ENHANCING MARINE AQUACULTURE IN THE TROPICAL U.S.: METHODS FOR SUSTAINABLE COMMERCIAL CO-CULTIVATION OF SHELLFISH AND SEAWEED IN FLORIDA

***What*:** A workshop to provide an overview of a recently funded Saltonstall-Kennedy award (FY-21) that is exploring methods for sustainable commercial co-cultivation of shellfish and seaweed in Florida. In addition to invited talks from experts in the field, the project team will update audience on project objectives and engage participants in discussions about industry potential.

***When*:** Thursday, November 17, 2022, *Time:* 1:00 – 4:00 PM Eastern Time
Did you miss it? No worries, the recorded workshop is here or here: https://youtu.be/eiUYElUPk8s.

WORKSHOP AGENDA

I. Introductions and overview of project objectives
Dr. Loretta Roberson & Dr. Aaron Welch

II. Background on topic (30 minutes)

Experts will discuss successful examples from other parts of the U.S.

- Dr. Charlie Yarish, University of Connecticut: *Seaweed Aquaculture for Nutrient Bioextraction & Ecosystem Services*
- Dr. Scott Lindell, Woods Hole Oceanographic Institution: *Sea Vegetable Farming in Coastal Embayments*
- Industry practitioners:
  - Kendall Barbary, GreenWave: *Seaweed: An Industry Perspective* and
  - Dr. Michael Doall, Stony Brook University: *A Farmer Perspective*

III. Florida Project Review

Project team will provide detailed update on project status and discuss potential market.

- Dr. Loretta Roberson, Marine Biological Laboratory: *Seaweed Production in Florida: Current Project Overview*
- Dr. Aaron Welch, Two Docks Shellfish: Seaweed Production in Florida: *Business applications and market reality*

IV. Facilitated Panel Discussion and Audience Q & A

Panelists include speakers above as well as the following regulatory and Extension experts:

- Charlie Culpepper and Portia Sapp, Florida Department of Agriculture and Consumer Services, Division of Aquaculture
- Anoushka Concepcion, University of Connecticut and Connecticut Sea Grant

LINKS TO ADDITIONAL RESOURCES AND NOTES FROM WORKSHOP CHAT

Link to workshop recording: https://youtu.be/eiUYElUPk8s

Additional contact info for presenters:

- Aaron Welch: http://www.twodocksshellfish.com/our-roots
- Loretta Roberson: https://www.mbl.edu/research/faculty-and-whitman-scientists/Loretta%20Roberson
- Charles Yarish: https://eeb.uconn.edu/charles-yarish/
- Scott Lindell: https://www2.whoi.edu/site/lindell-lab/
- Kendall Barbary: https://www.greenwave.org/
- Mike Doall: https://www.instagram.com/michaeldoall/
- Anoushka Concepcion: https://seagrant.uconn.edu/person/anoushka-concepcion/
- Charlie Culpepper: https://www.fdacs.gov/Divisions-Offices/Aquaculture
- Angela Collins: https://www.flseagrant.org/fsg-directory/dr-angela-collins/

Relevant publications as provided during the workshop chat:

What can you do with excess Gracilaria? Extract agar:

Rocha C.M.R., A.M. Sousa, J.K. Kim, J.M.C.S. Magalhães, C. Yarish and M.P. Gonçalves. 2019 (April). Characterization of agar from cultivated Gracilaria tikvahiae: influence of environmental conditions on the agar quality. Food Hydrocolloids 89:260-271. https://doi.org/10.1016/j.foodhyd.2018.10.048.

Kim, J.K., G. Kraemer and C. Yarish. 2019 (June). Food safety evaluation of farm grown Gracilaria tikvahiae and Saccharina latissima in Long Island Sound and New York Estuary. Algal Research 40, June 2019 https://doi.org/10.1016/j.algal.2019.101484

Stefenoni, H.A., S. E. Räisänen, S. F. Welchez, D. E. Wasson, C. F. A. Lage, A. Melgar, M. E. Fetter, P. Smith, M. Hennessy, B. Vecchiarelli, J. Bender, D. Pitta, C. L. Cantrell, C. Yarish and A. N. Hristov. 2020. Effects of the macroalga Asparagopsis taxiformis and oregano leaves on methane emission, rumen fermentation, and lactational performance of dairy cows. J. Dairy Sci. 104 (4) https://doi.org/10.3168/jds.2020-19686

