USE OF AN EDIBLE RED SEAWEED TO IMPROVE EFFLUENT FROM SHRIMP FARMS

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Sept 2009

Research location - Moloka'i

Molokai Aquaculture Project

- Seaweed production
- Seaweed nursery
- Fish culture
- Integrated seaweed-shrimp culture

Gracilaria parvispora

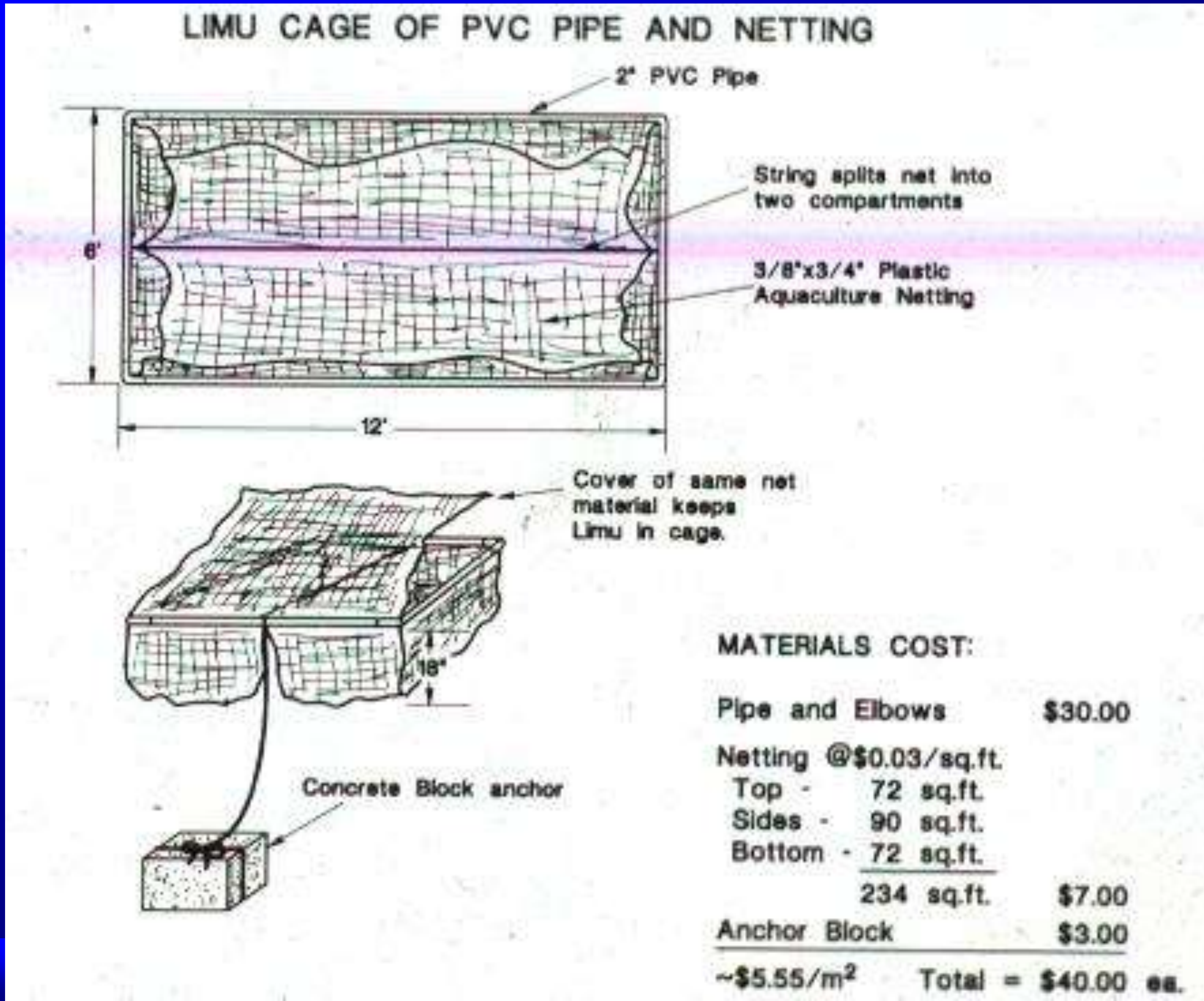
- Introduced from Japan
- Commonly called long ogo or long limu
- Wild harvest in Hawaii by Japanese, Filipinos and Native Hawaiians

Goals of the Moloka'i Project

- Cottage industry for Native Hawaiians in rural Hawaii.
- Re-introduce a traditional food to the Hawaiian diet.
- Market to chefs producing native dishes for tourist trade.
- Provide economic incentive to protect ancient Hawaiian Fish Ponds

