Quarterly Progress Report

Project Title: Kelp-based Amendments to Increase Agricultural Carbon Storage (KAIACS)

Reporting Period: May – July 2026

Submitted to: Alaska Mariculture Cluster / Southeast Conference

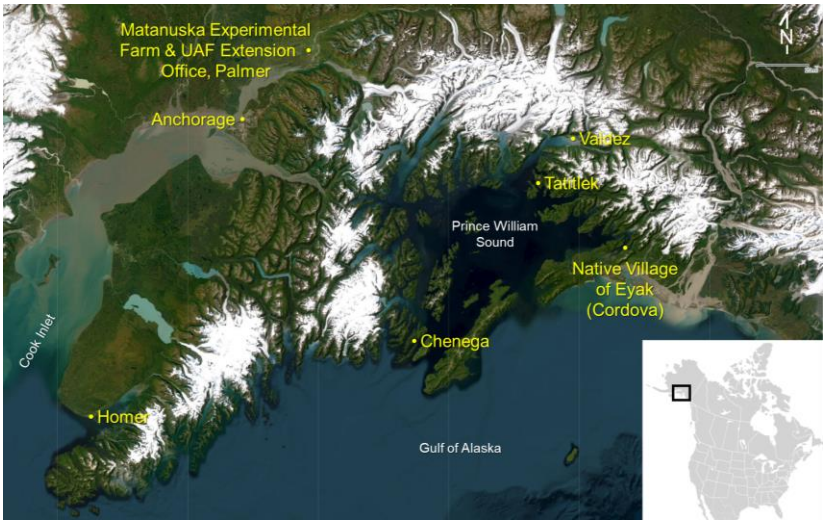
Submitted by: Native Village of Eyak

In Partnership with Washington State University and the Matanuska Experimental Farm & UAF Extension Office

Project Overview

The Native Village of Eyak (NVE) in partnership with Washington State University is leading the Kelp-based Amendments to Increase Agricultural Carbon Storage project (KAIACS) to evaluate whether sugar kelp, grown through the Tribe's mariculture program, can be used as an amendment to improve soil health in a manner that may enhance carbon sequestration in agricultural fields. The project included laboratory trials in winter 2025/2026 and field components in summer 2026 to understand these dynamics. Laboratory incubations determined how kelp and carbon amendments affected microbial activity, nutrient cycling, and carbon dynamics in soil under controlled conditions. Current field trials have then applied those findings to agricultural plots to evaluate how these amendments influence crop growth and soil health in real growing conditions.

During this reporting period, work focused on completing field trials during the 2026 growing season. This phase of the project has successfully lead to purchase of over 3,600 lbs of kelp from local Prince William Sound (PWS) kelp farmers, planting of almost 200 zucchinis in soil treated with various amounts of kelp and cardboard, and the involvement of several interns looking to explore careers in mariculture.



Map of Southcentral Alaska where the present study took place at the Matanuska Experimental Farm and where sugar kelp was grown in the Prince William Sound.

Review of Task 1: Laboratory Trials

During the previous reporting period, laboratory incubation experiments were completed at the Matanuska Experiment Farm and UAF Extension Office (MEF) in partnership with Washington State University. These experiments evaluated sugar kelp alone and in combination with shredded cardboard to determine how different carbon to nitrogen (C:N) ratios influence microbial activity, nutrient availability, and soil carbon dynamics. Six amendment treatments were tested over a 56-day incubation period, including kelp only, cardboard only, three kelp and cardboard combinations targeting final C:N ratios of 20:1, 30:1, and 50:1, and an unamended

control. Throughout the experiment, soil respiration, microbial biomass, available nitrogen, active carbon as potassium permanganate oxidizable carbon (POXC), pH, and salinity were measured to evaluate how each amendment affected soil function.