Vijn, S., D.P. Compart, N. Dutta, A. Foukis, M. Hess, A.N. Hristov, K. Kalscheur, E. Kebrea, S. Nuzhdin, N.N. Price, Y. Sun, J.M. Tricarico, A. Turzillo, M. Weisbjerg, C. Yarish and T. Kurt. 2020. Key Considerations for the Use of Seaweed to Reduce Enteric Methane Emissions from Cattle. Front. Vet. Sci., 23 | https://doi.org/10.3389/fvets.2020.597430

Cottier-Cook, E.J., N. Nagabhatla, A. Asri, M. Beveridge, P. Bianchi, J. Bolton, M. Gondad-Reantaso, J. Brodie, A. Buschmann, J. Cabarubias, I. Campbell, T. Chopin, A. Critchley, P De Lombaerde, V. Doumeizel, C.M.M. Gachon, L. Hayashi, C.L. Hewitt, J. Huang, A. Hurtado, C. Kambey, G.H. Kim, V. Le Masson, P.E. Lim, T. Liu, G. Malin, I. Matoju, V. Montalescot, F.E.

Msuya, P. Potin, M. Puspita, Z. Qi, L. Shaxson, I. Sousa Pinto. G D. Stentiford, J. Suyo and C. Yarish. 2021. Ensuring the Sustainable Future of the Rapidly Expanding Global Seaweed Aquaculture Industry – A Vision. UNU Institute on Comparative Regional Integration Studies. PB - 2021 – 6. 15pp. (UNU-CRIS Policy brief). https://cris.unu.edu/gsstarpolicybrief

Wasson, Derek E., C. Yarish and A.N. Hristov. 2022. Enteric methane mitigation through Asparagopsis taxiformis supplementation and potential algal alternatives. Frontiers in Animal Science, pp 1-10; http://doi.org/10.3389/fanim.2022.999338

Han S., J-S. Park, S. Umanzor, C. Yarish and J.K. Kim. 2022 Sargassum horneri, a new source of biostimulant: the effect of extraction methods on the growth of a red alga, Neopyropia yezoensis. Scientific Reports, https://www.nature.com/articles/s41598-022-16197-0

Redmond, S., Green, L., Yarish, C., Kim, J.K., Neefus, C. 2014. "New England Seaweed Culture Handbook" Seaweed Cultivation. Paper 1. https://opencommons.uconn.edu/seagrant_weedcult/1/

Yarish, C., J.K. Kim, S. Redmond, C.D. Neefus and L. Green. 2014. Part 1-6. Seaweed Culture in New England. https://seagrant.uconn.edu/2014/01/01/new-england-seaweed-culture-handbook-nursery-systems/ 93 pp.

Redmond, S., J.K. Kim, C. Yarish, M. Pietrak and I. Bricknell. 2014. Culture of Sargassum in Korea: techniques and potential for culture in the U.S. Orono, ME: Maine Sea Grant College Program. http://seagrant.umaine.edu/files/SargassumManual_070914.pdf . 13 pp.

Links to relevant websites and other online resources:

NOAA Sea Grant Seaweed Hub: https://seaweedhub.org/

- State of the States of Domestic Seaweed, updated annually: https://seaweedhub.org//wp-content/uploads/2022/09/State-of-the-States_For-Posting_Sept2022.pdf
- National Seaweed Nursery Directory, updated annually: https://seaweedhub.org//wp-content/uploads/2022/07/National-Seaweed-Nursery-Directory_Final2022.pdf
- Seaweed market outlet infographic: https://seaweedhub.org/commercially-cultivated-domestic-seaweed-101-infographic/

FAO WHO Report on Seaweed Food Safety:
https://www.fao.org/documents/card/en/c/cc0846en/

Safe Seaweed Coalition – building a safer seaweed industry globally:
https://www.safeseaweedcoalition.org/

Florida Department of Agriculture shellfish harvesting and aquaculture lease map: https://www.fdacs.gov/Agriculture-Industry/Aquaculture/Shellfish-Harvesting-Area-and-Aquaculture-Lease-Map

State of the States for Seaweed: https://seaweedhub.org/https-seaweedhub-org-wp-content-uploads-2022-09-state-of-the-states_for-posting_sept2022-pdf/

Seaweed Culture in New England, 6 Video play list: https://www.youtube.com/playlist?list=PLjT8rkCZmfJex1Eyr0IIlXlW8lsp90WPC

