# Seaweed Labour Market Engagement Study: Preliminary Findings from the British Columbia Seaweed Sector.

**Final Report: Phase 1**
**14 December, 2022**

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PACIFIC SEAWEED INDUSTRY ASSOCIATION

Canada BRITISH COLUMBIA

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*The views and opinions expressed in this report are those of its author(s) and not the official policy or position of the Government of British Columbia.*

## ACKNOWLEDGEMENTS

On behalf of the PSIA, I would like to thank all of the seaweed sector businesses, First Nations and other stakeholders who participated in this engagement project over the last seven months.

I would also like to thank and acknowledge our Working Group consisting of myself, Jennifer Woodland (Grieg Seafood), Bruce Wallinger (PSIA) and Jordan Hawkswell (PSIA).

Thank you also to our summer intern, Molly Gunn (Memorial University of Newfoundland), and to the Project Manager and consultant, Kerry Jothen of Human Capital Strategies.

Thank you to the Ministry of Post-Secondary Education and Future Skills for funding this project and to Matthew Boddy, Senior Project Manager of the SLMP Program in the Ministry for his guidance throughout.

Thanks to you all this project has laid a solid foundation of knowledge and informed input with which the Association can move forward to continue building our sector including taking action to ensure it has the talent necessary to support the growth of the seaweed sector in British Columbia.

Sincerely,

Mark C. Smith,
President and CEO,
Pacific Seaweed Industry Association

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## EXECUTIVE SUMMARY

The Pacific Seaweed Industry Association (PSIA), with support from the British Columbia (B.C.) Ministry of Post-Secondary Education and Future Skills (Sector Labour Market Partnerships Program), engaged with B.C. seaweed-sector stakeholders and First Nations to develop preliminary insights into the labour market development needs of the emerging seaweed sector. The focus of this process and report was to identify in-demand skills; career paths; transferable skills; skills training requirements; and to understand the implications for recruitment and the retention of human resources.

The report uses secondary and primary research, including extensive analysis, individual interviews, focus groups, surveys and SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis to expand the knowledge base about the future of seaweed sector jobs and skills in B.C. The report further aggregates information from many sources regionally, nationally, and internationally that assist in contextualising the economic development of seaweed cultivation and associated job creation.

To understand the outlook of the labour market for seaweed cultivation, production and commercialization, the fundamental objectives of this report were attained:

- through those engaged in and interested in the sector,
- through the collection of relevant information and estimates to extrapolate the current and future labour market demand and supply issues,
- through identified knowledge gaps, and
- through those already engaged with workforce development systems to obtain perspectives on gaps.

As an outcome of this work the PSIA created a diverse group of sector representatives to form a Governance Committee (details on pg. 59) and is developing an action plan based on the outcomes and findings of the project.

The process included meaningful discussions involving the role of repurposing existing skills or upskilling, on-the-job training, the digitization of work processes, increasing education opportunities and post-secondary course and research offerings, and consideration of the well-being challenges that can arise by a shift to rural work. The tracking of seaweed training programs and the emergence of new job positions globally will provide insight for B.C. to consider as well providing incentives and investment.

Within the report, key highlights were identified as areas of opportunity/recommendations to build upon from both a research and action item perspective. First Nation and Coastal Communities relationship development is paramount given the historical relationship to the coast and seaweed. Leveraging existing knowledge coupled with new educational training and scientific research will form the foundation of a sector roadmap and will play a critical role in the structuring of a globally competitive regulatory framework for the sector. Generating overall public awareness is a critical driver for the industry.

Not unlike most industries, the B.C. seaweed industry will have longer term labour market implications with less people interested in routine manual seasonal work, maintaining competitive wages, worker retention, and jobs that will be displaced by technological adoption and/or a shift in the division of labour. However, the rural development opportunity of seaweed can't be underestimated to support economic growth in the province.

With growing concerns about the environment, food security and climate change, seaweed could play a major role in various sustainability plans in B.C. As an integral player in Canada's Blue Economy, the Province has an opportunity to lead in this emerging sector. With an already established aquaculture industry, existing skill sets (e.g., commercial fishing), and infrastructure that can be leveraged to accelerate employment, the seaweed industry in B.C. is positioned for growth.

The British Columbia commercial seaweed sector is in its infancy, in fact it has a ways to go before it competes on the global stage. In the interim, while focusing on scaling up production, we must concurrently work to identify, attract, retain, and engage labour to support the sector at all levels. Awareness around the opportunity, coupled with new educational programming will position B.C. businesses as leaders in the space.

Regards,

Mark C. Smith

Mark C. Smith
President and CEO
Pacific Seaweed Industry Association (PSIA)

## PROJECT PURPOSE & OBJECTIVES

The purpose of the Project was to fulfil the 'Engagement & Planning' activities laid out by SLMP program and engage with stakeholders from the seaweed sector in B.C. to identify in-demand skills, career paths into and within the sector, transferable skills from other sectors, skills training requirements and implications for recruitment and retention to support the continued development of the seaweed industry in B.C.

The Project Objectives were to:

- Engage seaweed sector organizations and the broader stakeholders and First Nations with interests in the sector on workforce challenges and opportunities in the shorter and longer terms, ensuring a diversity of geographic, sectoral (parts of the sector), Indigenous, supply chain input and perspectives during an accessible engagement process.
- Collect information on and estimate to the extent possible current and future labour market demand and supply issues related to the sector and identify workforce-related skill data and knowledge gaps related to the sector.
- Engage with the workforce development ecosystem (K-12, public and private post-secondary, employment service providers, government programs, etc.) to obtain perspectives on gaps in and opportunities for meeting the sector's workforce needs.
- Create a diverse group of sector representatives, stakeholders and First Nations interested in participating in the Project and ensure relevant Project follow up, including drawing from the coalition a representative group to serve on a Governance Committee.
- Develop an action plan for next steps based on the findings of this Project.

The Pacific Seaweed Industry Association (PSIA) is a non-profit, member-driven, industry association that works to develop awareness around the benefits and diverse uses for seaweed.

The seaweed sector primarily operates in rural areas and represents a key opportunity for reconciliation and economic development within coastal and Indigenous communities, who have long-standing traditional knowledge and have been early adopters in seaweed cultivation and production.

With the funding provided from the B.C. Ministry of Post-Secondary Education and Future Skills (Sector Labour Market Partnerships Program), the PSIA has engaged seaweed stakeholders and First Nations across B.C. to develop preliminary insights into labour market development needs.

This work aims to deliver results for Phase 1 of the SLMP project activities: Engagement & Planning.

The Project activities included the following:

- Engage with key First Nations and stakeholders to gain input on workforce development challenges facing the seaweed sector in B.C.
- Maintain a consultative process with key sector stakeholders throughout the project to identify and develop an understanding of in-demand skills, career paths into and within the sector, transferable skills from other sectors, and skills training requirements.
- Conduct interviews of industry professionals from across the seaweed sector.
- Conduct a focus group representing the diversity of the seaweed sector and First Nations communities.
- Establish the Governance Committee and conduct the first formal meeting of the governance committee.

This final report fulfils the Project Final Engagement Report per the SLMP Contract # C22LMP009.

1. *A narrative that describes the full scope of all Project Activities, including but not limited to:*

   a) *Who was engaged, including the name of the organization engaged and the title of the individual that participated in the engagement activities.*
   b) *How the sector was engaged, including the number of sessions, location(s), and methods such as face to face, individual interviews, group-based workshops etc.*
   c) *The scope of the problem(s) the Project was seeking to understand.*
   d) *Key themes and findings.*
   e) *Consensus and direction on next steps to address the sector's human resource and/or labour market issue(s).*
   f) *If applicable, a description of the leadership and governance structure for undertaking a subsequent SLMP Program phase.*

2. *Appendices:*

   *Include any relevant materials information, questionnaires etc. created and disseminated in this project phase.*

The methodology for this Project is described in each subsequent section of the secondary and primary research and engagement.

## SECONDARY RESEARCH

The secondary research for this project was conducted collaboratively with Kerry Jothen of Human Capital Strategies to gain a deeper data driven overview of the workforce opportunity. The research involved reviewing existing literature and data including a scan of literature in several Canadian and international jurisdictions. This information includes a Sector Profile, a review of global literature, and an inventory of seaweed-related education and training resources. The secondary research focused predominantly on countries and regions with emerging or growing seaweed sectors that are largely outside of Asia to best compare with the state of the B.C. seaweed sector and North American stakeholders. Literature pertaining to the Asian seaweed industry is extensive and detailed, however a thorough review of it was outside of the scope of this research. As such, references to the seaweed industry in Asian countries are limited. A SWOT analysis follows this section and was the result of a brainstorming meeting of seaweed companies and the PSIA.

### Sector Profile

Both the Province of BC[1] and the Government of Canada have committed to developing a clean, sustainable economy which includes the Blue Economy to promote economic growth, social inclusion, and the preservation of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas.

It is estimated that the Blue Economy contributes approximately $31.7 billion annually in gross domestic product and accounts for close to 300,000 jobs across Canada[2]. Furthermore, Canada is developing a Blue Economy Strategy that “will help guide and support growth and modernization of high-potential ocean sectors and job creation in our Indigenous and coastal communities”[2].

*"Those wishing to work in this sector now in B.C will have the opportunity to contribute to shaping how it looks in the future as a thriving industry and an opportunity to be working with some of the biggest names that will exist in the B.C seaweed sector"*

This includes the importance of aquaculture and the world’s growing reliance on aquaculture, which is now the world’s fastest-growing source of food production.

[1] Province of BC. A Coastal Marine Strategy for British Columbia. Policy Intentions Paper 2022. Retrieved at https://engage.gov.bc.ca/app/uploads/sites/121/2022/12/Coastal-Marine-Strategy-Intentions-Paper.pdf

[2] Government of Canada, Fisheries and Oceans Canada. *Blue Economy Strategy Engagement Paper*. Retrieved at https://www.dfo-mpo.gc.ca/about-notre-sujet/blue-economy-economie-bleue/engagement-paper-document-mobilisation/part1-eng.html. 11 Mar. 2022

Fisheries and Oceans Canada cites the Food and Agriculture Organization of the United Nations noting that aquaculture's contribution to the food supply, through finfish, shellfish and aquatic plants, overtook that of wild fish for the first time in 2014[2].

Much of the current seaweed industry is based in China, Korea, Southeast Asia and West Africa, contributing significantly to many coastal economies and communities. Worldwide seaweed production more than doubled from 1995 to 2016, increasing from 13.5 million tonnes to 30 million tonnes, largely due to its popularity as a flavourful food, rich in micronutrients (magnesium, calcium, iodine, potassium), vitamins and omega-3 fatty acids and is now worth around $5 billion annually[3].

The seaweed sector represents an opportunity to diversify B. C's economy and to be an important part of B.C.'s growing aquaculture sector, along with shellfish and finfish.

At present there is a need to engage the sector to learn more about its labour market needs, including understanding in demand skills, career paths into and within the sector, transferable skills from other sectors, and skills training requirements.

This will enable the sector to develop an understanding of key in-demand skills and occupations (current and future) and implications for recruitment and retention to support the continued development of the seaweed sector in B.C.

## LITERATURE REVIEW

The Project literature review started with the review documents collected by the PSIA and the Working Group as well as conducting an online search for pertinent domestic and international literature and data.

A range of literature (Appendix 1) from across Canada and around the world were collected and reviewed. Relevant literature was found in B.C. and the East Coast of Canada, as well as in Alaska, Australia, Chile, Indonesia, Korea, Maine, New Zealand, and Norway. A summary of reports, studies, media articles, websites, etc. was prepared, and a thematic analysis was conducted with the following themes emerging:

- Sector success factors
- Best practices

[3] FAO to focus on seaweed farming biosecurity. Retrieved from: https://thefishsite.com/articles/fao-to-focus-on-seaweed-farming-biosecurity

- Barriers to sector & workforce growth
- Types of occupations & skills needed in the sector

## Seaweed Sector Success Factors

Key factors identified for a growing seaweed sector in B.C. included collaboration among governments, First Nations, post-secondary institutions and coastal communities. In addition, collaborating with aquaculture and fishing industries to draw from existing knowledge and experiences applicable to the seaweed sector is vital to the sustainable growth of the emerging industry.

The literature pointed to the importance of rural communities employing targeted strategies to attract and retain workers for seaweed and other resource-based sectors. An example being to market job opportunities to other seasonal marine harvesting workers (i.e., those working in clam digging) that have gaps in employment schedules that could be filled by working contracts in seaweed seeding or harvesting. This allows seasonal workers to fill more of their year with employment in the sector in rural communities. Providing training and education in rural areas has also shown great success. For example, the Aquaculture Field School is a training program developed by the Food and Agriculture Organization of the United Nations (FAO) in Vietnam in the 1990s to help communities expand aquaculture activities and has since expanded throughout Asia, Africa, the Middle East and Latin America. The program has provided rural communities with access to the knowledge and skills required to engage further in fisheries and aquaculture sectors. This has given rural communities a sense of entrepreneurship, financial stability, and contribution to the community while removing the burden of travelling to urban areas to receive training [4].

Other themes identified as key growth factors for the seaweed sector in B.C. included: having a fully developed seaweed-specific regulatory framework with strong policies, integrating seaweed into economic and environmental sustainability planning, a thorough market analysis of the seaweed value chain, a reliable seaweed seed supply and development of efficient technologies that can support business in scaling production and reducing costs.

[4] Food and Agriculture Organization of the United Nations (FAOUN). *The State of World Fisheries and Aquaculture: Towards Blue Transformation*. Retrieved at https://www.fao.org/state-of-fisheries-aquaculture. June 1, 2022.

## Seaweed Sector Best Practices

A number of sector best practices or lessons learned from the literature were identified. These include the following examples.

Seaweed cultivation has improved the livelihood in rural communities in some developing countries. Coastal areas of Malaysia have implemented a Homestay program based on seaweed farming as a form of Community Based Tourism (CBT) that involves residents of rural communities drawing in tourists and providing overnight accommodation. Including seaweed-cultivation in the homestay program has attracted positive attention to the sector while enhancing the socioeconomic status of the participating communities[5]. Other tourism initiatives, such as The Seaweed Co., are available and being used in Zanzibar that include seaweed farm tours for tourists that generate a fixed salary for farmers. Seaweed cultivation and processing in these countries is dominated by women and has helped to provide a sense of economic independence. In recent years, seaweed production in Zanzibar has shown declining trends due to climate change. Initiatives such as SeaPoWer have been put in place to combat climate induced stressors by introducing tubular netting technology to cultivate species fit for deeper, cooler water. Other successful activities in Zanzibar have included skills training for women to process seaweed for higher value products such as soaps, shampoos, cookies, and juice. Women have also come together to form cluster farms to share business costs and labour[6].

Investing in the agricultural applications of seaweed will be essential in the coming years as concerns around food security are addressed and sustainable agriculture methods continue to be developed. According to a report published by Seaweed for Europe in 2021, agrifeeds and bio stimulants are projected to be among the most valuable market segments by 2030 [7]. Seaweed as an additive to agrifeeds is also being researched. Studies show feeding seaweed to livestock can significantly reduce methane emissions, potentially helping Canada reach the goal

[5] Kunjuraman, V., Yasir, S.M. and Hussin, R. "Potential of Seaweed Cultivation as a Community-Based Rural Tourism Product: A Stakeholders' Perspective." *Advances in Environmental Biology*. https://www.researchgate.net/publication/273124445_Potential_of_Seaweed_Cultivation_as_a_Community-Based_Rural_Tourism_Product_A_Stakeholders%27_Perspectives. 9[5]m 154-156.

[6] de Jong, Cleyndert, Newman, R. Brugere, C., Cuni-Sanchez, A. and Marchant, R. *African Handbook of Climate Change Adaptation: Adaptation of Seaweed Farmers in Zanzibar to the Impacts of Climate Change*. Retrieved at https://link.springer.com/content/pdf/10.1007/978-3-030-45106-6_54.pdf. July 1, 2021.