Results demonstrated that combining kelp with shredded cardboard produced a more balanced soil amendment than kelp alone. While kelp-only treatments generated a rapid increase in microbial activity and nitrogen availability, the combined treatments sustained microbial activity over a longer period and increased microbial biomass while maintaining higher levels of active soil carbon. These findings suggest that balancing carbon and nitrogen inputs improves microbial function and may promote greater carbon retention within the soil. The laboratory results were used to refine the 2026 summer field trial by selecting amendment rates, determining appropriate carbon to nitrogen ratios for the combined treatments, and informing the timing of amendment application before planting. The field experiment described in this report builds directly upon these laboratory findings and represents the next phase of evaluating kelp-based soil amendments under agricultural growing conditions.

Task 2: Field Trials

Following completion of Task 1: Laboratory Trials, the KAIACS project entered the field implementation phase at the beginning of the growing season in May 2026. The laboratory results showed evidence that combining sugar kelp with the carbon-rich shredded cardboard could improve microbial activity and nutrient cycling compared to kelp alone. These findings were used to refine the experimental design for the field study, where amendment performance could be evaluated under realistic agricultural conditions.

During the 2026 spring kelp harvest season, NVE staff and Prince William Sound College interns harvested sugar kelp from NVE's Sheep Bay Research Farm and purchased additional kelp from local growers, as described in **Task 3**. An unusually warm and sunny weather window, with temperatures exceeding 70°F (21°C), provided an opportunity to begin drying kelp outdoors before transporting it to MEF. Wet kelp was spread across tarps and allowed to dry in direct sunlight. Kelp exposed to approximately 12 hours of continuous sunlight dried sufficiently for transport, while partially dried material was moved to Palmer where drying was completed in the MEF greenhouse.

Not all harvested kelp reached the desired moisture content before transportation. Rather than discarding this material, it was incorporated into NVE's parallel composting project where it was combined with sawdust and shredded cardboard to produce compost for future Tribal gardening and soil amendment applications. This approach maximized use of the harvested kelp while supporting NVE's broader goal of developing locally produced soil amendments that can improve food production and provide Tribal members with affordable alternatives to commercial fertilizers and imported soil.

Field trials were established at MEF’s agricultural plots. Building on the successful 2025 carrot trials, this year's experiment expanded to include a crop species with different nutrient requirements compared to carrots. Zucchini served as the primary research crop and received the full suite of amendment treatments.

Prince William Sound College intern Michelle Ladd lays out partially dried sugar kelp to complete the process in the greenhouse of the Matanuska Experiment Farm and UAF Extension office in Palmer, AK. Photo credit: NVE

Prior to amendment application, baseline soil samples were collected from each experimental plot. These samples were submitted to Brookside Laboratories for analysis of total carbon, total nitrogen, and micronutrient concentrations (results are pending). Additional soil was retained for in-house analyses, including microbial respiration, microbial biomass, available nitrogen, POXC, salinity, and pH. Collecting baseline data before treatment application will allow changes in soil properties to be measured throughout the growing season and attributed to specific amendments.

Nine amendment treatments were evaluated in the zucchini plots using a randomized complete block design with four replicate plots per treatment. Treatments included an untreated control, a commercial fertilizer treatment, cardboard only, dried sugar kelp applied at rates of 1000, 2500, and 5000 lbs. per acre, and three combined kelp and shredded cardboard treatments. Each combined treatment received the same kelp application rate of 2500 lbs. per acre, while the amount of shredded cardboard varied to achieve target final soil carbon to nitrogen ratios of 20:1, 30:1, and 50:1. This design allows direct comparison between conventional fertilizer practices, kelp-only amendments, and kelp combined with an additional carbon source.

To encourage microbial decomposition before planting, kelp and kelp + cardboard treatments were incorporated into the soil approximately two weeks before crops were planted. This timing was based on findings from the laboratory incubations, which showed that microbial activity increases rapidly following amendment application. Allowing time for decomposition before planting should improve nutrient availability during early crop establishment. Commercial fertilizer was applied immediately before planting following standard agricultural practices.

Zucchini plants were started from seed in the greenhouse and transplanted (n = 180) to field plots during early June. Throughout the growing season, soil moisture has been monitored one to two times per week in each zucchini plot depending on weather conditions. A second round of soil sampling was completed approximately 30 days after amendment application to measure early changes in soil chemistry, microbial activity, nutrient availability, and active carbon. These

measurements will be compared with baseline conditions to evaluate treatment effects through time and discussed in the final report.

