentation methods to produce a stabilized kelp slurry and identified high-quality plant biostimulants as one probable market.
- Collaborated with APMI and introduced two simple stabilization methods to community members from the native communities in Port Graham and Seward.

Objective 2: Identify nested primary processing steps that can be used in place of or in addition to blast freezing as an intermediate post-harvest step.

- While we successfully implemented new primary processing protocols (salting, fermenting) we were not successful in using either as an intermediate step to drying a food grade product. Fermentation produced a liquid suited to the plant biostimulant market, and our attempts to dry the remaining solids were not successful, though would likely need a mechanical dryer—and market—for that to be worth pursuing. Salting could work as a “holding” step before drying but we found it to be too labor intensive to be cost effective.

Objective 3: Align methods with markets by matching the suitability of stabilization method(s) to secondary processing steps, end products, and markets.

- Successfully dried food grade kelp and were able to sell all of it as whole leaf, milled as an ingredient to other food producers, or incorporated into our own value-added products.
- Created and successfully introduced a new skincare/bath product using dried sugar kelp.
- Produced a palatable, shelf-stable salted product that was successfully introduced to the public by a local chef.
- Produced a high-quality plant biostimulants using a fermentation process.

Objective 4: Identify and use existing resources and coastal infrastructure that can be seasonally shared with other industries and sectors.

- We had hoped the IR dryer could be used to process seaweed and be shared with other local industries (peony, fish waste). Unfortunately, it was never set up in Alaska during the course of the project so our ability to test the dryer was limited. However, our limited results suggest it’s not a great resource for seaweed processing at the community/farm collective scale required for the Kachemak Bay region.

Objective 5: Build on and add to learning from our 2022 and 2023 processing seasons.

- All of our work builds on previous learning, and we were able to both improve and expand our processing capacity and improve our marketing efforts.
- We were able to produce high-quality, food grade dried kelp and sell all of it from both the 2023-24 seasons.
- We diversified our product offerings, adding a bath soak and salted kelp, and introduced them to market.
- We built on initial 2023 fermentation tests and created a process and product that we intend to refine and bring to market in 2025.
- We built on our prior relationship with APMI to engage members of the Native communities of Port Graham and Nanwalek in primary processing activities.

Objective 6: Leverage current S-K funding, including our existing high-tunnels, processing equipment and rental agreement at 4501 Ice Dock Rd, the former fish processing plant owned by Salmon Sisters, adjacent to the Homer Public Dock.

- We successfully leveraged our existing SK-K funding to provide the foundation for this grant, including rent, prior equipment purchases, and local labor.

Lessons Learned

- Using diverse approaches to stabilize kelp expanded both our processing capacity and our markets.
- While the salting and fermenting methods we tested were energy efficient, they were also labor intensive, at least at the test scale and using test equipment.
- While we were able to greatly improve and maximize the drying performance of the high tunnel under all weather conditions, and while it is energy efficient, it remains a labor-intensive approach that is not practical at the small-medium farm collective scale.
- We need scaled up equipment and methods to improve labor efficiency and minimize the need to freeze any for later processing.
- Scaling up all of these processes would require careful planning, coordination across approaches, and additional equipment to improve labor efficiency.
- Building capacity in local communities, both in terms of equipment and training, will be important to the success of having some processing activities take place in the region's Native communities.
- We are fortunate to have the interest and support of an established local and e-commerce company, Salmon Sisters, that have helped market and distribute our products. As we diversify our products (and target markets) we will need to explore other distribution and marketing channels.
- While we successfully began to match processing methods to markets, each processing method results in a unique product—or set of products-- which requires distinct marketing strategies that may be beyond the capacity of community hubs and/or farm collectives.

Continuation & Dissemination of Results

Our project team was awarded a second JIP grant that we will use to build on the experience and lessons learned from the work carried out under this grant. While our ability to efficiently process farmed seaweed has improved, current supply of Alaskan farmed sugar kelp exceeds demand, indicating the need to put greater emphasis on both expanding existing markets and creating new ones through species diversification, product differentiation, and the development of diverse markets.

The objectives of the project are as follows:

- Engage with seaweed farmers and nurseries to expand the variety of farmed seaweed species grown and processed to enable both learning within the mariculture community and new market opportunities.
- Build on learning from 2023-24 season to dry new species and expand whole leaf/gourmet food product markets.
- Expand development of salt-stabilized kelp products and markets with more efficient, scaled-up production, diversified species, nutritional and product quality testing, and expanded outreach to potential user groups.
- Develop local markets for fermented seaweed plant biostimulants through scaled-up production, lab and bioassay testing, and expanded outreach through local food and ag networks.

- Provided a kelp farm and Kelp Hub tour and filmed interview with representatives from Hatch, including demonstration and discussion of the methods and preliminary results of the three primary stabilization approaches we are currently testing.

We have submitted an abstract to present the results of this grant at the Annual Mariculture Conference of Alaska in February 2025.

