The Journal of Extension

Volume 62 | Number 3 Article 18

9-8-2024

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Recommended Citation

Concepcion, A., Bradt, G., Chadsey, M., Clemetson, A., Good, M., Janasie, C., Otts, S., Reitsma, J., & Robidoux, J. (2024). Using Virtual Platforms to Convene and Engage Diverse Sectors of the Emerging Seaweed Aquaculture Industry. *The Journal of Extension, 62*(3), Article 18. https://open.clemson.edu/joe/vol62/iss3/18

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Cover Page Footnote

This project was funded by the Oceanic and Atmospheric Research (OAR), National Oceanic and Atmospheric Administration (NOAA), Department of Commerce, funding opportunity number: NOAA-OAR-SG-2019-2005963.

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JOURNAL OF Extension Ideas at Work Volume 62, Issue 3, 2024

Using Virtual Platforms to Convene and Engage Diverse Sectors of the Emerging Seaweed Aquaculture Industry

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Abstract. Engaging relevant stakeholders, specifically those with opposing views, is a challenge many Extension professionals face. Employing practical methods to engage opposing sectors is critical in implementing projects to ensure long-term success. Advocacy-driven messaging has fueled interest in seaweed farming, however, existing practical challenges have led to frustration from relevant sectors. The National Seaweed Hub serves as a central clearinghouse for available science-based, non-advocate, and practical resources related to the emerging domestic seaweed aquaculture industry. Through facilitated sector-driven work groups and other engagement activities, seaweed sectors collaborated and strategized to generate implementable projects, ideas and resources targeting barriers to industry expansion.

INTRODUCTION

Seaweed aquaculture—specifically, sugar kelp (*Saccharina latissma*)—is an emerging industry in the United States. Besides its use as food, seaweed is an important source of hydrocolloids (agar, alginate, and carrageenan) and can be used as fertilizer, in animal feed, in pharmaceuticals and cosmetics, and potentially in the production of biofuels and the provision of ecosystem services (Cai et al., 2021; McHugh, 2003). Currently, sugar kelp is primarily sold as food in the United States (National Seaweed Hub, 2023). Despite some interest, Sea Grant Extension professionals identified barriers preventing the expansion of this new industry as lack of identified and established diverse markets for domestic seaweed, lack of commercial-scale postharvest processing and storage, increasing food safety concerns and lack of guidelines, production methods that may be affected by regional and/or state differences, and lack of clarification in the permitting process for seaweed aquaculture.

Advocacy-driven messaging from nonprofits and media outlets touting the many environmental benefits and potential uses of seaweeds (mitigation of climate change, use in biofuels, use in cattle feed, etc.) further fuels interest, but established pathways for those outlets are nonexistent (Cai et al., 2021), leading to frustration for prospective growers and other sectors. As trusted, neutral brokers of science-based information and guidance, Sea Grant routinely fields inquiries from individuals interested in seaweed farming (personal communication, Sea Grant Extension, 2019). Therefore, it became necessary to better understand the current landscape of the industry and scope of challenges and provide science-based, practical resources in a mechanism that was easily accessible by multiple audiences.

Established in 2019 with funding through the National Oceanic and Atmospheric Administration (NOAA) National Sea Grant Program, the National Seaweed Hub is a collaborative, extension-based project of eleven Sea Grant programs (Alaska, California, Connecticut, Maine, Rhode Island, New Hampshire, New York, Oregon, Washington, Woods Hole Oceanographic Institution [Massachusetts], and the National Sea Grant Law Center) focused on (a) understanding the current landscape of the emerging seaweed industry in the United States; (b) addressing emerging challenges through outcome-based strategic planning; (c) and providing responsive, non-advocate resources in a publicly accessible format. Facilitated and guided by Sea Grant Extension (hereafter referred to as "Seaweed Hub Extension"), the National Seaweed Hub employs traditional and innovative engagement strategies to create a mechanism for seaweed sectors to collaborate, strategize, and generate implementable projects, ideas, and resources that target barriers to industry expansion. To better understand the current landscape, including needs and opportunities of the emerging domestic seaweed aquaculture industry, the first

comprehensive national needs assessment involving nine relevant sectors of the industry (e.g., farmers, regulatory authorities, researchers, nonprofit organizations, end users, and others) was deployed in January 2020 (Kotowicz et al., 2024), followed by the first National Seaweed Symposium, to gather baseline knowledge and ground-truth data from across the United States. The results of these activities identified common thematic topics that were considered barriers to the industry's expansion, which led to the formation of sector-driven work groups.

