

COMMENTARY

Developing a nascent agriculture industry: Lessons learned with sugar kelp

Stacey F. Stearns^{a*} and Anoushka Concepcion^b
University of Connecticut

Submitted May 4, 2024 / Accepted May 5, 2024 / Published online June 17, 2024


Citation: Stearns, S. F., & Concepcion, A. (2024). Developing a nascent agriculture industry: Lessons learned with sugar kelp [Commentary]. *Journal of Agriculture, Food Systems, and Community Development*, 13(3), 131–134. <https://doi.org/10.5304/jafscd.2024.133.028>


Copyright © 2024 by the Authors. Published by the Lyson Center for Civic Agriculture and Food Systems. Open access under CC BY license.

Seaweed is developing into a nascent agricultural industry in the United States. It has long been a staple in Asian and other diets, used in a variety of food dishes because of its taste and nutritional benefits that could rank it among the superfoods (Cherry et al., 2019). Although sugar kelp (*Saccharina lattissima*) is native to Connecticut's coast (Redmond et al., 2014), its use as a food product in Connecticut and in other parts of the U.S. is limited because there is a need for post-harvest and marketing infrastructure (Venolia et al., 2020;

Yarish et al., 2017; Yarish et al., 1998). The Cooperative Extension System and Sea Grant programs are frequently asked to help develop new agricultural products, methods, and market strategies. Connecticut Sea Grant Extension is developing the nascent sugar kelp industry, and this commentary outlines the lessons learned.

Fishing communities and those economically dependent on our waterways are seeking options for diversification because overfishing and the changing climate are decreasing their viability (Engle et al., 2018). In Connecticut, sugar kelp production happens during the fall and winter, which means shellfish farmers could add another crop—sugar kelp—without disrupting their current production practices (Connecticut Sea Grant, 2020; Kim et al., 2015). Connecticut Sea Grant started exploring the state's sugar kelp industry with applied research that showed gaps in the infrastructure and markets needed for a robust sugar kelp industry, as well as identifying target audiences for farmers and consumers (Getchis et al., 2020; Kotowicz et al., 2024; National Seaweed Hub,

^{a*} *Corresponding author:* Stacey F. Stearns, Communications Specialist, Cooperative Extension System, UConn College of Agriculture, Health and Natural Resources; 1376 Storrs Road, Unit 4134; Storrs, CT 06269-4134 USA; +1-860-486-9228;  <https://orcid.org/0000-0002-4711-7244>; stacey.stearns@uconn.edu

^b Anoushka Concepcion, Associate Extension Educator, Connecticut Sea Grant and Department of Extension, UConn College of Agriculture, Health and Natural Resources;  <https://orcid.org/0000-0002-6148-3240>; anoushka.concepcion@uconn.edu

2023). One gap in this applied research that future projects should consider is an economic analysis that determines how many farmers a sustainable industry can support and the total infrastructure and marketing investment needed to build it.

In the next applied research phase, team members researched and developed a guide on food safety practices and hazards for safe production and consumption for sugar kelp (Concepcion et al., 2020). A multifaceted approach helped develop strong working relationships with the Connecticut Department of Agriculture, the regulatory agency, as well as the aquaculture farmers with the greatest interest in the nascent industry. The team members presented webinars, continued the applied research, held events with chefs, and conducted numerous one-on-one meetings with current and prospective sugar kelp farmers. Establishing the National Seaweed Hub provided a national approach and best practices to leverage existing resources (Concepcion et al., in press).

Farmers face two major concerns when considering whether to engage in sugar kelp production: a lack of processing and product manufacturing infrastructure, and a lack of consistent and profitable consumer markets. While there is interest in product diversification through sugar kelp, the infrastructure, support systems, and markets still need further development. Addressing these challenges is something Connecticut Sea Grant Extension is facilitating with all vested parties while recognizing that solutions need to be collaborative and sustainable. This need is further highlighted by the increasing number of prospective kelp farmers entering the industry with high expectations for this new crop.

The lack of infrastructure and market-support systems creates barriers for new entrants to an industry that the current support systems could quickly saturate. This is especially of concern in Connecticut, where farmers are forced by a lack of processing facilities to sell local sugar kelp in its highly perishable fresh (wet) form while in season, but they want to expand that market without oversaturating it (Tian et al., 2022). Infrastructure investment to support manufacturing to expand into other product forms and commodities (e.g., nonfood, including fertilizer) could ensure the sus-

tainability of this emerging industry; however, these forms and commodities are lower in value and require higher volumes to be profitable. The industry must find solutions for a myriad of additional challenges to move forward. These include access to real estate for production facilities (despite high-cost coastal real estate demands), the cost of manufacturing equipment, and the production scale needed for post-harvest infrastructure to be feasible, whether for an individual or a cooperative of farmers.