Seaweed Aquaculture in Connecticut: https://portal.ct.gov/DOAG/Aquaculture1/Aquaculture/Seaweed

- CT Seaweed Food Safety Guide: https://seagrant.uconn.edu/wp-content/uploads/sites/1985/2020/01/Seaweed-Hazards-Guide_Jan2020_accessible.pdf
- CT Aquaculture Permitting Guide: https://seagrant.uconn.edu/2019/09/30/guide-to-marine-aquaculture-permitting-in-ct-now-available/

Leslie Sturmer noted that Randy Laabe with Atlantic Corp just revealed their results of a NOAA-funded project looking at consumer preferences and attitudes for farm-raised seaweeds. The dashboard is really neat, but the url is very long: https://app.powerbi.com/view?r=eyJrIjoiODhmN2UyOTUtMmIwYy00MDFiLWJmYTgtNGNlMGI4MjBiMjAxIiwidCI6ImVmY2VjMmM5LTQzYTEtNDEzMy04MzkyLThiZWJhNzMxZGRhYiJ9&pageName=ReportSection8358f1c56e7525225300

The first seaweed food safety guide in the country: https://seagrant.uconn.edu/wp-content/uploads/sites/1985/2020/01/Seaweed-Hazards-Guide_Jan2020_accessible.pdf

On the food safety side, the regulatory requirements will largely hinge on the intended use of the finished product (RTE?), and how the product is processed. In short, if its considered Ready to Eat, it may fall under the Preventive Control for Human Foods (PCHF) 21 CFR 117, which is considerably more stringent than the Seafood HACCP reg, 21 CFR 123. https://nsglc.olemiss.edu/projects/regulatingseaweed/files/seaweed-food-safety-webinar.pdf

GreenWave value chain coordination effort called Seaweed Source: https://www.greenwave.org/seaweed-source

FAO WHO report on seaweed food safety and considerations: https://www.fao.org/documents/card/en/c/cc0846en/

General comments:
Anoushka Concepcion notes they are growing seaweed in land based systems, Small-scale at the Bridgeport Aquaculture High School

Kendall Barbery (GreenWave): We do not site above SAV sites. There are some emerging studies out of University of New England (Dr. Carrie Byron's lab), University of Auckland (Dr. Andrew Jeffs' lab), and others looking at impacts of seaweed farms on biodiversity.

Loretta Roberson: Great point about site selection and partnerships Kendall! A research lease is much easier to get than a commercial lease. In addition, our approach was to permit multiple sites for small scale testing with vertical lines and selecting one optimal site to put in the large gear.

Scott Lindell: If FL is interested in encouraging seaweed farming, it might consider Limited Production Applications for small scale trials. A good model for this is Maine's example with 400 sq ft limit and streamlined permitting.

Charles Yarish: Florida has had tank cultivation of red seaweed at Oceanographic Inst. (FAU) and the University of Miami (Aplysia cultivation).
Charles Yarish: Crop Insurance is now available for seaweed (algae) from the farm bill.
Charles Yarish: The Algae Biomass Organization (ABO) has been working on assisting the algae industry in getting crop insurance.

Charles Yarish: See these companies for [using seaweed in] animal feeds: The Source (Maine) and North American Kelp (Maine).

Kendall Barbery (GreenWave): Ocean Rainforest, in conjunction with the ANCIENT MARINER team led by Dr. Mike Stekoll at UAF, is testing use of fermented kelp products as silage for pigs.

Charles Yarish: SBIR Phase 1&2 at USDA and NOAA have funds for businesses [that may be applicable to starting a new business venture in seaweed.]

Kendall Barbery (GreenWave): USDA Climate Smart Commodities program may also be appropriate for this research.

Charles Yarish: As levels of nitrogen drop in Gracilaria tissue, agar content increases!

Loretta Roberson: FDACS has been really proactive about this and getting seaweed gear approved for use in shellfish harvesting areas was a great way to get rapid approval for seaweed farming, and as Charlie Culpepper mentioned, they are working on getting approval for outside those areas.

Anoushka Concepcion provided an example of that permitting looks like in Connecticut: CT permitting guide: https://portal.ct.gov/DOAG/Aquaculture1/Aquaculture/Permit-Requirements-for-Aquaculture-in-Connecticut

Kendall Barbery (GreenWave) notes that for seaweed farming, on most sites, farmers have to secure permits from Army Corps and well as other state and local agencies.