[7] Vincent, S. and Ring, J. "Hidden Champion of the Ocean: Seaweed as a Growth Engine for a Sustainable European Future." Seaweed for Europe. Retrieved at https://www.seaweedeurope.com. October 2020.

of cutting back methane emissions by 30% by 2030 [8,9,10]. Other applications of seaweed in sustainable farming methods include its ability to be a nature-based solution to agricultural runoff. The Australian Seaweed Institute is developing seaweed biofilters in an effort to mitigate the effects of eutrophication from farming activities. By cultivating seaweed in concentrated areas of agricultural runoff, seaweed biofilters can effectively filter excess nutrients and reduce risks of harmful algal blooms (HABs) as it grows. Harvesting the seaweed can then provide biomass to be processed as an agrifeeds additive or fertiliser, generating returns as an end product[11]. Overall, this area shows great potential for increasing soil health, reduction of methane, and has a high consumer demand.

The practice of Integrated Multi-Trophic Aquaculture (IMTA) has been shown to reduce environmental impacts of intensive aquaculture practices by farming multiple species within the same aquaculture operations. This action harnesses the natural biodiversity in ecosystems to balance excess nutrients and create an added value stream for the farm. Cape Breton, Nova Scotia has experienced huge success in pilot projects after partnering with three shellfish producers to cultivate kelp and oysters together. Both species were able to benefit from each other as the kelp took up inorganic nutrients that allowed enhanced growth rates in the oysters, while the shellfish-maintained water clarity through filter feeding to allow productive photosynthesis required by the kelp. The most active season for kelp aquaculture coincides with the off-season for shellfish production, thereby generating employment opportunities throughout the year[12]. IMTA can also address environmental concerns around waste build up from finfish aquaculture activities. Studies in Norway have identified IMTA as an option to reduce this risk while addressing the potential to significantly increase the productivity of the site[13]. New York has also recognized the benefits of farming seaweed alongside shellfish for its ability to improve water quality in some areas. Recently the State of New York passed what is

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[8] Hon, D. “BC's Marine Tech Sector is Riding a Wave of Innovation.” *BC Business*. https://www.bcbusiness.ca/BCs-marine-tech-sector-is-riding-a-wave-of-innovation. August 19, 2021.

[9] Lang-Wong, A., Drews, C., Schulz, N., McDonald, R., Plant, T., Heavyside, P., Mora-Soto, A. and Sattler, M. Seaforestation: “Benefits to the Climate, The Ecosystems and the People of British Columbia.” *Ocean Wise*. Retrieved at https://ocean.org/app/uploads/2022/06/Oceanwise-Seaforestation-report-JUNE21.pdf. June 1, 2022.

[10] Cascadia Seaweed. *Integrating Seaweed Aquaculture into Canada's Blue Economy Strategy: A Call to Action.* Retrieved at https://www.cascadiaseaweed.com/blue-economy-report. 2021.

[11] Australian Seaweed Institute. *ASI Seaweed Biofilters*. Retrieved at https://www.australianseaweedinstitute.com.au/. Undated

[12] Jackson, L. “Pilot Project Cultivating Kelp on Shellfish Leases Demonstrates 'Extraordinary' First Year Growth.” *Global Seafood Alliance*. Retrieved at https://www.globalseafood.org/advocate/pilot-project-cultivating-kelp-on-shellfish-leases-demonstrates-extraordinary-first-year-growth/. September 27, 2021.

[13] Stevant, P., Rebours, C. and Chapman, A. “Seaweed Aquaculture in Norway: Recent Industrial Developments and Future Perspectives.” *Aquaculture International*. Retrieved at https://www.researchgate.net/publication/313331392_Seaweed_aquaculture_in_Norway_recent_industrial_developments_and_future_perspectives/link/5fbcc866299bf104cf6ede2f/download. February 1, 2017.

commonly referred to as the Kelp Bill, including seaweed onto 110,000 acres of shellfish leases. Ocean farmers have used kelp to diversify their businesses and build an added value stream in the off season[14]. A similar idea was used to establish the highly successful non-profit organization, GreenWave, where diversification through kelp was used to minimise the risk of total loss of shellfish yields from natural disasters.

Norway-based company 'Seaweed Solutions' has vertically integrated to cultivate seaweed from seed to final product. They have an in-house hatchery, farming and harvesting operations, and use a variety of processing methods suited to the buyers' needs, selling seaweed in bulk, and creating a reliable and controlled supply chain[15]. In addition, Norway is looking into alternative efficient processing methods and has found potential in using energy surplus from existing industrial facilities on the coast for seaweed processing[13].

## Barriers to Sector and Workforce Growth

A number of potential barriers or risks to sector and sector workforce growth were found in the literature.

The State of the World Fisheries and Aquaculture report, published by the FAO, recognizes the important role seaweed cultivation has to play in supporting sustainable aquaculture and food security. However, the report points out the need for more data on seaweed production and its uses globally[4]. Organizations such as Seaweed First have been working to build out the industry with one of their main goals to provide current and reliable information on the sector market and supply chain[16]. Fully developing this market will improve its stability and give newcomers the confidence to enter into the industry.

Confusing and inconsistent regulatory requirements are another major limiting factor to the growth of the seaweed industry. FAO highlights the importance of addressing this regulatory obstacle for seaweed cultivation along with other restorative aquaculture practices such as IMTA and considers this an area of significant need for private investment. Additionally, FAO suggests government support at all levels to ensure smart and sustainable decision making[4].

[14] Robey, Charity. "Kelp Guru has a Vision for the Coast of New York." *New York Times*. Retrieved at https://www.nytimes.com/2022/06/10/nyregion/sugar-kelp-farming.html. Page 39, June 12, 2022.
[15] Seaweed Solutions. *Seaweed Farming: The future of cultivation is at sea*. Retrieved at https://seaweedsolutions.com/. Undated.
[16] Seaweed First. *About Seaweed First.* Retrieved at https://seaweedfirst.org/about-seaweed-first. Undated.

Most seaweed farming and processing will be located in rural and remote regions with infrastructure challenges (e.g., processing facilities, transportation routes, etc.)[17]. Such communities can have difficulty attracting and retaining an influx of workers as farms and processing begins and expands[9,18,19].

Innovative processing methods will be an area of high priority when considering scaling up production, especially in coastal B.C. where wet, cold winters can inhibit effective drying of seaweed. Using innovative and efficient technologies to process large volumes of seaweed while maintaining a low carbon footprint will be necessary to answer growing demand and uphold seaweed's carbon neutral appeal[20]. Technology and processing innovation, such as seeding systems and drying machines, have been vital in South Korea for its rapid rise in seaweed production[21].

Another obvious area of concern is a lack of data and knowledge about seaweed-specific occupations and skills in B.C. and Canada. The only body of work on this subject is at the non-seaweed aquaculture level through national aquaculture and agriculture industry groups. The small size of the current seaweed industry in B.C. presents a challenge in collecting relevant data. In order to map out a plan for workforce growth as the sector expands, the sector needs data. Until there is a critical mass, the sector will need to rely on 'proxies' for skill and occupational data, making assumptions from finfish and shellfish aquaculture, agri-tech and agriculture and food processing.

The seaweed industry in B.C. and in the rest of North America and Europe are still in the developing stages with unfamiliar products and limited knowledge behind environmental or economic benefits to the workforce and general public.

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[17] Canadian Aquaculture Industry Alliance (CAIA). *Canada's Blue Economy Strategy 2040*. Retrieved at https://fisheriescouncil.ca/wp-content/uploads/2020/10/Canadas-Blue-Economy-Strategy_FINAL-9-15-2020.pdf. Undated.

[18] MQO Research. *Labour Market Analysis of the Newfoundland and Labrador Aquaculture Industry.* Newfoundland Aquaculture Industry Association. Retrieved at https://naia.ca/application/files/8015/4237/6237/Labour_Market_Analysis_Report_-_FINAL_-_oct_24.pdf. October 1, 2018.

[19] Canadian Agriculture Human Resource Council (CAHRC-CCRHA). *How Labour Challenges Will Shape the Future of the Aquaculture Industry: Agriculture Forecast to 2029*. Retrieved at https://cahrc-ccrha.ca/sites/default/files/2021-11/factsheetAQU_E_web.pdf. Undated.

[20] Orr, Kyla. Facilitating Development of the Seaweed Cultivation Industry in Scotland. The Sustainable Inshore Fisheries Trust. Retrieved at https://sift.scot/wp-content/uploads/2022/02/Facilitating-development-of-the-seaweed-cultivation-sector-in-Scotland-Feb-2022.pdf. February 1, 2022.

[21] Seaweed cultivation and utilization of Korea. Retrieved from: https://www.e-algae.org/journal/view.php?doi=10.4490/algae.2020.35.5.15

The literature identifies a number of workforce needs which if met will support sector growth and sustainable access to and retainment of talent in the industry:

1. Education and training programs are needed on sustainable seaweed cultivation and IMTA;
2. Training and skills in innovative technologies in farming and processing facilities (e.g., automated harvesting, line seeding technology, processing methods to maintain product freshness).
3. Addressing workers' health and safety skills and needs – strong health and safety standards within aquaculture promotes a safety culture within the industry and reduces negative association with aquaculture.
4. Promoting gender equality and diversity in the seaweed workforce to create an inclusive environment.

## Types of Occupations and Skills

In reviewing the literature, the following areas of skills/competencies emerge:

1. A range of commercial marine skills and certifications (e.g., Transport Canada Marine Safety & Security training courses) .
2. Aquaculture and hatchery management, Agrology, and Agriculture
3. Environmental impact assessment and monitoring and resource management.
4. Marine spatial planning to identify available/optimal farming locations and minimise spatial conflict.
5. R&D in technology throughout the supply chain (seed supply, farm design, harvesting, efficient processing, distribution, product development).
6. Indigenous leadership.
7. Rural community program development and community planning.
8. Scientific communication and outreach management.
9. Education and training program development for ocean farmers.
10. Management and guidance regarding permits, licensing, and other beginning stages of farm set-up or IMTA seaweed cultivation.

Some of the marine, seaweed and aquaculture focused areas of skill development are addressed by programs referenced in Appendix 2.

Below are three specific examples of workforce distribution and education from North American sources:

Atlantic Sea Farms (atlanticseafarms.com), an established kelp farming company on the East Coast of the U.S. lists its management team positions:

- President/CEO
- Continuous Improvement & Sustainability Manager
- Production Manager
- Chief Marketing Officer
- Food Service and University Dining
- Sales Team Coordinator
- Controller
- Seafood Supply and Advancement Manager
- Fermentation Lead
- Director of Quality and Food Innovation
- Production and Fermentation Lead
- Seaweed Supply & Innovation Manager
- Sales & Partner Growth, Ingredients
- Sales Director

The Dean of Trades & Technology at North Island College (NIC) and her team have developed an outline for a kelp production training program. NIC has a track-record of aquaculture-related

training and certification and is interested in leveraging this experience for training in the seaweed/plant aquaculture sector. The outline is as follows:

| |
|---|
| **Introduction to Kelp Production**<br>Opportunities<br>Products<br>Ocean and land-based Kelp production<br>Sites<br>Provincial, Global context<br>Climate change |
| **The Business of Production**<br>Product<br>Business Models<br>Financing<br>HR<br>Networks<br>Resources |
| **Kelp**<br>Product and Uses<br>Medicinal<br>Cosmetics<br>Food<br>Human and Pet Health Supplements<br>Agricultural |
| **Introduction to Kelp Cultivation and Harvesting** |
| Product Life Cycle |
| **Site Selection and Environmental Considerations**<br>Water quality analysis = metres, terminology and equipment uses<br>Microscope skills<br>Anchor systems – planning, setup, and tear down |
| **Species Selection and Seasonality**<br>Species of interest<br>Uses of species |
| **Regulation and Permitting** |
| **Site Setup (Hatchery, Transport, Seeding)**<br>Roles and cycles<br>Farm design based on site |
| **Growth (seasons and cycles)**<br>Nitrogen cycle<br>Climate change |
| **Harvest Methods, Product Possibilities and Processing** |
| **Marketing and Distribution** |
| **Industry Certifications** |

| |
|---|
| Vessel safety<br>Equipment operations<br>WHMIS<br>OFA<br>Rope splicing |

The Seaweed Academy[22] provides seaweed-specific training in the UK. Below are the outlines of two short courses offered on seaweed cultivation:

Seaweed Farming Course includes the following modules over one week:

- Introduction to seaweed farming (introduction, species identification, traceability/sustainability)
- Economics (business plan, mapping economics of sector)
- Licensing (crown, social)
- Nursery (requirement, considerations, methods)
- Farming (monitoring, maintenance, farm design)
- Cultivation (practical farm visit, harvesting)
- Aquaculture (blue carbon, IMTA system)
- Processing (primary, secondary)
- Market (drivers, considerations)

Seaweed Farming Course includes the following modules over two days:

- Introduction to seaweed farming
- Nursery (species, twine, binder)
- Boat maintenance
- Farm Design (requirements, longlines, grid-based)
- Site selection (areas, challenges, benefits & pitfalls)
- Deployment (seasonality, growth rate, timeline)
- Integrated systems (IMTA, benefits, stock value, limiting risk)
- Monitoring and Maintenance (inspection, water temp, nutrients, salinity, turbidity , light, floatation)
- Biofouling (timing, dangers, avoidance)
- Practical site visit.

The most current source of Canadian workforce and occupational data on the broader aquaculture industry including plant-based growers, harvesters and hatcheries and processing is the Newfoundland Aquaculture Industry Association's (NAIA) commissioned study on the development of an Aquaculture Attraction and Retention Strategy. This work included a labour

[22] U.K. Seaweed Academy. Retrieved at https://seaweedacademy.co.uk/?page_id=9041

market analysis of the Newfoundland and Labrador aquaculture industry prepared by MQO Research.[18]

This research identifies as the "primary" occupations (with National Occupation Classification System codes) in the growing and farming of aquaculture plants and animals, in the processing of seafood and plants, and in other commercial marine operations that are transferable to seaweed work as:

- NOC 0823 Managers in aquaculture
- NOC 2123 Agricultural representatives, consultants and specialists, Agrologists
- NOC 2221 Biological technologists and technicians
- NOC 8613 Aquaculture and marine harvest labourers
- NOC 9618 Labourers in fish and seafood processing
- NOC 9213 Supervisors, food, beverage and associated products processing
- NOC 9463 Fish and seafood plant workers
- NOC 72602 Deck officers, water transport
- NOC 752110 Boat and cable ferry operators and related occupations
- NOC 80022 Managers in Aquaculture
- NOC 83121 Fishermen/women
- NOC 84121 Fishing vessel deckhands
- NOC 85102 Aquaculture and marine harvest labourers

NOC 8613 (Aquaculture and marine harvest labourers) is profiled in the Ministry of Advanced Education and Skills Training WorkBC statistics with estimated employment in 2021 on Vancouver Island to be 350 people.

In terms of the North American Industry Classification System 2022, identified relevant codes are:

- NAICS 112510 Aquaculture (including seaweed farming)
- NAICS 111419 Seaweed grown under cover
- NAICS 311710 Seafood production, preparation and packaging
- NAICS 114113 Commercial fishing
- NAICS 541330 Engineering services
- NAICS 541710 Research and development in physical, engineering and life sciences

From a review of the above, a combination of seaweed-specific skills and knowledge (e.g., kelp, site setup, species, etc.) are directly transferable with other aquaculture (finfish & shellfish), as well as other commercial vessel operations and maritime safety, etc. This occupational and industrial nomenclature will help scope out data collection and analysis in the next phases of the PSIA's work.