Routine field maintenance has continued. Experimental plots have been regularly weeded and monitored to minimize competition from surrounding vegetation and ensure consistent growing conditions across treatments. Crop growth, plant health, and general field conditions are documented throughout the season with additional soil and crop measurements planned through harvest.

Field plots of zucchini to test kelp amendment rates and carbon sequestration at the Matanuska Experiment Farm and UAF Extension Office in Palmer. Photo credit: NVE

Field implementation was supported by two interns, Michelle Ladd and Dakota Bell, through the Prince William Sound College Marine Natural Resource Technician Certification Program. Working alongside NVE and Washington State University staff, the interns participated in every stage of the field trial, including harvesting, processing, and drying sugar kelp, establishing research plots, transplanting zucchini, collecting soil samples, monitoring soil moisture, and maintaining the experimental plots through weeding. Their participation provided hands-on training in mariculture, agricultural research, soil science, and experimental design while strengthening the local workforce needed to support Alaska's growing mariculture industry. Ladd, an NVE Tribal member, also gained experience connecting mariculture research with Tribal food sovereignty initiatives by helping evaluate new uses for locally grown kelp as a sustainable soil amendment.

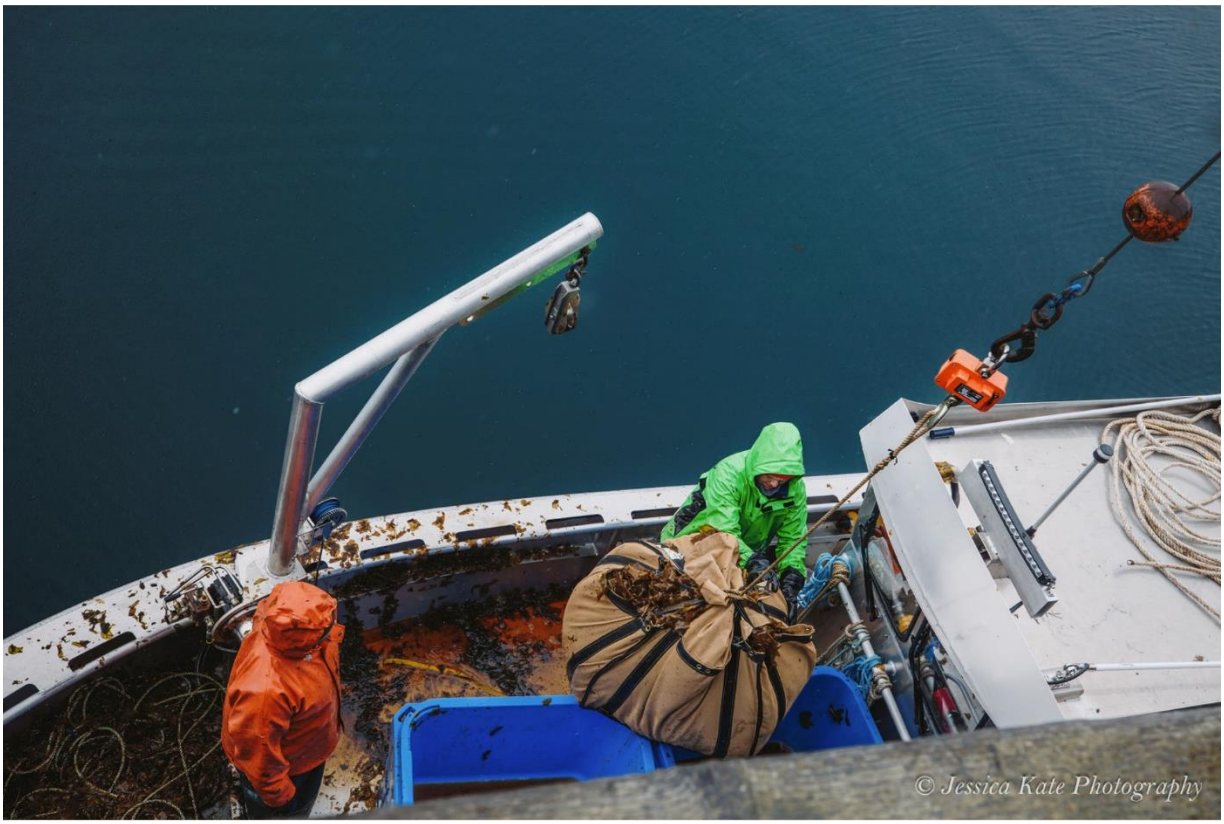
This field experiment represents the next phase of the KAIACS project by translating laboratory findings into an agricultural setting. The results will improve our understanding of how kelp-based soil amendments influence crop production, soil health, and carbon cycling under Alaskan growing conditions. The information gained from this work will help identify practical amendment strategies that can be applied by growers while advancing our understanding of how kelp can be used to sequester carbon in agricultural soils.