Cages stocked in Uahaulapue Fish Pond

Simple cage construction



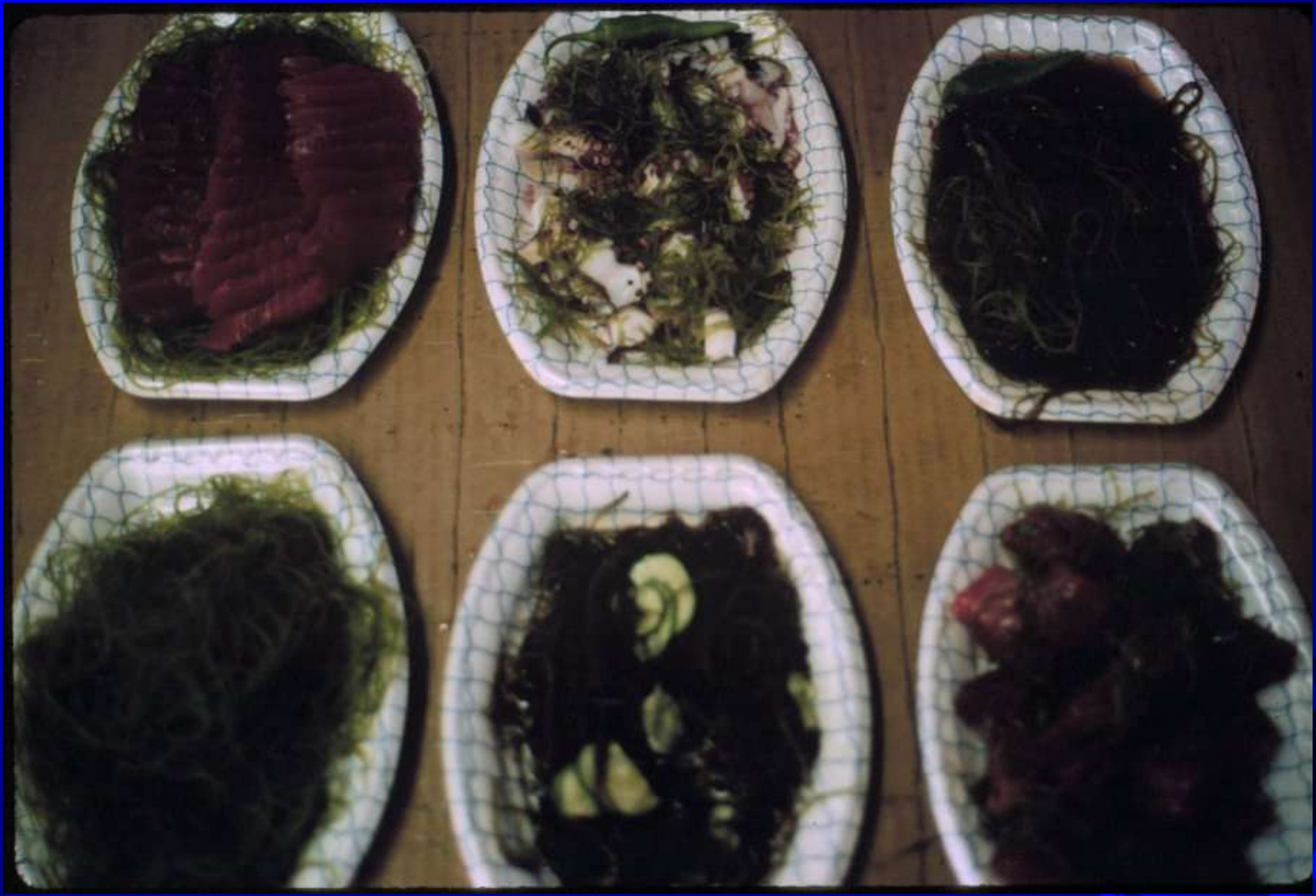
Gracilaria being washed in cage

Rinsing *Gracilaria* at harvest

Packing *Gracilaria* for off-island markets

Seaweed market outlet

w/ Tuna   w/ Octopus   Kimchi



Blanched   w/cucumber and oil   w/ Ono

Environmental impacts from conventional shrimp culture

- **Effluents and nutrient enrichment.**
- **Destruction of mangroves.**
- **Diseases, exotic species, genetic contamination.**
- **Changes in estuarine flow patterns.**

Green Peace says

Ohia shrimp farm pond

Ohia shrimp farm

- Slightly inland - behind mangroves (which are not native to Hawaii)
- Effluent goes to through drain channel to leach channel.
- Effluent filters through porous soil and coral rubble, into ocean.