## Seaweed-Related Education & Training Inventory

The PSIA research consultant reviewed B.C., the rest of Canada and international information sources and identified several education or training programs and/or resources around the world related to seaweed. Listed in Appendix 2, the following information is provided for each program:

- Program title
- Industry (e.g., food, pharmaceutical, consumer products, other)
- Area of Focus (e.g., harvesting, processing, storage, distribution, sales/marketing)
- Training Provider (name, location, contact info, website)
- Mode(s) of delivery
- Fees
- Certification (if any)
- Relevance to Seaweed

In Canada, programs are mostly aquaculture (finfish and shellfish) and fishing in subject matter with the exception of a few small seaweed programs in B.C. and on the East Coast of Canada. The major gaps in the current programs include definitive and dedicated seaweed content, however the basis for such content would first need to be based on seaweed aquaculture in other global regions until Northeastern Pacific seaweed cultivation could be studied enough to create specific course content. Much of the seaweed specific content that does exist is based in other global regions; outside of Asia, seaweed-specific education or training programs were identified in Australia, the Caribbean region, Ecuador, France, Ireland, Scotland and the U.S. (i.e., Alaska, Maine and California). While there certainly is a growing list of educational opportunities surrounding seaweed, there is still a lack of Canada-specific knowledge as well as training for multiple roles in the supply chain, such as for seaweed farm engineering and processing along with farming skills training. Another major gap is hands-on learning experience as there is a lack of seaweed infrastructure from which to learn. Learning and training farms or partnerships with existing farms would allow for in-depth, experiential learning that could fill in the gaps that exist in classroom learning.

In B.C. most of the training has been created by independent providers that are more specific to identification and ecology than commercial cultivation. A selection of small-scale seaweed-specific programs in on Vancouver Island include the following:

- Bamfield Marine Sciences Centre (Bamfield) – Ecological Adaptations of Seaweed
- Cascadia Seaweed (Sidney) – Seaweed Farming 101
- Dakini Tidal Wilds (Sooke) – Seaweed Workshops with Amanda Swinimer
- Raincoast Education Society (Ucluelet) – Seaweeds of the West Coast 2022
- Wildrose College of Herbal Medicine (Cumberland) – Seaweed Therapeutics

The programs listed above are primarily basic knowledge courses that can build an understanding of Pacific seaweed, however cannot support a growing seaweed cultivation economy in B.C.

Established aquaculture (mostly finfish) programs in B.C. can provide a base of knowledge and experience to build on. These include the following:

- Excel College – Aquaculture Technician Certificate
- North Island College – Aquaculture Technician Diploma/Certificate (funded through an SLMP project), also Hatchery Certificate and Shellfish Certificate
- University of British Columbia – Graduate Certificate in Aquaculture
- Vancouver Island University – Fisheries and Aquaculture Diploma

The above programs, while focused on finfish, could be adapted or expanded to include more seaweed-related content or provide a proof of concept to gauge interest in the creation of seaweed specific streams within an aquaculture umbrella training. These existing programs likely have more capacity to expand and support growing interest in seaweed and aquaculture. Support will be needed to aid in the expansion of such programs.

There also exists some company-specific aquaculture training provided by companies, such as Cermaq and Mowi.  These companies have international connections that may be able to provide foundational knowledge for seaweed specific training, however it would likely be private training only available to internal employees.

There are various options for pursuing seaweed-specific training as the demand for such skills grows. The industry could work with institutions involved in aquaculture programs to add a seaweed-specific stream of educational content to existing aquaculture programs to create a ‘core’ and ‘specialty streams’ program concept. After completing an aquaculture core program, students could choose to move into seaweed specialties

such as: nursery management, farm operations, or IMTA techniques.

Alternatively, industry and training institutions could create a comprehensive seaweed training program from scratch, using existing aquaculture content, and having seaweed modules relating to different parts of the seaweed value chain and skill sets needed for them.

Either of these options could also include seaweed micro-credentials courses that individuals can complete as standalone certifications or as part of a full program.

A critical question regarding the development of training opportunities is: does the sector first develop a comprehensive seaweed program with various pathways that can support and influence sector growth; or does it rely on piecemeal training to support sector start-up and build out a comprehensive program once the sector is larger with clearer needs? In order to build capacity the sector may have to start with the latter option, then build out comprehensive programs once the needs become clearer.

From this scan of programs in B.C., it appears seaweed-specific training is employer-specific or offered at a small-scale by private institutions or individual consultants. Aquaculture training is delivered mostly by colleges and universities. The lack of public, accredited seaweed training provides an opportunity for this gap to be filled by program development at educational facilities and institutions in coastal regions of the province.

## SEAWEED SECTOR STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS (SWOT)

A working group of the Project Steering Committee headed a virtual SWOT workshop early in the project and identified the following key sector and talent strengths, weaknesses, opportunities and threats.

| | | |
|---|---|---|
| **Internal** | **Strengths**<br>● Fosters reconciliation – value-led practices – emerging FN partnerships and FN support; leverage UNDRIP and DRIPA.<br>● Low input food & material source<br>● Regenerative potential for ocean habitats/ecosystems.<br>● Potential for significant carbon sequestration & mitigation of climate issues such as ocean acidification & coastal erosion.<br>● Increasingly attractive to young people – healthy, sustainable and interesting.<br>● Existing transferable skills from other aquaculture and food processing.<br>● First Nations rural workforce potential (interested youth and relevant experience on the water) in coastal regions.<br>● Massive B.C. coastline to draw upon – geographically advantageous ability to grow kelp.<br>● Academic involvement in research and development. | **Weaknesses**<br>● Provincial regulatory process for marine plants is in need of updates, currently a long (3-5 year) licensing timeline; risking growth of the sector.<br>● Access to capital – investors are focused on market potential and pathways, which are still in development.<br>● Capital returns are lengthy – government support needed, but there is a lack of government investment funding, other regions are ahead in this (i.e., Asia, Europe).<br>● Distributed workforce in small communities.<br>● Remote, farming, outdoor work may not be perceived as desirable.<br>● Limited processing infrastructure is a significant barrier to producers and getting seaweed to market, as well as a lack of specific seaweed processing experience.<br>● Broad labour gaps/shortages across many sectors, results in increased competition for seaweed. |

| External | **Opportunities** | **Threats** |
|---|---|---|
| | ● New uses of seaweed (e.g., biostimulants, pet foods, biomaterials, etc.).<br>● Increased food production and security.<br>● Transferable Skills – marine work, research, labour, management, policy, sales, marketing, operations, QA and food safety, logistics, transport<br>● Seafood/food processing experience in B.C. – leverage processing capabilities and infrastructure – adapt and modify.<br>● Education and training institutions on Vancouver Island are willing and able to develop programs for seaweed cultivation. | ● Conditions of aquaculture licences may change as the province updates and reforms seaweed and marine management plans and regulations.<br>● Licensing timelines are threatening sector growth and challenging with First Nation partners.<br>● Science gaps (e.g., genetic interactions – cultivated vs. wild and impacts on the ecosystem, seaweed carbon sequestration); government support needed for research<br>● Limited sector understanding of federal regulations (e.g., Species at Risk Act) and how they can impact applications or operations, education needed.<br>● Uncertain seed supply and more so, policy surrounding seed sourcing and transfer is still under development.<br>● Lack of seasonal / part time labour supply (harvesting & processing).<br>● Living costs / living standards in remote communities / interest rates impacting personal debt / affordability. |

The seaweed sector strengths include building upon reconciliation and relationships with intentional First Nations partnerships at the pre-planning stage. This will lead to community focused, value-led and long-term sustainability practices that are extremely important for all British Columbians. With a massive rural coastline, First Nations and rural communities have an opportunity to attract a younger generation of diverse workers, professionals with transferable skills, and educational support from academia, trade schools and programs.

The commercialization of B.C. seaweed provides labour and market opportunities that capture new uses of seaweed in biostimulants, human and pet food, biomaterials, etc. Transferable skills from a variety of careers and a local labour workforce can be utilized. Coastal seafood operations (including existing infrastructure & facilities) and local communities provide existing marine skills and job experiences that can be transferred to seaweed operations.

There are many challenges that need further investigation and solutions in order to be effectively addressed. These include streamlining and centralizing B. C's current licensing / tenure process; access to capital and investor confidence; competition and distribution for remote/rural workers; infrastructure supply, availability and production modifications.

Factors that are outside of the sector's control, such as provincial regulatory changes, science and environmental impacts, and macroeconomic factors (interest rates, cost of living increases and recession) are all components to sector success that require awareness, mitigation assessments and an understanding of how they impact the growth of the sector and labour supply. Another factor worth noting is uncertain seed supply, mostly due to limited infrastructure and early stages of methodology development in new nurseries. While seed supply and nurseries are an opportunity for further business development, there are very few suppliers of seaweed seed currently available, therefore new and growing businesses are competing for seed supply or may bear the burden of using capital to create their own seed nurseries to ensure consistent seed supply. This is an often overlooked aspect of the seaweed industry that will need to remain at the forefront of industry growth plans.

## PRIMARY RESEARCH & ENGAGEMENT

The primary research for this project was conducted collaboratively with Kerry Jothen of Human Capital Strategies in an effort to gain a deeper data driven overview of the workforce opportunity. The Project primary research and engagement was conducted by Kerry Jothen of Human Capital Strategies, consisting of a diversity of methodologies involving almost 100 sector, Indigenous and stakeholder representatives, primarily from within B.C. coastal regions. The methodology and approach included an online survey of sector businesses, stakeholders, and First Nations (completed July 2022), as well as interviews of 19 representatives of similar organizations (completed August-September 2022), and a focus group of twelve participants on October 4, 2022.

## Online Survey Overview

The online survey was sent directly via email to over 400 contacts including Pacific Seaweed Industry Association (PSIA) members, other seaweed stakeholders, several coastal First Nations, and other organizations with an interest in seaweed sector development.

The survey was open from July 4, 2022, to July 25, 2022. While it was open, the survey was viewed 463 times, with 109 individuals starting it and 58 completing it. *Survey results include responses from those who did not complete every question in the survey, resulting in the total number of responses to each question ranging from 58 to 109.*

In addition to the initial email invitation and PSIA social media, there were three follow up reminders to prospective respondents to complete the survey.

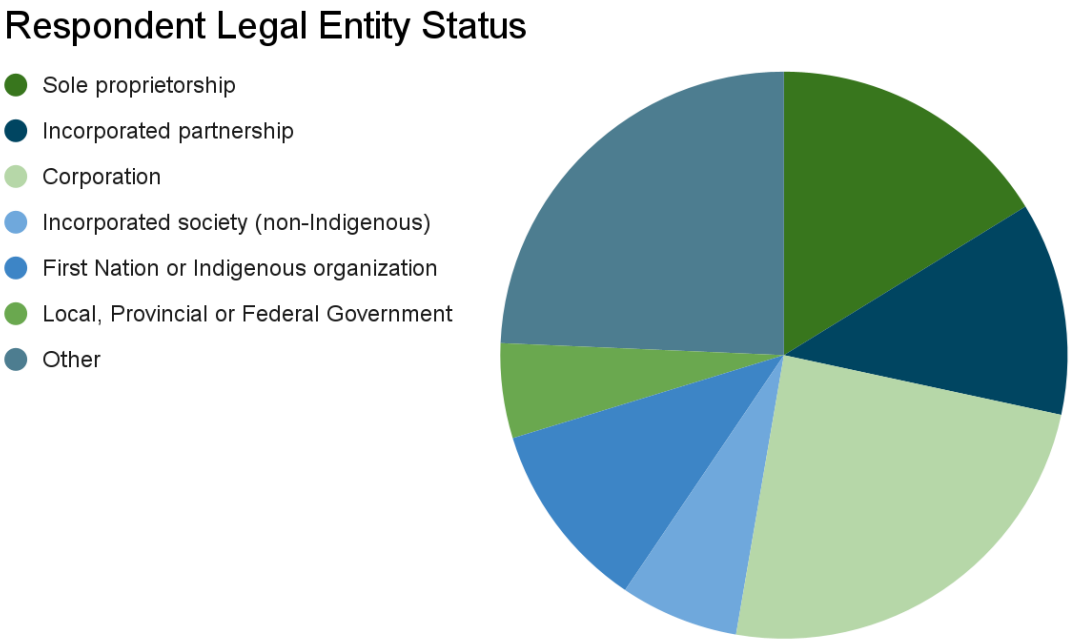
The following section is a representation of the PSIA's online sector survey, showcasing the 17 questions that were asked in the survey and the results from the 58 respondents who completed them.

1. **Respondent legal entity status (select one only)**

The range of responding organizations included: 24% (18) corporations, 16% (12) sole proprietorships, 12% (9) legal partnerships and 11% (10) First Nations or other Indigenous

organizations. Most of the 24% (18) who selected “other” were individuals from non-profits and from academic institutions.

This distribution of respondents is a good representation of the current stakeholders in the seaweed industry, though there are likely to be other stakeholders looking to enter the sector in some capacity (e.g., tech companies) and the proportions of each type of stakeholders are likely to shift over time.




| | Answer | Count | Percent |
|---|---|---|---|
| 1. | Sole proprietorship | 12 | 16.22% |
| 2. | Incorporated partnership | 9 | 12.16% |
| 3. | Corporation | 18 | 24.32% |
| 4. | Incorporated society (and not Indigenous) | 5 | 6.76% |
| 5. | First Nation or Indigenous organization (including incorporated societies) | 8 | 10.81% |
| 6. | Local, Provincial or Federal Government | 4 | 5.41% |

| | Answer | Count | Percent |
|---|---|---|---|
| 7. | Crown Corporation/Agency | 0 | 0.00% |
| 8. | Other (please specify) | 18 | 24.32% |
| | Total | 74 | 100% |

**2. Number of employees you have (contract, employed, part-time/full-time) (select one only)**

Employee breakdown included: 26% (19) of respondents have no employees, while 32% (23) have 1 to 10 employees, 18% (13) have 11 to 50 employees, 21% (15) have over 100 employees (likely representing government agencies and corporations).

| | Answer | Count | Percent |
|---|---|---|---|
| 1. | No employees | 19 | 26.03% |
| 2. | 1-5 employees | 16 | 21.92% |
| 3. | 6-10 employees | 7 | 9.59% |
| 4. | 11-25 employees | 11 | 15.07% |
| 5. | 26-50 employees | 2 | 2.74% |
| 6. | 51-100 employees | 3 | 4.11% |
| 7. | Over 100 employees | 15 | 20.55% |
| | Total | 73 | 100% |

**3. Regional location of respondent (select all that apply)**

Not surprisingly, the respondents' regional location was concentrated within the Vancouver Island/Coastal region (55% of 52), Mainland-Southwest (17% or 16) and North Coast (9% or 9). Some respondents operate in multiple regions thus the total adds to more than 57.