DEVELOPING RESPONSIVE RESOURCES THROUGH DIVERSE SECTOR ENGAGEMENT AND COLLABORATION

Most aquaculture sectors (i.e., industry, regulators, researchers) work in silos (Bento et al., 2020; Scott & Gong, 2021), rarely engaging due to opposing roles leading to mistrust of one another. In addition, states are at varying levels of seaweed production and commercialization, further contributing to siloed conversations and misaligned information. To address these issues, engagement practices to foster collaboration and strategic problem-solving across sectors, states, and regional boundaries were implemented.

VIRTUAL SECTOR-DRIVEN WORK GROUPS

Engaging relevant sectors representing diverse regions and roles in the seaweed industry is necessary to address national challenges. Capitalizing on the use of Extension professionals' ability to "establish partnerships and collaborations" (Warner et al., 2017) and Kahl's (2016) approach to reaching goals by bringing people together to work on an agreed-upon issue or challenge, Seaweed Hub Extension formed and facilitated four virtual sector-driven work groups (Marketing Opportunities, Postharvest and Processing Infrastructure, Regulations, and Production Systems) to reflect the common barriers identified in the needs assessment. The goal of each work group was to develop a strategy or work plan to address its topical barrier. Seaweed Hub Extension ensured that appropriate sectors and regions were represented, contributing to an informed and balanced discussion. Although stakeholders were compensated for their travel and participation in the National Seaweed Symposium to kick-start the work-group process, they were not compensated for their participation in the virtual work groups. Therefore, expectations were adjusted regarding level of effort.

Work-group participants reflected every seaweed-producing state as well as federal and state agencies involved in all aspects of seaweed aquaculture. In these work groups, Seaweed Hub Extension facilitated targeted discussions and used strategic thinking exercises (i.e., Strengths, Weaknesses, Opportunities, and Threats [SWOT] analysis) and virtual tools to prioritize challenges and opportunities that could be achieved in the short, medium, and long terms. Collectively, work-group participants identified more than 200 challenges, opportunities, and recommendations related to the four key topic barriers. Each work group generated ranked lists of priorities and tasks to serve as the basis for strategies or work-plan development.

Zoom Video Communications was the preferred platform used by Seaweed Hub Extension. Each work group was facilitated by two Extension professionals, one to lead the discussion and the other to serve as a note-taker and technical support, according to the methods suggested by Cagle (2022). Participants were recruited from state Seaweed Hub Extension contact and National Seaweed Symposium registration lists. Each work group met consistently over the course of 2 years (frequency varied between bimonthly and quarterly, depending on topic and focus) to refine potential tasks or project ideas down to at least two that were achievable and could be completed within the overall project's time frame. These strategies and work plans set the foundation for longer-term research and extension efforts to take place, establishing a collaborative and relevant path forward for this new industry. To encourage meaningful collaboration, applied project funds were provided to support the execution of small-scale projects (deliverables) achieving outcome-based results. Applied projects were short-term and goal-based and had to be completed within 1 year.

Seaweed Hub Extension employed several methods and tools to assist work groups in reaching their goals. In an emerging industry fueled by advocacy, many passionate voices are involved in trying to shape it. These personalities are often at odds with one another and rely on Sea Grant to create a "safe space" for discussion, transparency, and accountability. To address participant concerns, Seaweed Hub Extension created a Rules of Engagement document outlining acceptable behavior, expectations of participants, and goals for the work groups. Each work-group participant signed a virtual document to take part. To assist with refining tasks, Zoom polling and Miro whiteboard tools were used to ensure that all participants were able to contribute and to document (in real time) priority tasks to address. For topics that required more discussion, breakout rooms were established

through Zoom, enabling participants to choose their topic of interest and area of expertise. Meeting summaries and resources developed from work groups (including those from applied project activities) are available on the National Seaweed Hub's website (https://seaweedhub.extension.uconn.edu/) to ensure transparency, enable others to learn from work-group discussions, and empower work-group participants to feel proud of the progress they have made toward reaching their goals.

RESULTS

Seaweed Hub Extension effectively used virtual meeting tools to assist all four work groups with identifying strategies addressing their topical barrier. These strategies, including deliverables produced from applied projects, can be found in the Work Group Summary Fact Sheets posted on the National Seaweed Hub's website. Table 1 outlines each work group's progression toward identifying and refining short-term, achievable tasks resulting in the completion of applied projects and associated deliverables. Deliverables were reviewed by work-group participants prior to finalization and made available on the National Seaweed Hub's website.