A further challenge is that many farmers are excited about sugar kelp and jumping into production without understanding this nascent agriculture industry's status. Although Sea Grant professionals and others have tried to communicate that the lack of infrastructure and market-support systems means few operations will be economically viable, many are adding sugar kelp production anyway. This may lead to an oversaturation of the existing market for fresh, in-season sugar kelp during the spring, and frustration for the farmers as they are left with unsold products.

Sugar kelp is not unique in facing these challenges. Açai, one of the many superfood berries produced in Brazil, had obstacles related to how to farm it (versus it growing wild), post-harvest handling, use in conjunction with other foods, and finally, consumer demand (Andrango et al., 1999; Araujo et al., 2024; Binois, 2012). While açai processing strategies exist, they are not always sustainable or cost-effective (Araujo et al., 2024), as is seen with sugar kelp; in both cases, a usable end-product that can be integrated into other foods is needed to realize the full market value. The post-harvest infrastructure is part of the value chain, and building this requires the cooperation of multiple stakeholders, and thus is a process in and of itself (Andrango et al., 1999).


A further challenge is that any post-harvest practices cannot diminish the nutritional value of the products, although those that augment it could be even more beneficial (Araujo et al., 2024). Research in sugar kelp is ongoing but somewhat limited, and this matches research funding trends. Investment in research would increase research and could find solutions to these challenges sooner (Araujo et al., 2024). Previous crops in various

countries have shown the team that the combination of infrastructure investment and education through Extension and other channels can help an agricultural product develop (Andrango et al., 1999; Hewett, 2012). Developing public policy is often a strategy to help develop nascent agricultural sectors (Iles & Marsh, 2012). Different avenues this can take include pathways for the ecosystem services that sugar kelp provides or helping remove constraints on farmer knowledge and capabilities (Iles & Marsh, 2012).

We learned many lessons through the work with sugar kelp. First, developing any new product is time-intensive and all-consuming. While team members had other responsibilities in their roles, these projects were paused or reduced to focus on sugar kelp. Education and communication are crucial, and at times it can feel like the stakeholders are having the same conversations repeatedly, but these are necessary in building a coalition of stakeholders to work on the industry. Finally, whenever possible, manage expectations among the various stakeholder groups. Sugar kelp has become a magic bullet of sorts in the opinion of aquaculture farmers, and it may fail to fulfill these high expectations. Multiple strategies for managing expectations should be employed, especially in a nascent industry.

References

- Andrango, G., Blare, T., & Hareau, G. (1999). Functional foods: Fad or path to prosperity? Data visualization. *Choices*, 35(4). Agricultural and Applied Economics Association. https://www.choicesmagazine.org/UserFiles/file/cmstheme_762.pdf
- Araujo, N. M. P., Berni, P., Zandoná, L. R., de Toledo, N. M. V., da Silva, P. P. M., de Toledo, A. A., & Junior, M. R. M. (2024). Potential of Brazilian berries in developing innovative, healthy, and sustainable food products. *Sustainable Food Technology*, 2, 506–530. <https://doi.org/10.1039/D3FB00130J>
- Binois, D. (2012). *The obstacles to açai exportation in Brazil* [Master's thesis, School of Business Administration, São Paulo of the Getulio Vargas Foundation]. <https://hdl.handle.net/10438/9985>
- Cherry, P., O'Hara, C., Magee, P. J., McSorley, E. M., & Allsopp, P. J. (2019). Risks and benefits of consuming edible seaweeds. *Nutrition Reviews*, 77(5), 307–329. <https://doi.org/10.1093/nutrit/nuy066>
- Concepcion, A., Bradt, G., Chadsey, M., Clemetson, A., Good, M., Janasie, C., Otts, S., Reitsma, J., & Robidoux, J. (in press). Using virtual platforms to convene and engage diverse sectors of the emerging seaweed aquaculture industry. *Journal of Extension*.
- Concepcion, A., DeRosia-Banick, K., & Balcom, N. (2020). *Seaweed production and processing in Connecticut: A guide to understanding and controlling potential food safety hazards*. Connecticut Sea Grant. https://seagrant.uconn.edu/wp-content/uploads/sites/1985/2020/01/Seaweed-Hazards-Guide_Jan2020_accessible.pdf

While much work remains, the initial results from efforts in Connecticut, along with sugar kelp's global use and history, show the continued benefits and impact of involving Sea Grant and other Extension programs in developing new agricultural commodities and practices. The Extension model has a long history of helping build sustainable food systems. Potential ecosystem services provided by sugar kelp can add a greater benefit to its primary use as a food product (Crawford, 2022) and could be another factor influencing consumers and farmers. These experiences in building a nascent agricultural industry warrant further research questions, though. First, we should determine how a state or region can support infrastructure needs and at the same time build demand. Second, we should research the best way to build consumer demand for agricultural products. In this case, we focused on aiding farmers in their own marketing strategies and creating data visualizations. Future research could determine what works best for agriculture products, as sugar kelp will not be the last new product farmers want to try. Work with the sugar kelp industry is ongoing, and it has not transitioned from a nascent to an accepted agricultural industry yet. But the progress to date and indicators from other crops like açai offer an optimistic future for sugar kelp. 