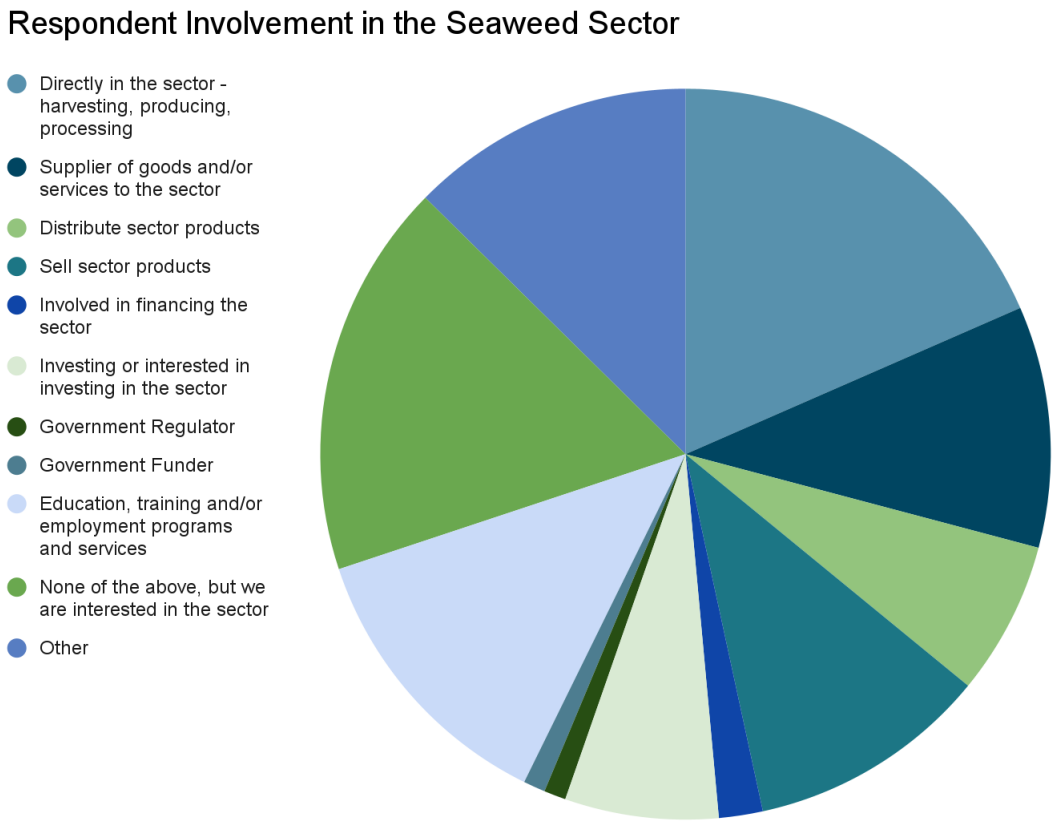
Almost 20% (18) respondents were located outside of coastal regions in B.C.

| | Answer | Count | Percent |
|---|---|---|---|
| 1. | Cariboo | 3 | 3.16% |
| 2. | Kootenay | 3 | 3.16% |
| 3. | Mainland-Southwest | 16 | 16.84% |
| 4. | Nechako | 3 | 3.16% |
| 5. | North Coast | 9 | 9.47% |
| 6. | Northeast | 5 | 5.26% |
| 7. | Thompson/Okanagan | 4 | 4.21% |
| 8. | Vancouver Island and Coast | 52 | 54.74% |
| | Total | 95 | 100% |

**4. Respondent involvement with the seaweed sector? (select all that apply)**

Results show that 18% (19) of respondents are directly in the sector through harvesting, producing and/or processing with another 30% (31) involved in the seaweed sector supply chain through supplying, services, distribution, sales and financing.

A further 7% (8) are interested in investing in the sector and a further 17% (18) are not in the sector but are interested in it. Thirteen percent (13) provide education, training and employment programs and services related to the sector.




| | Answer | Count | Percent |
|---|---|---|---|
| 1. | We are directly in the sector in harvesting, producing, processing | 19 | 18.45% |
| 2. | We are a supplier of goods and/or services to the sector | 11 | 10.68% |
| 3. | We distribute sector products | 7 | 6.80% |
| 4. | We sell sector products | 11 | 10.68% |
| 5. | We are involved in financing the sector | 2 | 1.94% |
| 6. | We are investing or interested in investing in the sector | 7 | 6.80% |
| 7. | We are a government regulator | 1 | 0.97% |
| 8. | We are a government funder | 1 | 0.97% |

| | | | |
|---|---|---|---|
| 9. | We provide education, training and/or employment programs and services | 13 | 12.62% |
| 10. | None of the above, but we are interested in the sector | 18 | 17.48% |
| 11. | Other (please specify) | 13 | 12.62% |
| | Total | 103 | 100% |

**5. Growth outlook in economic output of the sector in 5-10 years?**

Respondents were positive about the sector's outlook over the next 5 to 10 years. Eighty percent (51) of respondents think the outlook is very significant (29) or significant (22) for seaweed in B.C. No respondents project little or no growth.

| | Answer | Count | Percent |
|---|---|---|---|
| 1. | Very significant growth | 29 | 45.31% |
| 2. | Significant growth | 22 | 34.38% |
| 3. | Some growth | 13 | 20.31% |
| 4. | Little growth | 0 | 0.00% |
| 5. | No growth | 0 | 0.00% |
| | Total | 64 | 100% |

**6. Action needed (and by whom) to support the sector growth**

The most frequent responses to this question prioritize the following actions required:

1. Increasing Indigenous participation in the sector.
2. The sector working with government to advocate for research and development funding.
3. The sector working with government regarding clarity on seaweed farming regulations.
4. Promoting the sector and increasing its visibility.
5. The sector working with government to advocate for industry marketing strategies and funding.

The responses to this question point to a direct need to continue discussions with the appropriate agencies to streamline and expedite regulatory issues. The sector clearly needs support in this specific area in a timely manner to allow for significant growth to occur.

| | Question | Count | Score |
|---|---|---|---|
| 1. | Government clarity on regulation | 67 | 4.343 |
| 2. | Less government regulation | 65 | 2.831 |
| 3. | Government funding for industry marketing and development | 64 | 4.094 |
| 4. | Government funding for research and development | 65 | 4.400 |
| 5. | Government funding for education and training programs | 64 | 4.078 |
| 6. | Stimulating international trade and investment | 64 | 3.641 |
| 7. | Supporting more partnerships between organizations in the sector | 64 | 4.000 |
| 8. | Increasing Indigenous participation in the sector | 65 | 4.446 |
| 9. | Promoting the sector and increasing its visibility | 64 | 4.219 |
| | | Average | **4.006** |

### 7. Importance of adoption of technology for the growth of the sector

Almost 47% (30) of respondents indicated the adoption of technology is “extremely important” for the seaweed sector growth. Another 27% (17) rated it “very important” – together over 73% (47) rated technology as extremely or very important to seaweed sector growth.

These remarks highlight the opportunities for technological advancement in the aquaculture sector and how multidisciplinary the growth of the seaweed industry will be. The sector will be looking for farm site engineering, remote monitoring, traceability technology, harvesting and processing automation, and more. Already there are funding opportunities through organizations such as Canada’s Ocean Supercluster for those looking to develop technology to support the growth of the Blue Economy, including seaweed cultivation.

| | Answer | Count | Percent |
|---|---|---|---|
| 1. | Not at all important | 1 | 1.56% |
| 2. | Slightly important | 3 | 4.69% |
| 3. | Moderately important | 13 | 20.31% |
| 4. | Very important | 17 | 26.56% |
| 5. | Extremely important | 30 | 46.88% |
| | Total | 64 | 100% |

**8. Other important issues facing the sector**

When asked what other important issues the sector is facing, three-quarters of participants responded with comments. The most frequent issues or needs raised are paraphrased here:

- Understanding the environmental impacts of the seaweed sector growth and its role in addressing climate concerns. Ongoing marine ecosystem research and monitoring to understand short- and long-term effects of wild harvest, cultivation, and conservation; with ongoing reporting to policymakers and political leaders to inform opportunities and risks.
- Communicating the social and economic benefits of growing seaweed to local communities and groups.
- Government grants to support R&D for seaweed cultivation in western Canada.
- Labour force supply and competition for talent in the midst of labour shortages; education, training, and awareness.
- Developing a functional supply chain for seaweed production and processing.
- Streamlining the approval process for licensing new seaweed farms and improving the government's ability to process applications.
- Access to capital (public and private); raising the financing to facilitate growth in the sector.
- Indigenous partnerships are a reconciliation opportunity between government and private sector, especially with Indigenous coastal First Nations. This includes recognizing strong alignment with Indigenous worldviews on sustainability and that coastal communities are often the first to feel impacts of food insecurity and environmental challenges within land and waters management. Indigenous ownership and operation in traditional waters and territories should be promoted and increased.

- Market development and processing capacity; access to markets. Without sophisticated processing infrastructure, the sector is limited to how much volume it can sell to a wider variety of buyers.
- Growing and reproduction knowledge and technical expertise development to the level of the land agriculture level will be critical for the industry to generate efficiencies and economies of scale to allow seaweed to be a viable competitor to land based agricultural products.
- Continued creative and applied research – there are over 600 species on the west coast - determine best species for human consumption (direct or nutraceutical); identify and commercialize new uses for seaweed and kelp; including the need for a biobank for conservation of seed and development of resilient seed.
- Lack of shared seaweed infrastructure that is accessible to small/new businesses entering the sector; lack of fundamental knowledge of transitioning various marine skills into the seaweed sector.
- Investing in production and processing techniques and government programs that specifically address food security to stabilize and distribute seaweed as a whole food and an ingredient will be important.
- Awareness, respect, understanding of potential seaweed products, strategic investment into product development. Product and marketing strategies to encourage adoption of seaweed into the North American palate.
- Addressing misinformation and existing negative connotations of the aquaculture sector, increasing public education surrounding sustainability of farmed seafood.

**9. Most important obstacles to the sector having a qualified and motivated workforce now and into the future (select all that apply)**

Challenges to building a qualified and motivated workforce for the sector identified by respondents are:

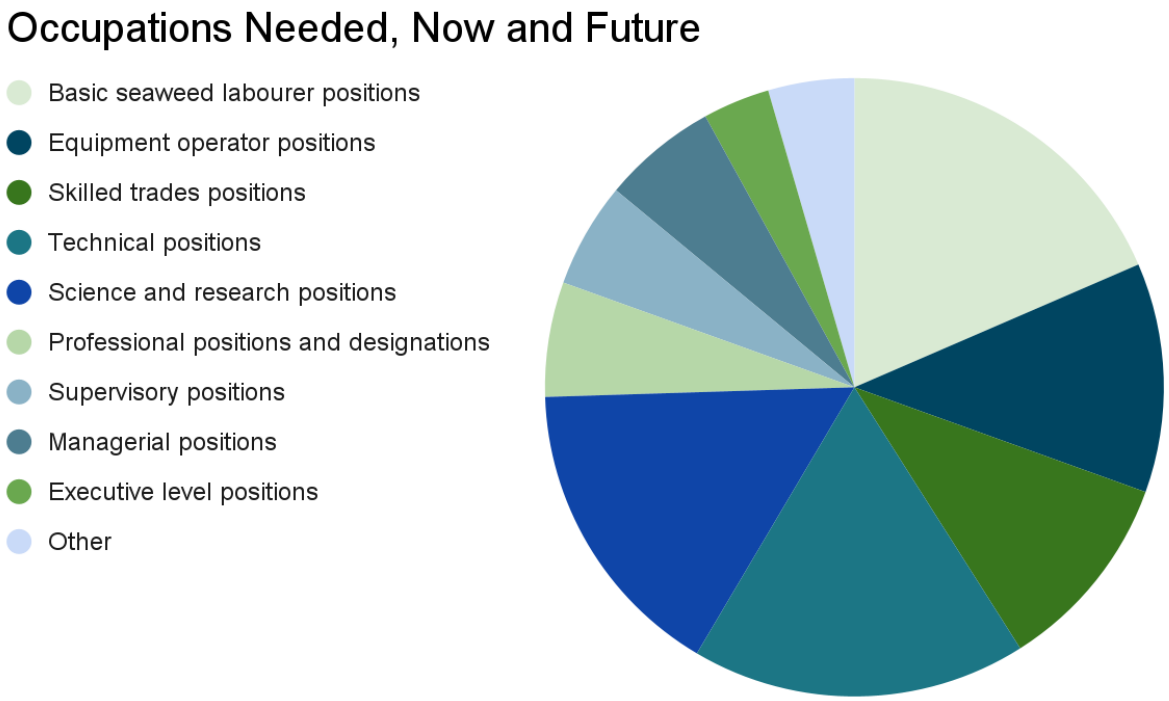
- Building awareness of the sector in young people and attracting them (21% or 37)
- Adequate education and training programs (17% or 29)
- Lack of clearly defined careers (15% or 26)
- Attracting and retaining workers in part-time, temporary jobs (11% or 20 and 10% or 18, respectively)

| | Answer | Count | Percent |
|---|---|---|---|
| 1. | Being able to make young people aware of the sector and attracting them to it | 37 | 21.14% |
| 2. | Lack of clearly defined careers | 26 | 14.86% |
| 3. | Retaining workers in lower skilled positions | 16 | 9.14% |

| | Answer | Count | Percent |
|---|---|---|---|
| 4. | Attracting workers to part-time, temporary positions | 18 | 10.29% |
| 5. | Retaining workers in part-time, temporary positions | 20 | 11.43% |
| 6. | Adequate education and training programs | 29 | 16.57% |
| 7. | Employment services to link employers and job-seekers | 12 | 6.86% |
| 8. | A lack of job opportunities | 11 | 6.29% |
| 9. | Other (please specify) | 6 | 3.43% |
| | Total | 175 | 100% |

**10. Occupations which will be in greatest need by the sector now and into the future (select all that apply)**

The occupations in greatest demand were seen by respondents as being: basic seaweed labourer positions (19% or 37); technical positions (18% or 35); science and research positions (16% or 32); equipment operators (12% or 24); and skilled trades (11% or 21).



| | Answer | Count | Percent |
|---|---|---|---|
| 1. | Basic seaweed labourer positions | 37 | 18.50% |
| 2. | Equipment operator positions | 24 | 12.00% |
| 3. | Skilled trades positions | 21 | 10.50% |
| 4. | Technical positions | 35 | 17.50% |
| 5. | Science and research positions | 32 | 16.00% |
| 6. | Professional positions and designations | 12 | 6.00% |
| 7. | Supervisory positions | 11 | 5.50% |
| 8. | Managerial positions | 12 | 6.00% |
| 9. | Executive level (C-Suite) positions | 7 | 3.50% |
| 10. | Other (please specify) | 9 | 4.50% |
| | Total | 200 | 100% |

**11. Sectors which the seaweed sector will have to compete with for talent (select all that apply).**

Other sectors identified as competing for talent needed by the seaweed sector:

1. Other aquaculture (shellfish, finfish).
2. Food processing.
3. Other non-agriculture resources.
4. Manufacturing.
5. Professional and technical services.

| | Question | Count | Score |
|---|---|---|---|
| 1. | Other parts of aquaculture | 55 | 4.109 |
| 2. | Agriculture | 53 | 3.151 |

| | Question | Count | Score |
|---|---|---|---|
| 3. | Other resource (non-agriculture) sectors | 53 | 3.283 |
| 4. | Food processing sector | 53 | 3.377 |
| 5. | Other manufacturing sectors | 52 | 3.212 |
| 6. | Construction sector | 53 | 2.887 |
| 7. | Transportation sector | 53 | 2.868 |
| 8. | Warehousing sector | 53 | 2.981 |
| 9. | Professional and technical services (including research) sector | 52 | 3.231 |
| 10. | Retail and wholesale trade sectors | 52 | 3.000 |
| 11. | Government sector | 47 | 2.851 |
| | | Average | **3.177** |

**12. Best sources of workers for the sector now and into the future (select all that apply).**

The most likely current and future talent pool demographics identified by respondents include Indigenous people, women, persons of colour and persons with disabilities. The remainder of the options ranked fairly closely to each other for likelihood of workforce sources. This highlights the wide variety of backgrounds that can be tapped into to provide talent for the seaweed sector.

| | Question | Count | Score |
|---|---|---|---|
| 1. | High school graduates | 55 | 3.855 |
| 2. | Post-secondary graduates | 54 | 3.870 |
| 3. | Unemployed persons | 54 | 3.630 |
| 4. | Workers in other industries | 54 | 3.796 |
| 5. | Workers from other parts of Canada | 53 | 3.396 |

| | | | |
|---|---|---|---|
| 6. | Specific talent pools (e.g., Indigenous, women, persons of colour, persons with disabilities) | 54 | 4.296 |
| 7. | International workers (permanent or temporary) | 54 | 3.278 |
| | | Average | **3.732** |

**13. Occupations or skills which should be (but are not being) addressed by existing education or training programs.**

When asked what occupations or skills need to be addressed by existing programs to support the sector, twenty-five respondents offered suggestions. These suggestions are aimed at small businesses or companies building teams that have a range of the listed experiences, not necessarily one occupation having all the listed attributes. The suggestions centred around two themes: types of skills and occupations needed and how these should be developed/acquired.