Drain channel and leach channel

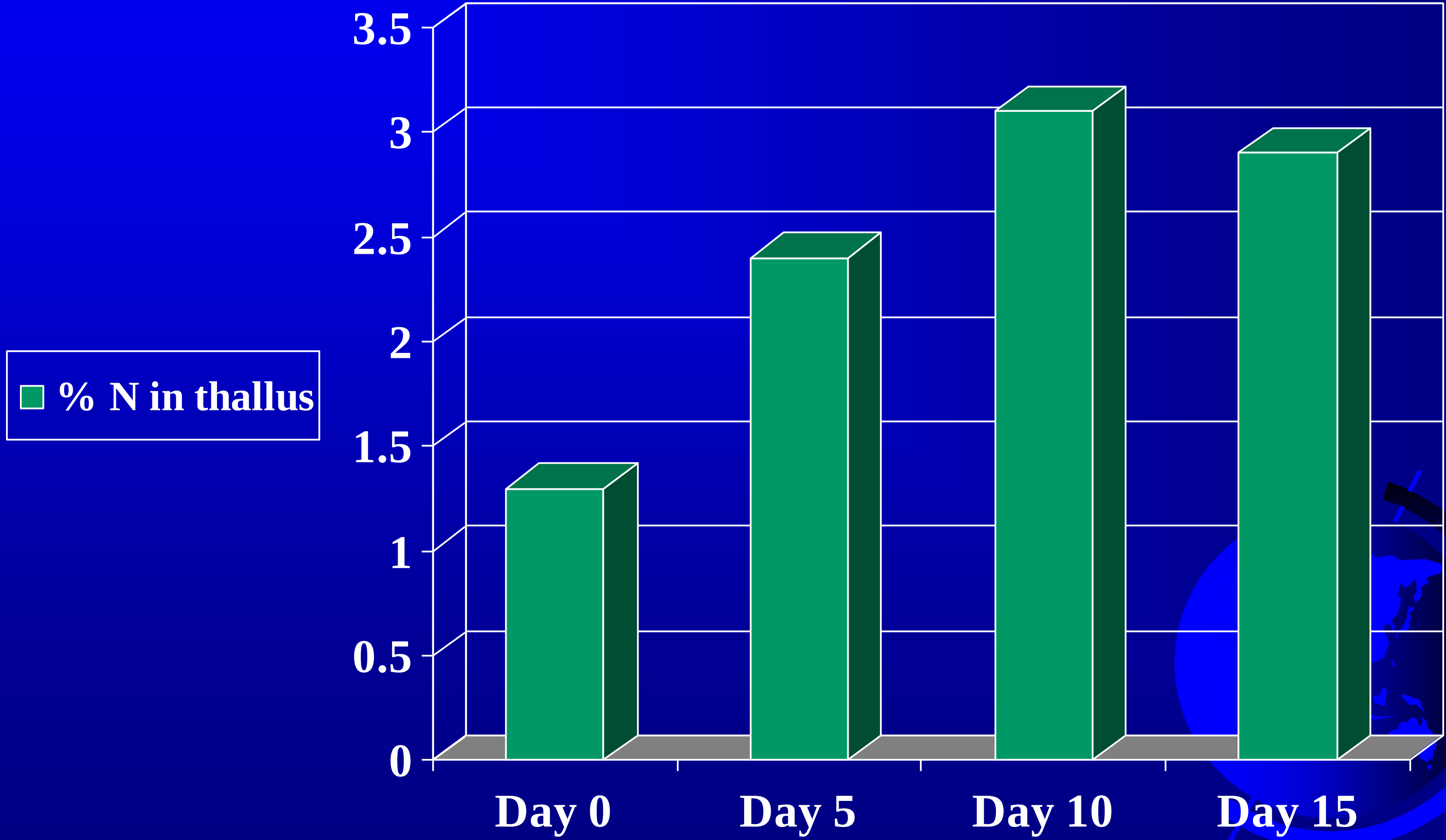
Gracilaria was stocked into effluent drain and leach pond

- *Gracilaria* was removed from cages in ponds.
- Individual thalli were weighed and stocked into effluent channel at 4 kg/m^3.
- Thalli were weighed weekly.
- Samples were taken for C:N determination.
- Water samples analyzed for NH_4, NO_3, PO_4 and turbidity.