Table 1. Overview of Work-Group Progression Toward Creating Needs-Based Seaweed Resources

Work group	Total C/O/R*	Goals	Deliverable
Marketing opportunities	60+	Build education and outreach. Identify product development needs and opportunities. Consider benefits and options for industry representation (associations, institutes, etc.).	Seaweed Marketing Toolkit
Postharvest and processing infrastructure	30+	Develop BMPs for seaweed harvest.	Resource for Seaweed Parameter Testing
Regulations	60+	Develop a user-friendly resource summarizing considerations for siting seaweed farms. Explore and outline the process for developing a seaweed-specific food-safety training course.	Interactive guide comparing Seafood HACCP and FSMA Preventive Controls and indicating where seaweed fits into each
Production systems	30+	Improve seed-stock supply. Increase nursery capacity.	An annually updated, Web-accessible national directory of seaweed seed sources

Note. BMP = best management practice; C/O/R = challenges/opportunities/recommendations

ADDITIONAL WORK GROUP RESOURCES DEVELOPED

In addition to the applied project deliverables, Seaweed Hub Extension used work-group discussions to develop additional responsive resources addressing multi-sector needs to facilitate informed decision-making. Two examples are provided below:

- Seaweed Postharvest Interactive Fact Sheet: The interactive fact sheet can be used when developing best management practices (BMPs) for postharvest handling and transport from seaweed harvest to sale.
- Infographic on Market Outlets for Cultivated Domestic Seaweed: This resource, providing an overview of the domestic seaweed aquaculture industry's market outlets (by most to least common), was produced by using input provided by virtual sector-driven work groups and common questions received by Sea Grant Extension. To ensure relevance and accuracy, the infographic was reviewed by representatives from the seaweed industry, regulatory agencies, and culinary professionals prior to publication.

CONCLUSIONS AND RECOMMENDATIONS

The National Seaweed Hub is one of 11 aquaculture hubs established in 2019 by NOAA's National Sea Grant Program to create and provide practical, science-based, and responsive resources to inform a wide range of stakeholders. After the initial round of funding, a second round of funding (NOAA-OAR-SG-2022-2007012) was awarded to extend the successful efforts of the National Seaweed Hub. Several external, federally funded projects have since been awarded to entities addressing tasks identified in the National Seaweed Hub's needs assessment and work groups, including the establishment of a national seaweed seed bank, the development of economic tools for prospective farmers, increased efficiency in seaweed production, and the development toward consistent, national seaweed food-safety guidance. As a result of the virtual work-group activities and other National Seaweed Hub engagement opportunities, more sectors are collaborating on projects and exchanging information.

Despite the COVID-19 pandemic, using a virtual meeting platform allowed representatives from various sectors, separated by great distances, to actively engage with one another to solve problems. Employing an outcome-based project approach (i.e., creation of practical resources) allowed individuals to work toward an achievable goal while fostering long-term relationships across sectors. Facilitated discussions provided a "safe space" for participants to address challenges and generate resources, supporting informed decision-making to yield positive outcomes. In addition, ensuring the diversity of work-group participants was beneficial in keeping the discussion general as opposed to state-specific (siloed), contributing to a better understanding of practical challenges while creating a sense of collaboration and not competition. As a result, resources developed do not contain proprietary information, are responsive to multiple sectors' needs and challenges, and can be implemented by a variety of stakeholders. Acknowledging that work-group participants were not compensated, Sea Grant Extension took on the workload to organize meetings and work-group activities, conduct appropriate follow-up, and lead the execution of strategy development. Agendas with clear objectives and outcomes to accomplish were provided prior to every meeting. Summaries from all meetings were made available on the website and through email to ensure transparency of the discussions and track the progression of work-group strategy development.

Maintaining active stakeholder participation following initial work-group meetings proved challenging. A combination of factors, including the COVID-19 pandemic, busy summer season, and unwillingness to share ideas due to fear of competition, could have been contributors. To address this challenge, Seaweed Hub Extension provided opportunities for stakeholders to contribute ideas in a variety of ways. Meeting summaries enabled stakeholders to provide input at any time. Seaweed Hub Extension also reached out to sector representatives to review deliverables produced to ensure that they were relevant and responsive to needs. The National Seaweed Hub provides a number of accessible resources for all audiences. As the non-advocate, Sea Grant Extension is in a unique position to respond to stakeholder needs through engagement services, needs-based research, and the creation and delivery of practical, science-based information to enable individuals to make more informed decisions.

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