## Identified Occupational and Skill Gaps

- **Core soft skills such as:**
  - Leadership and management
  - Communications
  - Team building and team management
- **Marine vessel operation**
  - Experience operating a commercial watercraft.
  - Experience driving boats, general maintenance, knowledge of local waterways and other maritime risks.
  - Transport Canada tickets for commercial vessel operation above and below 5 gross tonnes and other basic marine certifications (ROC, SVOP, MED-A3, Marine First Aid).
- **Specific education and training:**
  - Seaweed-specific technical and undergraduate courses including but not limited to:
    - Biology and coastal ecology
    - Seaweed cultivation and farming (including seed development and nurseries)
    - Standard engineering opportunities in the sector
    - Technology opportunities in the sector (e.g., alginate extraction)
    - Aquaculture and mariculture
  - Graduate level research and long-term studies of wild and cultivated seaweeds
  - SCUBA and commercial diving experience.

- **Seaweed processing**
  - Fertilizer processing
  - Food grade processing
  - Feed grade processing (agrifeeds)
- **Core technical training directly aligned with the industry:**
  - Ocean and land-based kelp operations.
  - Site monitoring (i.e., long- and short-term trends, water quality, seafloor changes)
  - Nursery operations.
  - Site selection, including sector regulations, tenure applications and permitting
  - Cultivation and harvesting techniques, infrastructure and technology.
  - Climate impacts and carbon economy research.
  - Business and product development, marketing, industry certifications
  - Work ethics and safety

## Methodology for Acquiring Occupational Competency/Skills

These suggestions are intended to meet the needs of small businesses and start-ups seeking to hire early-stage staff that can have skill sets that fill multiple roles. As businesses develop, more specialized training and roles may emerge that require more intensive training and education. The interdisciplinary nature of this work is a large opportunity for skilled professionals from multiple sectors to contribute or move into the sector (i.e., trades, business and marketing, culinary, food production, agriculture).

- Meaningful engagement and consultation with First Nations organizations to best support skills training within communities.
- Micro-credentials or short (<6 months) certification programs recognized by industry and institutions, delivered virtually or in person by educational institutions.
- Industry-led webinars and workshops, delivered in communities, virtually, and privately within industry organizations.
- Core technical training that can be built upon as workers move into specific roles, delivered internally or externally by businesses.
- Ongoing collaboration between education institutions and industry to develop courses and programs for those looking to enter the sector.

**14. Support needed from governments to ensure the sector can attract, recruit, and retain the workforce it needs for growth (select all that apply).**

When asked about government support related to sector talent, respondents' top suggestions were:

- Funding of education and training programs (16% or 45 respondents).
- Funding sector research and development (16% or 45).
- Help to promote awareness and attraction for the sector and its careers among students and jobseekers (15% or 42).
- Funding sector marketing and development and promotion of the sector throughout and outside of B.C. (both 13% or 36).

| | Answer | Count | Percent |
|---|---|---|---|
| 1. | Funding education and training programs | 45 | 15.85% |
| 2. | Help promote (awareness/attraction) the sector and careers within to students and jobseekers | 42 | 14.79% |
| 3. | Funding sector marketing and development | 36 | 12.68% |
| 4. | Funding sector research and development | 45 | 15.85% |
| 5. | Promotion of the sector throughout and outside of B.C. | 36 | 12.68% |
| 6. | Promote international investment in the sector | 22 | 7.75% |
| 7. | Develop a coherent regulatory framework | 36 | 12.68% |
| 8. | Reduce regulation of the sector | 19 | 6.69% |
| 9. | Other (please specify) | 3 | 1.06% |
| | Total | 284 | 100% |

**15. Action needed by the sector and others to attract and hire Indigenous workers.**

Regarding this question, 40 respondents offered suggestions based on their experiences. The themes which emerged from these responses revolve around the following topic areas:

## Indigenous ownership, co-ownership, and partnerships

- First Nations are going to be leaders in the sector; engage and listen to what is said. Integrate traditional ecological knowledge and work to support Indigenous representation in management positions.
- Ensure Indigenous peoples are part of the conversation, the value proposition and industry outreach within communities and work with communities directly to develop projects from the start.
- Support Indigenous led businesses and ownership models. Develop business in partnership with First Nations to ensure economic development, meaningful engagement, employment planning, and co-management agreements within their traditional territories.

## More Indigenous participation in sector business and leadership

- Collaboration with a wide variety Indigenous stakeholders will build relationships and grow awareness of the sector within First Nations communities, especially for coastal nation members that may seek to build businesses and find work within their traditional territory.
- Indigenous leadership throughout companies can result in attracting more Indigenous workers to the sector.
- Long-term planning and alignment with multifaceted skills development plans, workshops and training programs within Indigenous communities.
- Support in the development of profitable end to end business. Showcase examples of success within communities. Define regions that have optional environmental conditions for seaweed cultivation within First Nations' territories.

## UNDRIP, TRC, DRIPA and Reconciliation and Relationships

- There is a need for genuine engagement and involvement for Indigenous communities. Industry (if not doing so already) should be encouraged to incorporate the Truth and Reconciliation Calls to Action into their planning and engagement to demonstrate the benefit and opportunities for Indigenous communities specifically in this industry.
- Recognition and acknowledgement of Indigenous Rights and Title. Reading and understanding the UNDRIP and UNDRIPA and implementing a process that incorporates these.

- Find ways to develop relationships between First Nations local governments and provincial governments to create a path for reconciliation.

## Employment, Training, Compensation and Quality of Employment

- Develop direct communication and recruitment strategies in collaboration with First Nations.
- Facilitate Indigenous awareness training for companies operating in the sector.
- Provide hands-on, paid opportunities in or close to First Nation communities; encourage industry partnerships and ensure primary processing is positioned regionally in close proximity to seaweed farms.
- Connectivity to post-secondary institutions offering Indigenous training. Overall awareness throughout the education pathways (K-12) in relevant regions.
- Educational and specific skills training programs (e.g., kelp nursery technician) in communities, market opportunities, and managing farms alongside other coastal work. On-site training opportunities to provide a realistic sense of kelp sector work for those interested.
- Host job fairs in partnership with First Nations.
- Offer competitive wages similar to other marine industries.
- Provide meaningful and rewarding employment with opportunities for professional development.
- Provide flexible, seasonal schedules that factor in other marine-related work seasonality such as salmon fishing.
- Develop Indigenous support systems in the workplace, including family-oriented considerations and support specific for Indigenous women.

### 16. Other comments that will help the B.C. seaweed sector ensure it has the workforce it needs to grow and sustain itself

The following list showcases the comments from respondents regarding the growth of the seaweed sector in B.C. While many of the comments echo themes from previous questions, most are broad reaching and do not necessarily indicate specific action items but instead offer suggestions for the industry to consider moving forward.

- “Doing a great job of promoting the industry so far - personally as someone who has been working in the trades and small business, it's motivating to imagine being a part of an industry that does good for the environment”.

- “Government funding is significant in Scandinavia whereas we are in a race for developing technology that will be used globally. We either get in the game and catch up or wait for others to figure things out and then play nice with them. Are we a leader or a follower?”.
- “People need to understand the benefits seaweed brings to people and the planet”.
- “Advance automated harvesting and processing for competitiveness”.
- “The government needs to allow the sector to grow with reasonable and set regulations; given the urgency of food security and climate change, sector development can position B.C. as a world leader in the seaweed space”.
- “Make the sector attractive”.
- “Opportunity abounds for coastal people and the industry can attract people inspired by growing and processing a natural, nutritious, carbon-negative product with an expanding, global market”.
- “Long way off from the scale needed to be a sustainable industry, so growth is important. The industry, such as it is, must ensure wages are attractive and employment is full time”.
- “Don't over complicate it. Don't develop a huge training initiative and give people the false impression that their training is a guarantee of success. If people want to work in this industry, support businesses in hiring and training people, but too much emphasis is placed on developing training programs that provide irrelevant information”.
- “Developing tools for employers on how to train people on regulatory requirements, traceability, environmental monitoring would be very helpful, then we can adapt them to suit our sites”.
- “Many people and businesses already in the sector in some capacity want to leverage the growing interest in kelp to diversify their offerings and grow their businesses. The interest is there, especially among First Nations communities that have been exercising their rights and working sustainably with seaweed for generations”.
- “The high cost of labour in Canada needs to be thought of; labourers will find higher wages in other industries if there aren't competitive wages in seaweed. Seaweed is relatively cheap, so efficiencies need to be created from the start for businesses to maintain market advantage over other industries and other seaweed cultivation countries”.
- “Engage students (e.g., aquaculture students, biology classes, Canada Summer Jobs, research techs) in the big picture conversations to give them broader context for the potential of the industry as well as opportunities to work in/adjacent to the sector”.
- “It is not only the workforce; it is very important to consider locations with optimal environmental conditions so there is a better chance to succeed”.

- “B.C. is primed to have its seaweed sector grow and expand at unprecedented rates going forward. According to the 2022 SOFIA report, no other sector of the fisheries and aquaculture space grew as quickly as the cultivation of macroalgae. Those wishing to work in this sector now in B.C. will have the opportunity to contribute to shaping how it looks in the future as a thriving industry and an opportunity to be working with some of the biggest names that will exist in the B.C. seaweed sector. These opportunities - for influence, a good livelihood, and growth - need to be communicated to young professionals out of high school and post-secondary institutions”.
- “Prioritize and publicise efforts to learn how to farm seaweed sustainably in order to avoid the sector meeting the scepticism and resistance that the finfish aquaculture sector has attracted”.
- “Encourage the industry to connect with WorkBC Centres across the Province as well as the Indigenous Skills and Education (ISETS) program holders in the Province. In addition, local educational institutions (public and private) will be key in helping develop the necessary training programs to support the growth of the industry”.
- “As the industry looks to the future there is also an excellent opportunity to connect with school districts (especially along the coast) to promote opportunities within the industry. With all of this said, the industry needs to develop clear career pathways so people are aware of the opportunities and those supporting the industry can best communicate the opportunities available”.
- “Funding at the community level for training and development. It is too difficult for small start-ups to compete for federal or provincial funding. Difficult to get a project off the ground in a small community”.
- “Similar to other international areas with established seaweed cultivation, streamline a regulatory process that assists all stakeholders as soon as possible, encourage young people and entrepreneurs to enter the workspace by offering help with applications, licences, etc. Direct First Nations consultation, DFO consultation, Transport Canada consultation”.
- “Work on relationships with First Nations at all levels”.

**17. Prize**

Respondents who provided their name and contact information were eligible for a $100 prize from a random draw which occurred after the survey closed. A random draw was made and the prize has been awarded by the PSIA.

## KEY INFORMANT INTERVIEWS

The Working Group identified a list of 30 potential interviewees from inside and outside of the sector including among First Nations, suppliers, related sectors, post-secondary educators, etc. From this pool, 19 interviews were completed and represented a diversity of key informants as outlined below:

- Seafood and aquaculture businesses
    - of which 2 are seaweed specific and 1 is Indigenous owned
- First Nation government
- Provincial B.C. government
    - Ministry of Agriculture & Food, Ministry of Jobs, Economic Development, Innovation
- Municipal Vancouver Island government
- Federal government/ DFO
- Universities
- Ocean Industry Innovation Funders
- Industry Associations
- Colleges
- Accounting & Business Consulting firm
- Food distribution company

Interviewees identified several insights in their opening comments, most of which involved important linkages for PSIA and the seaweed sector, including the following:

- Ocean Super Cluster partnerships with B.C. companies/researchers.
- First Nations partnerships, including ownership and co-ownership.
- Linkages to facilitate seaweed and shellfish co-production.
- 'Piggybacking' on established salmon farming infrastructure, practices and training.
- Leverage Canadian Aquaculture Industry Alliance experience, research and resources.
- Leverage Canadian Agriculture HR Council experience, research and resources.
- Learning from other regions of North America and globally to gain insight into the development of best practices.
- Ensuring local government and First Nations development are considered as part of advancing seaweed development.

## Sector Growth in B.C.

Interviewees acknowledged the growing international demand for seaweed and sector competition, including within North America: East Coast of Canada and in the U.S., particularly

Alaska and Maine. Almost all interviewees saw long-term growth potential in B.C. seaweed as huge, including the potential to expand into the many uses of kelp and seaweeds beyond food.

B.C. has some comparative sector advantages with its coastline, clean and nutrient-laden water, First Nations interest, a large variety of seaweed species, existing aquaculture, fishing and processing infrastructure, and learnings from aquaculture (especially salmon farming).

The seaweed sector is likely to play a critically important role in climate change mitigation and environmental services in the longer term (i.e., habitat, breakwater, nutrient balancing), adding value to an already high potential sector. Growth will depend on addressing the obstacles to growth and opportunities for maximizing it as well as the ability of the sector to attract and retain motivated talent.

## Government Regulation


While it was not directly in the scope of this project, many interviewees had thoughts and suggestions about government policy and regulations. A common theme was the urgent need for a seaweed-specific, clear and fair regulatory framework involving both levels of senior government. Interviewees offered several specific suggestions of governments:

- Additional government staff are needed to expedite tenure approvals as requests continue to increase.
- A smoother process for amendments to add seaweed to existing aquaculture licences /tenures.
- Support from the B.C. Government in ensuring reliable seed stock supply.
- Create regional working groups and greater access to federal resources and regional staff.
- There is a need for more champions at the bureaucratic and political levels.
- Regular meetings with relevant government streams to ensure continued support of the sector.
- Government policies and regulation should reflect a holistic approach and interconnectedness in ecosystems, working with First Nations to incorporate traditional knowledge and ways of knowing.

Some interviewees pointed to what could be learned from other global regions, identifying a correlation with progressive, streamlined regulation in high growth seaweed jurisdictions like Norway, Chile, Vietnam, China, etc. They urged policymakers to build a new seaweed framework and not simply 'tack' seaweed onto existing finfish and shellfish regulation.

## Impediments to Growth

The primary obstacle to growth that was identified by interviewees is that the current regulatory framework needs to be more consistent, appropriately staffed, quicker and more transparent licensing and permitting, flexible (e.g., using existing aquaculture tenure for seaweed) and being seaweed specific.

Other growth obstacles identified by interviewees were the lack of clearly identified plausible markets for business planning purposes and a lack of a good base of sector data and production forecasts.

This is also a weak investor, consumer, resident, worker and student awareness of the benefits and uses of seaweed, the market opportunities and eventual seaweed career opportunities. Also, necessary infrastructure and supply chains need to be built out and seaweed science and applied research need to be boosted dramatically. Some interviews suggested that the sector, stakeholders, governments, and First Nations are all working in silos on seaweed growth needs.

One factor identified as a significant obstacle to sector expansion is a reliable volume of seaweed seed supply as there are currently limited seed nurseries in B.C. and seed stock programs are still in development. It will be crucial to have seaweed nurseries relatively close to key farming areas as large amounts of genetic material and juvenile seaweed will be difficult to transport. Ocean-based seaweed farming in B.C. will need to be regulated to ensure only native species are being cultivated and that farmers are not getting seed from unregulated or unapproved sources. The sector, suppliers and governments need to work together on addressing this risk.

## Maximizing Growth Critical Success Factors

When asked about this, interviewees identified three key themes related to First Nations, governments, and awareness of and education about the sector.

First Nations need to be 'at the table' from the start of discussions and they will be leaders in the sector. As part of a very deliberate plan, the sector should conduct regular engagements on ownership and partnership with coastal and other interested First Nations, perhaps using umbrella Indigenous organizations. The seaweed sector also would benefit from demonstrating how seaweed development can reflect true conciliation and principles of UNDRIP, TRU, DRIPA, & MMIWG.

On the role of government, interviewees suggested a clear, consistent regulatory framework with reduced timelines, increased staffing to process licences and permits, a separate department for supporting seaweed producers and regulations that are developed specifically for seaweed production.