Ave. water quality in effluent channel

- NH_4 = 62 mmol m^3 (1.1 mg/l)
- NO_3 = 2.9 mmol m^3 (0.2 mg/l)
- PO_4 = 3.7 mmol m^3 (0.35 mg/l)
- Turbidity = 4.0 NTU

Nitrogen content increase in thalli (% N)



G. parvispora growth in effluent channel

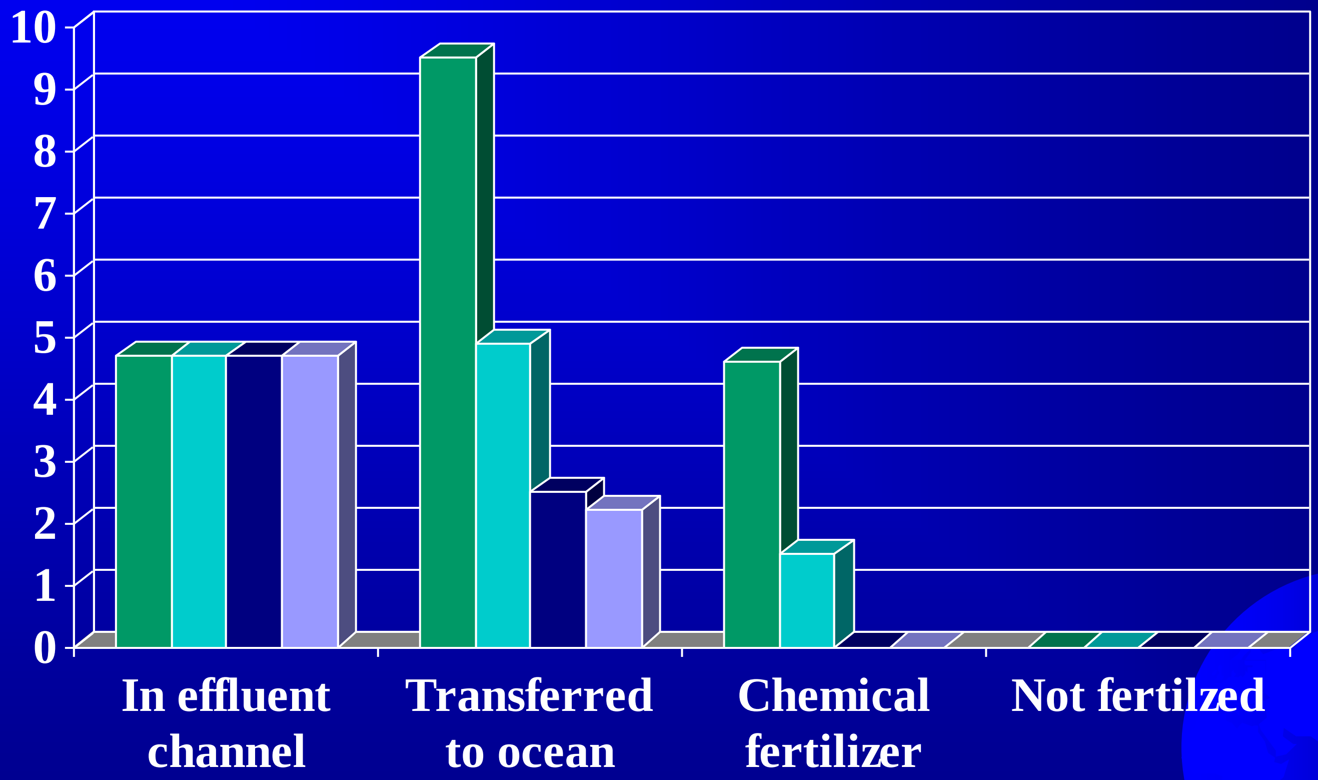
- 4.7 % daily relative growth rate
- Nitrogen content increased from 1.3% to 3.1%
- C:N ratio decreased from 30:1 to 10:1

G. parvispora returned to cages in ponds

- Treatment 1: Thalli from effluent channel stocked into cages stocked in pond
- Treatment 2: Thalli fertilized in on shore tanks with commercial fertilizers, stocked into pond
- Treatment 3: Thalli placed in tanks, no fertilizer, returned to cages in pond

Cages stocked in pond after soaking in shrimp farm effluent

Relative daily growth rates over 4 weeks



Results

- Thalli in effluent channel removed (fixed) 3 kg of N per every 100 kg of seaweed placed in channel.
- *G. parvispora* in channel grew 4.7 % per day.
- *G. parvispora* fertilized in channel and stocked back into cages in pond, grew 9.7% per day for first week.

Conclusions

- *G. parvispora* can grow in effluent channels and remove large amounts of nitrogen.
- The seaweed probably also removes significant amounts of other pollutants (nutrients).
- *G. parvispora* can be fertilized in channel and placed in cages in ponds for rapid growth.

Conclusions

- *Gracilaria* can also be used at salmon farms to reduce wastes, algae yield of 49 kg m^2 per year (Buschmann et al., 2001).
- We are also testing at experimental farms in Mexico and Eritrea.
- Shrimp and fish farms integrated with seaweed production should be economically and ecologically sustainable.

Acknowledgments

- USDA-SARE
- Office of Hawaiian Affairs
- Ke Kua Aina Limu Growers Coop