Task 3: Support Prince William Sound Kelp Farmers

Supporting the development of PWS's commercial kelp farming industry remained a central component of the KAIACS project during this reporting period. Throughout the 2026 harvest season, NVE coordinated closely with local kelp farmers to facilitate the procurement of kelp for

the project while helping address harvest and processing logistics during the busiest period of the season. In the months leading up to harvest, NVE staff participated in planning meetings organized by GreenWave with growers to coordinate harvest schedules, processing capacity, transportation needs, and opportunities for collaboration among producers.

Project staff also worked directly with growers throughout the harvest season to coordinate kelp deliveries and processing logistics. These logistics included coordinating pickup times, communicating processor availability, arranging temporary storage, and scheduling deliveries to maximize processor efficiency. This effort helped ensure that harvested kelp could be processed efficiently while reducing logistical challenges for participating farmers.



Commercial kelp farmers deliver sugar kelp to the docks in Cordova in May 2026. Photo credit: Greenwave and Jessica Kate Photography

During this reporting period, over 3,600 lbs. of kelp were purchased from PWS commercial kelp farms, including Royal Ocean Kelp Company, Noble Ocean Farms, and WildBlue Mariculture. The remaining kelp needed for the project was supplied from NVE's Sheep Bay Research Farm. Purchasing locally grown kelp directly supports regional mariculture businesses while creating new markets for Alaska-grown kelp beyond traditional food products.

Workforce development remained an important component of this effort. Through the partnership with Prince William Sound College and the Marine Natural Resource Technician Certification Program, NVE hosted three interns in Cordova during the 2026 kelp harvesting season. Two of these interns assisted NVE and Washington State University staff in Palmer at MEF. During the peak harvest period in May, the interns worked alongside NVE staff and local

commercial kelp farmers to support harvesting and post-harvest operations. Their responsibilities included harvesting kelp from commercial farms and NVE's research farm, transferring harvested kelp from vessels to the processing facility, sorting and grading kelp, assisting with new industrial processing techniques such as shredding and drying kelp, stabilizing wet product for shipment to buyers, and harvesting sugar kelp destined for both the KAIACS project and NVE's composting initiative.

Task 4: Project Administration and Reporting

Project management and coordination have continued throughout the reporting period. This includes financial tracking, procurement, partner coordination, and reporting. Communication between NVE, Washington State University, and MEF has supported successful completion of laboratory trials and ongoing field work.

Administrative work has ensured that the project remains on schedule and aligned with contract requirements. Reporting and invoicing have been completed in accordance with Southeast Conference guidelines.

Next Steps

- Harvest zucchinis produced by 180 plants for distribution to NVE Tribal members
- Collection of field data including soil characteristics, microbial community composition, soil carbon uptake, and zucchini biomass
- Analyze data collected and synthesize into understandable and actionable information
- Continue coordination with project partners
- Prepare final report including all data collected during this project

Kelp drying in the sun on a rare clear warm day in Cordova, AK. Photo credit: NVE