On education for and awareness of seaweed, it was suggested that the sector has to proactively engage in storytelling and highlight the benefits of seaweed, e.g., how seaweed can contribute to food systems directly but also through agrifeeds, pet foods, nutraceuticals, and fertilizers.

The sector needs to speak with a unified voice – including First Nations – through the leadership of its industry association, PSIA, which can galvanize the sector, supply chain, stakeholders, consumers, young people, and the general public to support B.C. seaweed growth. Alongside finfish and shellfish, seaweed can be branded as part of aquaculture, the single largest agri-food sector.

The other aspect of awareness that interviewees touched on was having a clear understanding of where the seaweed markets are now and what the potential is for the future – one respondent said, "never start seaweed farming without first knowing to which markets the product is going".

## Specific Roles & Actions of Stakeholders in the Sector

Interviewees were asked and were specific on 'who' should be 'doing what' vis-à-vis the B.C. seaweed sector and workforce development. Interview responses reflected the following themes:

- *Indigenous Organizations & Governments* – Interested First Nations will play a leadership and stewardship role and support individual Nations' capacity-building for seaweed development in B.C. Indigenous umbrella groups could play a facilitator role in working with sector leaders where relevant.

- *Seaweed Sector* – The PSIA has a key role to play in uniting stakeholders and representing the industry by being a voice for the sector. Additionally, the PSIA will be a key communicator for public education and raising industry awareness.
- *Private sector seaweed companies (producers, processors, and suppliers)* – Businesses will play a foundational role in development of the sector as farms and processing facilities are established to meet demand. Businesses will also be at the forefront of partnerships with First Nations, in learning from research and development for commercialization and in matching funding with governments for sector priorities. Companies in aquaculture, fishing, food processing and other marine sectors may be useful partners.
- *Education and Research* - University/college researchers and other scientists will be essential for increasing seaweed science knowledge and applied research. First Nations and other rural communities and local governments should be included in these activities. Partnership with sector businesses will also be encouraged. Post-secondary institutions should provide seaweed-specific courses and training, learn from any relevant workforce experiences on the East Coast of Canada; apply micro-credential training to seaweed workforce development and integrate seaweed into aquaculture curricula.

- *K-12* – The K-12 system needs to be consulted to work with the seaweed sector to raise awareness about seaweed and seaweed careers, build seaweed content into K-12 curriculum and explore and pursue mentorship and job shadowing opportunities.
- *Governments*
  - Federal and Provincial Governments need to recognize and champion seaweed and provide funding from their existing programs where the sector and companies are eligible. As mentioned, a key senior government role is to develop a clear, evidence-based policy on seaweed, including integrating efforts across various departments and ministries. This will need to include a review of regulatory

framework and development of a consistent, streamlined, timely (adequately staffed) seaweed regulatory framework.

- Local Governments need to be included in sector and government consultations on seaweed. The sector and First Nations might work with local governments to build seaweed-related opportunities into developments.

## Working With First Nations & Reconciliation

These were prominent topics among interviewees, particularly focused on partnership building, Indigenous ownership and Truth and Reconciliation.

It will be vital for First Nations to play a leadership role in seaweed development via equal partnerships, co-development of projects, consultations, and addressing Nations' increasing interest in ownership or some ownership stake in business projects and workforce development.


Some interviewees suggested that the PSIA should embed Indigenous principles in its strategic direction and activities, and it should work with Indigenous umbrella groups (e.g., First Nations Fisheries Council) to support First Nations capacity building and industry development. Further, PSIA should facilitate outreach to First Nations communities, engaging with their leaders, citizens, and youth.

Ensuring First Nations are involved from the beginning of seaweed development, relationships should focus on long-term trust and use a multigenerational approach. The sector must also recognize the diversity of B.C. First Nations – they are all unique and will look at seaweed and establish their priorities in different ways.

The sector should look at providing options for how First Nations are involved in seaweed farming, if interested, and to ensure interested First Nations are connected to research and development (with a focus on traditional knowledge) and are at the table during discussions on regulatory changes.

On Truth and Reconciliation, interviewees called for the seaweed sector to develop a specific plan for committing to reconciliation with First Nations. PSIA can play a role to help businesses understand reconciliation, UNDRIP and partnering with First Nations (e.g., support seaweed employers to reflect reconciliation in the workplace and support the retention of Indigenous employees). PSIA can also work with First Nations to enable them to be part of the voice and leadership for the sector. As one leader stated, “We need to work shoulder to shoulder with Indigenous people, not just consult and get their input.” A common-sense suggestion offered was to simply ask First Nations how the sector should reflect reconciliation and UNDRIP.

## Workforce & Training Opportunities

Interviewees offered the following suggested tactics with certain demographics or types of learning:

Youth

- Excite young people – connect seaweed development and addressing some of the major environmental issues of today through various communication strategies (i.e., social media). Youth are often looking for careers that address climate change and to be a part of businesses working in a regenerative and sustainable way. The seaweed sector can offer impactful and meaningful careers, including self-employment and sustainable business development.
- Address the physically demanding aspect and perception of negative aspects of seaweed jobs while showcasing the desired elements (i.e., working outside, growing sector, sustainable food systems).
- Start early in K-12 programs and partner with ocean-centric youth education organizations (i.e., Agriculture in the Classroom Foundation)
- Include focus on Indigenous youth in communications, education programs, and training opportunities.

Learning from Others

- Learn from other aquaculture and build seaweed into aquaculture training to support transferable skills.
- Learn from East Coast training institutions (e.g., Memorial University, l'École des pêches et de l'aquaculture du Québec (ÉPAQ), etc.) and the States of Washington, Alaska, and Maine.
- Leverage off of the Canadian Agriculture Human Resource Council's work in the agriculture sector and that of other national associations.

Training & Curricula

- Conduct an annual needs review for skills required in the seaweed sector as it continues to grow. New/different skills may become required over time.
- Collaborate with employment and training programs and institutions (i.e., NIEFS, WorkBC, NIC, VIU, Indigenous training organizations, etc.) to create/build on core curricula for aquaculture and specialty streams for seaweed.
- Focusing on innovation and creative thinking in seaweed training to maintain B. C's position as an industry leader.
- Use micro-credential training to increase flexibility and reduce training time for people with existing transferable skills.

Categories of Skills & Knowledge

- Core marine skills: the broad range of skills that are present in the marine industry (transport, fishing, safety, tourism, etc.) can all be transferable to the seaweed industry. Technical skills such as boating and commercial vessel operations, fishing experience, commercial diving, and other commercial marine work will be vital. As well as marine health and safety, logistics, cold transport, technical aquaculture skills, fish and food processing, business development.
- Research and science: monitoring of farms and cultivated species, nursery development and seed production, product development, aquaculture science, aquaculture engineering and automation, and ecological monitoring.
- Policy and regulations: policy analysis and creation, monitoring and updating regulations, and consulting stakeholders.

Other Ideas

- Work to retain talent and/or reach displaced or underemployed people in aquaculture and provide seaweed-related training and knowledge.
- Pursue partnerships with and leverage resources from training and employment service providers and ensure First Nations are part of the process.
- Provide training within relevant communities.
- Federal and provincial training funding programs (e.g., Ministry of Post-Secondary Education and Future Skills).
- Build on existing community knowledge, including traditional knowledge, and include the community in science and research.

## Seaweed Skills and Knowledge

A range of skills and knowledge were identified by interviewees as being necessary for working in various parts of the aquaculture sector. Many of these are closely related to skills that would be gained in other aquaculture (finfish and shellfish), fishing and food processing sectors.

Ideally, talent and talent development for seaweed careers would cover the whole lifecycle of seaweed cultivation from beginning to end as well as post-harvest, including processing and

supply chain jobs. This would involve a range of education and skills from entry level (labourer) to skilled technician and equipment operators, to scientific roles and management and supervisory roles.

Examples mentioned included:

- Carbon cycle and biological knowledge.
- Nursery management, cultivation, and farming.
- Commercial diving.
- Engineering and technician skills.
- Logistics/project management.
- Marine vessel operator permits (operation, safety, radios, etc.).
- Marketing, finance, business development.
- Research and scientific (e.g., marine biology/seaweed bioscience).
- Seaweed processing (e.g., drying)

## Education and Training Programs & Methodology

Interviewees offered ways of structuring and delivering seaweed-related training in the future. Until the sector grows and has a larger workforce, the most pragmatic approaches for talent acquisition and development are to use existing aquaculture and processing curricula and develop some seaweed-specific modules and possibly even micro-credentialed training. This would allow workers without or with some related experience to supplement their skill sets and be work-ready upon completion.

As the sector approaches a critical mass of workers needing similar training, the sector should work with training institutions to look at the feasibility and viability of developing a standalone seaweed training program.

Regardless of the training model, given where the seaweed jobs will be (on or near the coast, likely remote regions), for at least the knowledge-based training content the sector could consider online or virtual training.

Interviewees suggested the training design and development for sector-related training should be informed by First Nations, asking their communities to define how they want to be involved and to deliver the training in accessible locations. Further, it was suggested that the sector and training institutions consider barriers to learning and employment that some Indigenous youth may face (e.g., remote living situations, lack of financial means, limited secondary education,

seasonal commitments to traditional harvesting, etc.) and address these before or during training.

It was also suggested that the sector should do a scan of funding programs and incentives for employers and workers/jobseekers, as well working on increasing the attractiveness of rural communities to retain young people and skilled workers.

## Best Practices

The interviews with many informed individuals yielded a small number of best practices in Canada and globally. Examples are listed below:

Seaweed sectors in Europe (e.g., Ireland, Netherlands, Norway, Scotland), the States of Alaska and Maine, and Southeast Asia (e.g., Indonesia, South Korea) are working to engage Indigenous peoples and youth to increase awareness of jobs and careers in seaweed and how to pursue them. GreenWave, a non-profit, regenerative aquaculture organization, has actively worked to engage Indigenous groups such as the Shinnecock Kelp Farmers in the U.S East Coast. Through this partnership, Shinnecock has received technical training and guidance through the seaweed market with plans on expanding their current production[23].

Programs like the Ocean Superclusters' Indigenous Career Pivot Program has a network of over 460 maritime organizations which offer 12-month meaningful work placements for Indigenous people, including in seaweed-related roles. Ocean Wise Education offers 3-month placements for youth to work in sustainable ocean jobs or create their own projects that address ocean issues, of which seaweed could be a sector of interest.

The Scottish Association for Marine Science (SAMS) in Scotland integrates research, education and training programs to support industry development and employment opportunities, offering various streams of marine-related training including plant aquaculture practices. In 2020, the SAMS launched the Seaweed Academy, the UK's only dedicated seaweed industry facility offering a complete package of training, education, and business development.

[23] Greenwave. n.d. Indigenous Farmers Turn to Kelp to Restore Waters and Reclaim Cultural Practices https://www.greenwave.org/blog-who-farms-matters/shinnecock-kelp-farmers

The Safe Seaweed Coalition, based in France, is a global network which supports knowledge sharing on consumer, environmental and operational safety in the seaweed sector, including education and training programs.

The East Coast seaweed and aquaculture sector supports training through, for example, St. Andrew's Biological Station's Integrated Multi-Trophic Aquaculture Project, led by Dr. Thierry Chopin of the University of New Brunswick as well as aquaculture programs at Dalhousie University, Memorial University, and the University of Prince Edward Island.

In Gaspé, Quebec where, for example, the Mi'kmaq Aboriginal Fisheries Management Association is part of Fisheries and Oceans Canada's funded AAROM network – Indigenous-led organizations in the fields of technical and scientific capacity-building in the management of fisheries, aquaculture and oceans and are actively providing seaweed-related training integrated with other sciences. l'École des pêches et de l'aquaculture du Québec is also spearheading the development of seaweed-centric aquaculture programs for the aquaculture industry in Quebec.

## Workforce Strategy Priorities

When interviewees were asked about what a priority in a B.C. seaweed sector workforce strategy should be, they identified a number of factors to be built into such a strategy.

- Using social media and other marketing strategies to promote the sector to young people (e.g., Tik Tok, virtual reality of farms, etc.). Using the compelling story of seaweed to reach young people and attract potential talent to the sector – seaweed addresses important current issues such as food security and mitigating climate change.
- Tap into members of underrepresented groups for seaweed talent and increase Equity, Diversity, and Inclusion in companies, including ensuring non-Indigenous workers are culturally aware of Indigenous peoples.
- Employ strategies to ensure job and talent retention for people already in seaweed communities – consider a targeted Indigenous youth recruitment and retention strategy.
- Work on housing, transportation, services and supports for seaweed workers.
- Attract talent with the innovation and automation potential in the seaweed sector to tap into youth interested in Science Technology Engineering Math (STEM).
- Develop an online training course to equip workers with regulatory knowledge (keeping it updated).

- Develop an HR and Indigenous Relations tool kit for start-ups and small seaweed businesses.
- Seek targeted and sustainable funding for employers and Indigenous and non-Indigenous people for seaweed-specific training (including fees, accommodation, travel, etc.).
- Promote the “careers” aspect (not simply “jobs”) in the seaweed sector including the entrepreneurship opportunities – possibly consider a seaweed incubator program.
- Leverage national associations’ and national umbrella groups’ programs, resources, partnerships, networks, and funding, including Aquaculture Association of Canada (AAC), Canadian Aquaculture Industry Alliance (CAIA), Ocean Supercluster, Ocean Startup Project, etc.
- Partner with B.C. Restaurant Association and other hospitality groups on promoting and growing seaweed as part of expansion of seaweed as a sustainable food source in B.C. and Canada.

These and the aforementioned best practices will be explored further in the next phase of the PSIA’s work.

## FOCUS GROUP

A list of twenty-five potential focus group participants was developed by the Working Group with a goal of including a diverse group of key informants to interview. From this, a group of thirteen individuals confirmed and participated in the focus group. A three-hour virtual focus group was held October 4, 2022. The participants were:

- Best, Kiley – Fisheries Biologist, Centre for Fisheries Ecosystems Research, Marine Institute of Memorial University
- Byrne, Allison – Research Associate, Sustainable Aquaculture Program, North Island College
- Frommel, Dr. Andrea - Assistant Professor and Chair in Sustainable Aquaculture, UBC
- Gunn, Molly – Graduate Intern, PSIA (Recorder)
- Hawkswell, Jordan – Director, Communications & Engagement, PSIA
- Johnson, Larry - President, Nuu-chah-nulth Seafood Limited Partnership
- Jothen, Kerry (Facilitator) – Principal, Human Capital Strategies & Project Manager
- McCormick, David - Economic Development Manager, Uchucklesaht First Nation
- Regnier, Denice – Manager, Programs and Corporate Affairs, Island Coastal Economic Trust
- Sams, Linda – Sustainable Development Director, Cermaq Canada Ltd.
- Smith, Mark (Chair) - President & CEO and Board member, PSIA
- Wallinger, Bruce - Director, Strategic Initiatives and Board member, PSIA
- White, Jordan - Principal, Naas Foods

The focus group was hosted by PSIA, moderated by the PSIA CEO, Mark Smith, and facilitated by the Project Manager.

The discussion questions were provided to the focus group attendees prior to the meeting and introduced by Kerry in the meeting as listed below:

1. What barriers and opportunities need to be addressed to support short-term and long-term growth of the B.C. seaweed sector?
2. How and among whom can we collectively increase awareness of the importance and opportunities regarding seaweed in B.C. coastal communities?
3. Specifically, what changes to governments' regulatory approach and framework towards the seaweed sector are needed?
4. What will stimulate and support the necessary science and applied research involving seaweed in B.C.?
5. What are some key things the Pacific Seaweed Industry Association should be doing to support the growth and development of the seaweed sector in B.C.?