- Connecticut Sea Grant. (2019). *Business and economic planning for seaweed aquaculture systems in the United States* [Funded proposal: NOAA-OAR-SG-2019-2005953]. <https://seagrants.uconn.edu/wp-content/uploads/sites/1985/2021/01/Selected-Projects-Sea-Grant-AQ-Econ-2021.docx>
- Crawford, I. M. (2022). *The solution in the sea: New York recently legalized commercial kelp farming. Will it help solve the state's environmental and economic woes?* [Master's thesis, Massachusetts Institute of Technology]. <https://hdl.handle.net/1721.1/147596>
- Engle, C., Cygler, A., Kotowicz, D., & McCann, J. (2018, August 13). Potential supply chains for seaweed produced for food in the northeastern United States [Final grant report]. University of Rhode Island & Rhode Island Sea Grant. https://repository.library.noaa.gov/view/noaa/38074/noaa_38074_DS1.pdf
- Getchis, T. L., Kelly, M. R., Concepcion, A. P. & Bovay, J. (2020). *The Connecticut seafood survey: Assessing seafood consumption, knowledge, behaviors and preferences of Connecticut residents* [Report CTSG-20-03]. Connecticut Sea Grant. https://seagrants.uconn.edu/wp-content/uploads/sites/1985/2020/04/CTSeafoodSurvey.final_.pdf
- Hewett, E. W. (2012). High-value horticulture in developing countries: Barriers and opportunities. *CABI Reviews*, 2012, 1–16. <https://doi.org/10.1079/PAVSNNR20127054>
- Iles, A., & Marsh, R. (2012). Nurturing diversified farming systems in industrialized countries: How public policy can contribute. *Ecology and Society*, 17(4), Article 42. <https://doi.org/10.5751/ES-05041-170442>
- Kim, J. K., Kraemer, G. P., & Yarish, C. (2015). Use of sugar kelp aquaculture in Long Island Sound and the Bronx River Estuary for nutrient extraction. *Marine Ecology Progress Series*, 531, 155–166. <https://doi.org/10.3354/meps11331>
- Kotowicz, D., Concepcion, A., Bradt, G., Chadsey, M., Clemetson, A., Good, M., Reitsma, J., & Robidoux, J. (2024). Needs of the US domestic aquaculture seaweed industry. *North American Journal of Aquaculture*. [Forthcoming].
- National Seaweed Hub. (2023). *National Sea Grant seaweed hub results of needs assessment*. <https://seaweedhub-extension.media.uconn.edu/wp-content/uploads/sites/3646/2023/03/Needs-Assessment-Results-1.25.21.pdf>
- Redmond, S., Green, L., Yarish, C., Kim, J., & Neefus, C. (2014). *New England seaweed culture handbook- nursery systems* [Publication CTSG-14-01]. Connecticut Sea Grant. https://opencommons.uconn.edu/seagrants_weedcult/1
- Tian, Y., Croog, R., Bovay, J., Concepcion, A., Getchis, T. L., & Kelly, M. R. (2022). Who responds to health, environmental, and economic information about local food? Evidence from Connecticut seafood consumers. *Aquaculture Economics & Management*, 26(2), 131–151. <https://doi.org/10.1080/13657305.2021.1945166>
- Venolia, C. T., Lavaud, R., Green-Gavrielidis, L. A., Thornber, C., & Humphries, A. T. (2020). Modeling the growth of sugar kelp (*Saccharina latissima*) in aquaculture systems using dynamic energy budget theory. *Ecological Modeling*, 430, Article 109151. <https://doi.org/10.1016/j.ecolmodel.2020.109151>
- Yarish, C., Kim, J. K., Lindell, S., & Kite-Powell, H. (2017). Developing an environmentally and economically sustainable sugar kelp aquaculture industry in southern New England: From seed to market. *Environmental and Experimental Botany*, Article 38. Retrieved from OpenCommons@UConn repository: https://opencommons.uconn.edu/eeb_articles/38
- Yarish, C., Wilkes, R., Chopin, T., Fei, X. G., Mathieson, A. C., Klein, A. S., Neefus, C. D., Mitman, G. G., & Levine, I. (1998). Domestication of indigenous *Porphyra* (nori) species for commercial cultivation in Northeast America. *World Aquaculture*, 29, 26–29, 55. Retrieved from The University of New Hampshire Scholars Repository: <https://scholars.unh.edu/jel/242/>