DATA & PROJECT OUTCOMES

2024 Kelp Delivery Synopsis			
Farm	Purchased	Species	Notes
Spinnaker	1698.57	Sugar	B
Ebb Tide	1509.11	WH	Alaria, 73.2 lbs
Season Total	3207.68		

We dried 1565 pounds of kelp (sugar kelp, Alaria, and three additional species that were harvested as wild set from permitted aquaculture gear) in 12 high tunnel batches (avg ~150lbs/batch). Approximately ~300 lbs. were blast frozen prior to drying, the remainder was processed withing 48 hours of delivery. Two of the 12 batches, were smoked with alder pellets.

The total dry weight was 124lbs 10 oz. for a yield of ~8 dry lbs. dry/100 lbs. of wet kelp.

For comparison, the table below provides a snapshot of the inputs and outputs of the various stabilization methods tested under this grant.

Method	Lbs Fresh Kelp	Final Product Volume	Time/ Start to Finish
Solar Drying	1565	124.75 lbs	24 hrs
Salting	253*	49 lbs	7 days
Fermenting	372	30 gallons	23 days

*We salted 253 lbs. but only produced finished product from 95 lbs.

Raw data sheets summarizing all of the processing methods as well as lab test results can be found in **Attachment A**.

ADDITIONAL INFORMATION

Project Timeline:

We completed the majority of the proposed scope of work in the intended timeframe, which was from July 1, 2023-September 30, 2024. We continued to pursue testing of the IR dryer in October-November 2024, but finally determined that was not going to be possible. We had some delays in the lab tests of our fermented products due to mailing issues, so those were not completed until October. In November-December we continued our market outreach to local stores to test-market sales of our new bath product, and to chefs and other potential buyers of salted kelp.

BUDGET

The following is an updated budget with the actual amounts spent.

Personnel Costs	Total Request	Total Spent	Remaining
Subtotal Personnel	\$25,520.00	\$ 27,669.20	\$ (2,149.20)
Subtotal Travel	\$2,860.00	\$ 2,057.36	\$ 802.64
Subtotal Equipment	\$0.00	\$ -	
Subtotal Supplies	\$7,505.00	\$ 5,337.32	\$ 2,167.68
Contractual	\$63,351.00	\$63,994.86	\$ (643.86)
Subtotal Other	\$440.00	\$75.05	\$ 364.95
Total	\$99,676.00	\$ 99,133.79	\$ 542.21

The project did fall within budget. We had \$542 remaining at the end of the grant period. We did reallocate some of the funds, with permission from AFDF. We had savings in travel, supplies, shipping and from the limited IR dryer testing we were able to complete. We reallocated those funds to support more Saltwater labor and work by Regeneration North.

PHOTOS



Photo 1: Local crew setting up modified high tunnel.



Photo 2: Sugar kelp being hung in the high tunnel



Photo 3: Finished whole leaf dried sugar kelp.



Photo 4: Salting kelp for primary stabilization



Photo 4: Local chef with miso soup and featured salted kelp.



Photo 5: Grinding kelp prior to fermentation and production of a stabilized kelp slurry for plant biostimulants



Photo 6: Buckets of finished fermented/stabilized kelp slurry to be tested as a plant biostimulant



Photo 7: Community processing workshop hosted with APMI in the Native community of Port Graham



Photo 8: Sharing seaweed salad made from salted kelp with community members in Port Graham

SNAPSHOT SUMMARY SLIDESHOW

As well as this report, we are asking for a short slideshow presentation overview of your project. Think of this as your lightning talk style report. Something that can be shared to industry partners that is easily accessible and includes highlighted outcome data, photos, etc.

APPENDIX A

1. 2024 Season Data
<https://docs.google.com/spreadsheets/d/1aupSPmgrpEjsnhhBmWfJVU6hZX6YmJgddzB12jXBaRY/edit?usp=sharing>
2. IR Test Results
<https://docs.google.com/spreadsheets/d/1aupSPmgrpEjsnhhBmWfJVU6hZX6YmJgddzB12jXBaRY/edit?usp=sharing>
3. Midwest Lab Reports for Food-Grade Products
 - a. Dried Alaria,
https://drive.google.com/file/d/1Mn3ge2ysnXy_YDh04ln3vPxAMcTYsMXf/view?usp=sharing
 - b. Dried Sugar Kelp
<https://drive.google.com/file/d/1k9WLCwaHgdjr8lgcahtL3kpp7a3Pw60L/view?usp=sharing>
 - c. Salted Sugar Kelp
<https://drive.google.com/file/d/1VyJOKRnHafRBxVzXzUp5bGvmFeY4se4z/view?usp=sharing>
4. Spoitz Lab Results for Plant Biostimulants
<https://drive.google.com/file/d/1hVjx83L1rq3wCX5yRBZOQGXPvvXALiz/view?usp=sharing>
5. Kodiak Science Center Salted Kelp Mold Test Results
https://drive.google.com/file/d/1VZAHLN3ukGEiKwUIBMMEp5cdjD13_tef/view?usp=sharing