6. How can First Nations be supported to increase their participation in seaweed production and how can industry and others work with First Nations to advance reconciliation and the principles of UNDRIP and Truth and Reconciliation?
7. What workforce development, education and training activities are needed to ensure the seaweed sector has the base of talent needed to grow and flourish?
8. How and where should programs to develop seaweed knowledge and skills be structured and delivered?

Before beginning, comments were made on Indigenous Truth and Reconciliation as an important point to focus on throughout the meeting. Strong emphasis was placed on the need to build relationships first to allow further planning to be successful.

Q1. Barriers and opportunities in planning processes

There were a few key barriers identified around short-and long-term planning for industry growth. More data on the current seaweed industry in B.C. and future outlook is required for investors to get involved and make informed decisions. Public acceptance is a barrier that will need to be overcome by looking at previous mistakes and successes made in other aquaculture sectors. The application process needs to be improved with greater government human resources to manage applications and expedite the process. Communicating and coordinating throughout specific regions and the stakeholders within them is important to streamline the application process. The market is still limited and challenging for farmers to sell their product. There is a high need for capital investment in order to make a long-term plan for growth.

There was also valuable insight into opportunities for growth in the B.C. seaweed industry. Now is a good opportunity to push for and ensure seaweed industry partners are having early conversations with the provincial (and federal where applicable) government around implementing seaweed projects and policy as a part of the blue economy plan and strategies for growth. This could potentially reduce regulatory challenges further on. The large coastline is a major opportunity that we can use with careful planning and communication across government and jurisdictions. Determining optimal growing sites for certain species is important to reduce the trial-and-error process, ultimately saving time and money for farmers.

Q2. Increasing awareness

Raising awareness in the younger generation to encourage research and involvement in the industry was considered as a strategy in the conversation. Universities and colleges are receiving interest from students however it's been a challenge to line students up with employment opportunities in addition to a lack of funding to allow students to pursue this field. Educating

consumers around the various seaweed food products with taste testing and restaurant involvement has shown some success. Leveraging the tourism industry and partnering with seafood companies to introduce seaweed products to consumers could be effective strategies in raising awareness. B.C. is an area with clean waters that could be taken advantage of and used as a selling point, as the 'B.C. brand.' Focusing on rural communities, such as Tofino, with niche markets and strong Indigenous involvement in the marine sector, should be a part of short-term planning strategies.

Q3. Regulatory framework

The application process needs to be fully inclusive to ensure all applications are consistent. In addition, knowledge and experience in all areas included in the process such as the Species at Risk Act is important to make informed decisions. Educating regulators on the major benefits and unique environmental and economic opportunities would increase awareness and potentially expedite the process. Building a review process into the application submission process to save time and energy and increase the success rate of accepted applications. Indigenous guidance within the regulatory process was suggested to be inclusive and work within the rights and title of Indigenous groups. There is also a need to manage the underutilized existing tenures to provide more access to sites for newcomers.

Q4. Science and applied research

Organizing and directing new science and research is important to meet the needs of the environmental and economic objectives of the sector. Academic institutions can involve more industry professionals to be a part of teaching and relating to students. Improving communication and encouraging collaboration between academic and private sectors would be useful for pushing forward industry knowledge around both cultivation and environmental impacts. Broadening the research topics within projects would create a more holistic approach to research.

Q5. Suggestions for the PSIA

The main priority for the PSIA in the coming months of sector development is to focus on communicating with all levels of government to improve the regulatory framework. It was also suggested to provide public access to information on site selection to ensure applications are more successful and avoid unnecessary hurdles. Put together a working group with the provincial and federal government on the review process in the start-up phase. Encourage research by compiling a list of academic institutions research projects to allow private sectors to

connect with and collaborate on applied research. A job board on the PSIA website would be useful for academic institutions to link to for students with interest in the sector. An example of an interactive map of farmers and seaweed buyers from the Maine based Greenwave website was brought up as an interesting and useful tool that could be considered moving forward.

Q6. First Nations participation

Focus on building relationships with First Nation groups to create mutual trust and understanding. Industry needs to have the knowledge and recognition during the development stages in different areas of Indigenous rights and title. Ensure to present business opportunities to First Nations in addition to land consultation and job proposition all while remaining open and receptive to new ideas. There are challenges and unknowns on how to get in contact with First Nations groups. If this could be improved, it would create a pathway for First Nation groups to participate in research and development of the industry. Contacting Indigenous groups that are actively involved in the sector to help advocate for opportunities with recognition of their specific needs, objectives, and priorities that are unique to the group.

Q7., Q8. Education, training, workforce

Including a variety of marine and processing technical skills in training programs will be critical to the success of the emerging sector in B.C. as small businesses and start-ups will need staff with such skills. To relieve the burden of travelling to large city centres to receive training, more education programs were suggested to be offered in rural communities. Other suggestions and a current method being used at UBC is to provide the option for students to learn remotely for a portion of the course and attend the technical skills training program at the facility. In addition, tailoring these programs to meet the needs of various education levels has been a successful strategy in the past. This makes education more accessible and attainable.

Final/Closing Remarks

Next steps of the focus group and final pieces of the Project were presented by Mark Smith. This includes creating a Governance Committee to oversee future work as an important action item. The group was asked for consideration of being included in this committee with the PSIA to build a diverse representation across the board. In the time the Project has been in progress, the PSIA has pursued industry activities including presenting at the Vancouver Island Economic Association Annual Summit, and participating in an advisory committee around regenerative agriculture and Agri-tech.

Participants were thanked for their invaluable input and guidance on moving forward to advance the B.C. seaweed sector.

## GOVERNANCE COMMITTEE

The Project Working Group identified a list of key sector, stakeholder, and First Nations representatives to invite to serve on an on-going Project Governance Committee. During the month of October, 2022, the PSIA engaged the identified businesses, stakeholders and First Nations organizations on their interest in participating on the Project Governance Committee to oversee further work of the PSIA and its partners on building and implementing workforce and other strategies to grow the sector and its talent base. The Project Working Group approved a draft Terms of Reference of the Committee at its inaugural meeting on December 2, 2022. See Appendix 3.

The Committee membership is diverse in terms of geographic areas of the province, parts of the sector and its supply chain, Indigenous participation and those who provide employment, education and training programs and services related to the sector.

The geographic and First Nations representation reflects primarily coastal regions and Nations of B.C. Sectoral representation includes seaweed businesses, businesses that distribute and/or sell seaweed products and suppliers to seaweed businesses. Also, because of shared needs and programs, businesses in other parts of aquaculture and agriculture are part of the Committee.

## FINDINGS & RECOMMENDATIONS

### Key Findings Themes

Based on what was reviewed in the relevant literature and what was heard from sector businesses, stakeholders and First Nations through the online survey, key informant interviews and a focus group, the key findings which emerge are:

1. There is strong support expressed among sector businesses, sector stakeholders, education and training providers, First Nations, and government agencies for having a strong B.C. seaweed sector.
2. Relatedly, there is much qualified optimism about the sector's long-term growth potential among these same entities. It is qualified with reference to the degree to which certain barriers are addressed and appropriate vision and execution are effective.
3. Many sector organizations and stakeholders indicated they are hoping for a clear seaweed-specific regulatory framework to be developed and implemented by governments working with industry and First Nations.
4. Most sector organizations, stakeholders and First Nations recognize this sector will need significant investment from private and public sources in order for the sector to support more start-ups and grow to scale. The industry association, PSIA, will need support from industry and others to play a necessary leadership role in the sector's future.
5. The work of private and public organizations and individuals in existing aquaculture will be a solid base on which the seaweed sector can build, particularly within training institutions to adapt existing and develop new content and methodologies.
6. First Nations are strongly interested in the potential of seaweed and need to lead its development in partnership with seaweed companies and governments. Seaweed development represents an opportunity for sector businesses and First Nations to jointly pursue the realization of Reconciliation and UNDRIP principles.
7. Building a seaweed workforce and talent pools should start with those living in coastal areas adjacent to potential seaweed farming and processing. This would include Indigenous peoples, youth and workers looking to move from other marine industries including aquaculture as well as food processing; the latter options because of several transferable skills (e.g., marine safety, commercial vessel operations, trades, and

processing skills, etc.). A career map with transferrable and seaweed-specific competencies could be developed by the sector and training institutions.

8. The seaweed sector has a great story to tell and as such, must harness the power of storytelling to engage a broad audience, especially young people in schools, post-secondary institutions and within local communities to attract them to seaweed career paths. This could involve the development of promotional materials and social media campaigns by the sector and by training institutions.

9. The seaweed sector needs to widely broadcast the value chain benefits of seaweed including its value to local economic development, jobs, and careers, in mitigating climate change, contributions to sustainable food systems, pharmaceuticals, and helping to build other parts of the Blue Economy. The audience should include the public, culinary sector, agriculture sector, young people, parents, media, and other influencers.

10. The sector and academic institutions will need to invest in furthering seaweed science and research in B.C. to build and continue to develop the best understanding of seaweed cultivation in ocean ecosystems, including collaborating with corporations, private investors, institutions, and government research funding agencies.

## Recommendations

The overall purpose of this project was to identify in-demand skills, career paths into and within the sector, transferable skills from other sectors, and skills training requirements to support the continued development of the industry in B.C.

Based on what we heard from the sector, stakeholders and First Nations and learned from related literature, our recommendations on the above focus on two levels.

In the first level of recommendations, to have a strong workforce, we recommend certain actions and strategies needed to directly support sector growth – without a growing sector, there is no workforce.

In the second level of recommendations, we focus on actions and strategies which directly support workforce attraction, recruitment, training, development, and retention.

Recommendations for Seaweed Sector Growth

1. Continue to pursue funding for the PSIA in order to provide the necessary, ongoing sector leadership and a unified voice.
2. Undertake a project to complete a scenario-based forecast of seaweed production in B.C. for the next decade.
3. Initiate a project to track, collect, analyse and report on data on the B.C. seaweed sector and competitive regions.
4. Collaborate with First Nations that are working in the sector to identify interested leadership to join the Governance Committee and create a joint planning table to support First Nations' development in the sector.
5. Create a sector round table, including First Nations, to prioritize and address recommendations to governments on new and evolving seaweed regulatory policies and procedures.
6. Work with sector businesses and consultant experts to undertake market analysis and create a sector marketing plan, including a workforce component (e.g., attraction and retention).
7. Develop a sector growth strategy that mitigates obstacles to growth and includes assumptions on markets, investments, competition, etc.
8. Create a joint table with finfish, shellfish, food processors, commercial fisheries and Agri-tech sectors to identify and take action on shared needs and solutions.
9. Develop a seaweed sector reconciliation and trust plan with the leadership of Indigenous organizations in the sector.
10. Develop a business start-up and business development tool kit for sector small businesses.
11. Catalogue, promote and apply pan-Canadian and international seaweed best practices and success stories in B.C. and leverage national associations' and umbrella groups' resources and knowledge.
12. Pursue industry partnerships with post-secondary institutions, companies, and others to promote research and development funding for the sector – including research on nursery development, seed supply and seaweed genetics.

13. Work with governments, universities, and funding organizations to create a seaweed innovation, technology, and automation incentive program.

Some of the above recommendations could be implemented immediately as projects in the next phase of this work.

Recommendations for Growing Seaweed Talent

1. Undertake a future-focused labour market research project to clearly identify the quantity and quality of future actual and potential talent and talent pools to inform a workforce strategy.

2. Work with a Governance Committee of sector businesses, First Nations, education and training institutions and governments to develop aforementioned seaweed workforce strategy.

3. In conjunction with the labour market research project, undertake research on and develop strategies for creating pathways for people coming from aquaculture and related marine industries as well as members of relevant workforce groups (i.e., transport, trades, silviculture, agriculture) to enter seaweed careers.

4. Create a working group of businesses, educational institutions, First Nations, and employment service providers to identify best practices for developing seaweed-specific adult education programs, courses and certificates, focusing both on core content and potential specialized streams.

5. Work with colleges and universities to ensure that seaweed topics are included in undergraduate programs, graduate research, and that opportunities to work in seaweed jobs are promoted in co-op and internship programs.

6. Develop a seaweed sector career map showing various seaweed-related positions, career pathways, education and training, and necessary qualifications while including linkages with finfish and shellfish aquaculture and commercial fisheries in B.C.

Most of the aforementioned recommendations could be implemented as projects as part of the next phase of seaweed sector and workforce development and strategies. In fact, all of the recommendations for “Growing Seaweed Talent” could be near future implementation projects if resources can be obtained.

## ACTION PLAN & NEXT STEPS

The Sector Labour Market Partnerships program within the B.C. Government consists of five phases:

- Phase 1 - Engagement & Planning
- Phase 2 - Research
- Phase 3 - Strategy Development
- Phase 4 - Strategy Implementation
- Phase 5 - Evaluation

Moving forward, the PSIA seeks to use the results from this report (Phase 1) to formulate an Action Plan that includes conducting one or more of the next Phases of SLMP. There are two parts of the proposed Action Plan, which will be informed by the Governance Committee and Government approval. The two parts are: a) developing a B.C. Seaweed Sector Development Strategy; and b) developing and implementing a B.C. Seaweed Talent Strategy.

# Seaweed Sector Development and Talent Action Plan

## SEAWEED SECTOR DEVELOPMENT STRATEGIC ROADMAP

| 2023 | | | | 2024 |
|---|---|---|---|---|
| **January-March** | **April-June** | **July-September** | **October-December** | |
| | | | | |
| Finalize a sector development implementation plan. *By February 2023*<br>Undertake a project to complete a forecast of seaweed production in B.C. for the next decade. *By May 2023*<br>Gain funding for PSIA to provide the necessary, ongoing leadership & a unified voice, including developing a strong pitch deck. *Ongoing*<br>Broadcast findings of the PSIA engagement project. *Start January 2023*<br>PSIA will pursue, with post-secondary | Collaborate with First Nations working in the sector to identify interested leadership to join the Governance Committee & create a joint planning table to support First Nations' sector development. *By April 2023*<br>Work with sector companies & First Nations on recommendation s for new seaweed | Create a joint table with finfish, shellfish, food processors, commercial fishing & Agri-tech sectors to identify & take action on shared needs & solutions. *By September 2023*<br>Initiate a project to collect, analyse & report on data on the B.C. seaweed sector & comparative regions. *By August 2023*<br>Work with sector businesses & consultant experts to undertake market analysis & create a sector marketing plan. *By August 2023*<br>Catalogue, promote & apply pan-Canadian/ international seaweed best practices & | Develop a seaweed sector reconciliation & trust plan with the leadership of Indigenous organizations in the sector. *By December 2023*<br>Work with governments & universities to tap into seaweed innovation, technology/ automation incentives. *Ongoing*<br>Develop a sector growth strategy that mitigates obstacles to growth & includes | Implement sector growth strategy. *Starting January 2024*<br>Implement the Seaweed Workforce Strategy. *Starting February 2024* |

| | | | | |
|---|---|---|---|---|
| institutions, companies and others, research and development funding for the sector – including on seed supply. *Ongoing* | regulatory policies and procedures. *By June 2023* | success stories in B.C. & leverage national associations' & umbrella groups' resources & knowledge. *By August 2023* | assumptions on markets, investments, competition, etc. *By December 2023* | |

## SEAWEED SECTOR TALENT STRATEGIC ROADMAP

| 2023 | | | | 2024 |
|---|---|---|---|---|
| **January-March** | **April-June** | **July-September** | **October-December** | |
| | | | | |
| Submit an application to MPSEFS for Phase 2 and 3 SLMP funding – Labour Market Research & Workforce Strategy Development. *By February 2023*<br>● Finalize a project implementation plan. *By end of February 2023*<br>● Work with the newly created governance committee of sector businesses, First Nations, education/ training institutions & government to develop a workforce strategy. *Started in December 2022*<br>● Create a project team including a project manager and PSIA staff. *By February 2023*<br>● Complete a Project Communication Strategy. *By end of February 2023* | ● Undertake a labour market research project to clearly identify quantity & quality of future actual & potential talent and talent pools and inform the workforce strategy. *Complete by June 2023*<br>● Create a working group of businesses, colleges/ universities, First Nations & employment service providers to identify routes for developing seaweed-specific programs, courses/ certifications. *Start June 2023*<br>● In conjunction with the labour market research project, conduct further occupational research and analysis on key occupations/ skills needed in the sector & where talent with such skills will be found/ developed & identify occupational and skill gaps in the B.C. training system that inhibit the sector's growth. *By June 2023* | ● Develop a seaweed sector awareness/ education program directed at the general public, consumers, suppliers, youth, K-12 teachers & students – including social media/ digital marketing. *By September 2023*<br>● Work with the Ministry of Education, B.C. school districts, First Nations School Association & corporate sponsors to develop/ deliver seaweed awareness events in schools in coastal communities. *Start September 2023*<br>● Undertake research on & develop strategies for creating pathways for aquaculture & marine industry workers & members of relevant workforce groups to enter seaweed careers. *By September 2023*<br>● Implement awareness & education programs. *By September 2023* | ● Engage with sector, First Nations & stakeholders on a draft Seaweed Workforce Strategy. *Before December 2023*<br>● Develop a business start-up & business development tool kit for sector small businesses. *By December 2023*<br>● Complete a Seaweed Workforce Strategy, Implementation Plan & Sustainability Plan. *By December 2023* | ● Work with colleges/ universities to ensure seaweed curriculum is included in undergraduate programs, graduate research & that opportunities to work in the seaweed sector are promoted in co-op/ internship programs. *Start January 2024*<br>● Develop a seaweed sector career map showing various seaweed-related positions, career pathways, education & training/ necessary qualifications. *By June 2024* |

## SLMP Application for Next Phases

Based on the Governance Committee's support and the support demonstrated by sector organizations, stakeholders, and First Nations throughout this engagement process, the PSIA intends to submit an SLMP funding application to request funding to complete the following work over an 18-month period starting in Q1, 2023:

1. Create a joint table with finfish, shellfish, food processors, commercial fisheries and Agri-tech sectors to identify and take action on shared needs and solutions.
2. Undertake research on and develop strategies for creating pathways for people coming from aquaculture and marine industry as well as members of related workforce groups (i.e., transport, trades, agriculture) to enter seaweed careers.
3. Catalogue, promote and apply Canadian and international seaweed best practices and success stories in B.C. and leverage national associations' and umbrella groups' resources and knowledge.
4. Work with a Governance Committee of sector businesses, First Nations, education and training institutions and government to develop a seaweed workforce strategy.
5. Undertake a future-focused labour market research project and a scenario-based forecast of seaweed production in B.C. for the next decade to clearly identify the quantity and quality of future actual and potential talent and talent pools to inform a workforce strategy.
6. Create a working group of businesses, colleges and universities, First Nations, and employment service providers to identify a route for developing seaweed-specific programs, courses and certificates (incorporating both core seaweed content and specialized streams).
7. Work with colleges and universities to ensure that seaweed-based curriculum is included in undergraduate programs, graduate research, and that opportunities to work in seaweed jobs are promoted in co-op and internship programs.
8. Develop a seaweed sector career map showing various seaweed-related positions, career pathways, education and training and necessary qualifications while including linkages with finfish and shellfish aquaculture and commercial fisheries in B.C.

Some of these will be researched and/or developed over the 18 months but may be delivered or implemented in a subsequent phase.

## Rationale:

During this project, the PSIA has found strong support among businesses, stakeholders, academic and training institutions, First Nations, and national organizations for working together on the actions and strategies recommended in this report. This includes the need for the development of a workforce or talent strategy.

In addition, in order to inform further sector development and such a strategy, the PSIA needs to work with others in the sector to dig deeper on sector-related (i.e., aquaculture and other marine industry) production, markets, and labour market demand, supply and gaps in B.C. This will also include time to look more closely at labour market data in North America, particularly on the East Coast Canada, the State of Maine, the State of Alaska, etc. The PSIA will seek to identify what occupations currently exist in the sector and what skills current workers need to support the growth of the sector.

Therefore, the PSIA will continue to work with sector, governments, First Nations, post-secondary partners and other relevant stakeholders towards the recommendations identified in this report. The PSIA will apply for further support from SLMP in early 2023 to further thought leadership and develop strategies to address the current and future market needs of the seaweed sector in B.C.

# APPENDICES

## APPENDIX 1: Literature Review Reference Sources


Adams, S. n.d. Cawthron Institute Aotearoa New Zealand. Building a Seaweed Sector htttps://sustainableseachallenge.co.nz/our-research/building-a-seaweed-economy/

Adams, S. 2021. Cawthron Institute Research Project: Building a Blue Economy Sector - Seaweed (Abstract). https://www.cawthron.org.nz/our-news/seaweed-sector-report/

Alaska Fisheries Science Center, NOAA. 2022. Aquaculture Strategic Science Plan. https://media.fisheries.noaa.gov/2022-08/Aquaculture-StrategicSciencePlan-21JUL2022-%5B508%5D.pdf

Aquaculture Association of Canada. 2019. Canadian Aquaculture: R&D Review https://www.dfo-mpo.gc.ca/aquaculture/sci-res/rd-eng.htm

Arctic Kelp Canada. n.d. Project Description: ArcticNet. https://www.arctickelp.ca.

AtSeaNova. n.d. HoldiNova and At-Sea-Technologies. Discover Seaweed Farming, https://atseanova.com.

Australian Seaweed Institute (ASI). n.d. Protecting the Reef from Water Pollution Through Seaweed Biofilters, https://www.australianseaweedinstitute.com.au/.

Bradly, N., Syddall, V., Ingram, C., Clarkson, R., Elliot, A., Major, R. and Adams, S. 2021. Sustainable Seas Challenge Building a Seaweed Sector: Developing a Seaweed Sector Framework for Aotearoa New Zealand https://www.sustainableseaschallenge.co.nz/assets/dms/Reports/Seaweed-sector-review-part-1-Market-regulation/Seaweed-Sector-Review-part-1-Market-Regulation.pdf.

Cai, J. 2021. Food and Agriculture Organziation of the United Nations. The Global Status of Seaweed Production, Trade and Utilization. https://www.competecaribbean.org/wp-content/uploads/2021/05/Global-status-of-seaweed-production-trade-and-utilization-Junning-Cai-FAO.pdf

Camarena Gomez, Dr. Teresa and Lahteenmaki-Uutela. n.d. Nordic Council of Ministers European and National Regulations on Seaweed Cultivation https://www.submariner-network.eu/images/grass/FINAL-GRASS_GoA_3.2._SYKE_regulation_report.pdf

Canadian Agriculture Human Resource Council CAHRC-CCRHA. n.d. How Labour Challenges will Shape the Future of the Aquaculture Industry: Agriculture Forecast to 2029 https://cahrc-ccrha.ca/sites/default/files/2021-11/factsheetAQU_E_web.pdf.

Canadian Aquaculture Industry Alliance (CAIA). 2020. Canada's Blue Economy Strategy 2040 https://fisheriescouncil.ca/wp-content/uploads/2020/10/Canadas-Blue-Economy-Strategy_FINAL-9-15-2020.pdf.

Cascadia Seaweed. 2021. Integrating Seaweed Aquaculture into Canada's Blue Economy Strategy: A Call to Action. https://www.cascadiaseaweed.com/blue-economy-report.

Cleyndert, G., Newman, R., Brugere, C., Cuni-Sanchez, A., Marchant, R., African Handbook of Climate Change Adaptation, 2021. Adaptation of Seaweed Farmers in Zanzibar to the Impacts of Climate Change https://link.springer.com/referenceworkentry/10.1007/978-3-030-45106-6_54

Collins, B. and McCannel, J. 2019. Vancouver Island Economic Alliance. Business Cases for Foreign Direct Investment on Vancouver Island http://ftzvi.com/wp-content/uploads/2019/11/Foreign-Direct-Investment-Report.pdf.

Department of Natural Resources Tasmania. 2022. Tasmanian Government. Sea fishing and aquaculture https://nre.tas.gov.au/sea-fishing-aquaculture/marine-farming-aquaculture/seaweed-farming

Eco Cascade. N.d. Meet the Cultivators, https://www.eco-cascade.com/news/meet-the-cultivators

Flora, K. 2019. Food Unfolded. Seaweed - Growing and Harvesting Farms https://www.foodunfolded.com/article/seaweed-growing-harvesting-farms

Food and Agriculture Organization of the United Nations. FAO. 2022. The State of World Fisheries and Aquaculture: Towards Blue Transformation. https://www.fao.org/state-of-fisheries-aquaculture.

Giercksky, E., Doumeizel, V. 2020. Seaweed Revolution: A Manifesto for a Sustainable Future. www.seaweedmanifesto.com

Goldsmith, J., Schlegel, R., Filbee-Dexter, K., MacGregor, K., Johnson, L., Mundy, C. et al. 2021. Front. Mar. Sci. Kelp in the Eastern Canadian Arctic: Current and Future Predictions of Habitat Suitability and Cover. https://www.frontiersin.org/articles/10.3389/fmars.2021.742209/full

Greenwave. n.d. Indigenous Farmers Turn to Kelp to Restore Waters and Reclaim Cultural Practices https://www.greenwave.org/blog-who-farms-matters/shinnecock-kelp-farmers

Haines, M. Reid, P. 2021. Maine Aquaculture Workforce Development Strategy: Evidence Report https://gmri-org-production.s3.amazonaws.com/documents/Maine_AWDS_Full_Evidence_Report_13July20.

Hafting, Jeff, Stengel, D., Loureiro et al. 2015. Journal of Phycological Society of America. Prospects and Challenges for Industrial Production of Seaweed Bioactives https://onlinelibrary.wiley.com/doi/abs/10.1111/jpy.12326.

Hermans, S. 2022. Phyconomy. Alaskan mariculture gets $49M grant, registers 27% growth https://phyconomy.substack.com/p/alaskan-mariculture-gets-49m-grant?utm_source=post-email-title&isFreemail=true&utm_medium=email

Holmyard, N. 2020. Seafood Source. New Report Dives into Seaweed Production and Its Untapped European Potential https://www.seafoodsource.com/news/supply-trade/new-report-dives-into-seaweed-production-and-its-untapped-european-potential.

Hon, D. 2021. BC Business. BC's Marine Tech Sector is Riding a Wave of Innovation https://www.bcbusiness.ca/BCs-marine-tech-sector-is-riding-a-wave-of-innovation

Innovacorp. 2022. Ocean Innovators: Sabrena MacKenzie, SeaChange Biochemistry https://innovacorp.ca/news/ocean-innovators-sabrena-mackenzie-seachange-biochemistry

Jackson, L. 2021. Global Seafood Alliance. Pilot Project. Cultivating Kelp on Shellfish Leases Demonstrates 'Extraordinary' First Year Growth https://www.globalseafood.org/advocate/pilot-project-cultivating-kelp-on-shellfish-leases-demonstrates-extraordinary-first-year-growth/.

Kelly, J., 2020. Australian Seaweed Institute AgriFutures' Emerging Industries. Australian Seaweed Industry Blueprint: A Blueprint for Growth https://www.australianseaweedinstitute.com.au/australian-national-seaweed-industry-blueprint-report-agrifutures

Kunjuraman, V., Yasir, S.M. and Hussin, R. 2015. Advances in Environmental Biology. Potential of Seaweed Cultivation as a Community-Based Rural Tourism Product: A Stakeholders' Perspective. https://www.researchgate.net/publication/273124445_Potential_of_Seaweed_Cultivation_as_a_Community-Based_Rural_Tourism_Product_A_Stakeholders%27_Perspectives

Lang-Wong, A., et. al, OceanWise, 2022. https://ocean.org/app/uploads/2022/06/Oceanwise-Seaforestation-report-JUNE21.pdf

Maine Aquaculture Innovation Centre (MAIC), 2016. A Pilot Project to Stimulate Seaweed Production on Mussel Farms in Maine
https://seagrant.umaine.edu/wp-content/uploads/sites/467/2019/05/2011-MAIC-Seaweed-Project-Final-Report.pdf

McKinley Research Group. 2021. Alaska Fisheries Development Foundation. Alaska Seaweed Market Assessment.
https://phyconomy.net/wp-content/uploads/2021/09/Alaska-Seaweed-Market-Assessment-2021-08-FINAL.pdf.

MQO. 2018. Newfoundland Aquaculture Industry Association. Labour Market Analysis of the Newfoundland and Labrador Aquaculture Industry
https://naia.ca/application/files/8015/4237/6237/Labour_Market_Analysis_Report_-_FINAL_-_oct_24.pdf.

National Oceanic and Atmospheric Administration. 2020. NOAA Seaweed Aquaculture
https://www.fisheries.noaa.gov/national/aquaculture/seaweed-aquaculture

Notpla. 2021. Notpla Impact Report 2021
https://www.notpla.com/wp-content/uploads/2021/12/NOTPLA-Impact-Report-2021-3.pdf.

North Island College. n.d. Seaweed Processing Project Summary
https://www.nic.bc.ca/about-us/research/carti/projects/seaweed-processing/

Ocean Rainforest Sustainable Nordic Seaweed. 2021. MacroSystems
https://www.oceanrainforest.com/systems

Orange, R., 2022. The Guardian. International Edition. Sea-Farmed Supercrop: How Seaweed Could Transform the Way We Live
https://www.theguardian.com/environment/2022/apr/19/sea-farmed-supercrop-how-seaweed-could-transform-the-way-we-live

Orr, K. 2022. The Sustainable Inshore Fisheries Trust. Facilitating Development of the Seaweed Cultivation Industry in Scotland
https://sift.scot/wp-content/uploads/2022/02/Facilitating-development-of-the-seaweed-cultivation-sector-in-Scotland-Feb-2022.pdf

Pacific Seaweed Industry Association. 2022. How does seaweed fit into a Blue Economy?
https://seaweedindustry.ca/seaweed-for-a-blue-economy

Perry, Scott, 2021. Acadia University. SeaChange Biochemistry Inc. NS Company Making Waves with Acadia's Kelp

https://ice.acadiau.ca/home/case-studies-archive/nova-scotia-company-making-waves-in-atlantic-canada-with-acadias-kelp.html

Phyconomy. 2022. State of the Industry 2022.
https://phyconomy.net/state-of-the-industry-2022

Piconi, P., Veidenheimer, R. and Chase, B. Island Institute (Maine, U.S.). Edible Seaweed Market Analysis. 2022. https://www.islandinstitute.org/edible-seaweed-market-analysis/

Rimmer M. A., et. al, Seaweed Aquaculture in Indonesia Contributes to Social and Economic Aspects of Livelihoods and Community Wellbeing.
https://www.mdpi.com/2071-1050/13/19/10946

Robey, Charity . 2022. New York Times. Kelp Guru has a Vision for the Coast of New York
https://www.nytimes.com/2022/06/10/nyregion/sugar-kelp-farming.html

SeaChange Biochemistry Inc. 2022. It's Time for a SeaChange.
https://seachangebiochemistry.com/

Seaweed First. 2021. About Us. https://seaweedfirst.org/about-seaweed-first

Seaweed Solutions. n.d. Seaweed Farming: The future of cultivation is at sea
https://seaweedsolutions.com/

Scott, Alex. 2019. Chemical & Engineering News. How the Netherlands is Building a Seaweed Industry.
https://cen.acs.org/environmental/sustainability/Netherlands-building-seaweed-industry/97/i34

Scottish Government. 2022. Statement on the Seaweed Review.
https://www.gov.scot/publications/statement-seaweed-review/

Scottish Seaweed Industry Association. 2020. Vision. https://seaweedscotland.org

Stévant, P., Rebours, C. 2021. Landing Facilities for Processing of Cultivated Seaweed Biomass: A Norwegian Perspective with Strategic Considerations for the European Seaweed Industry.
https://link.springer.com/article/10.1007/s10811-021-02525-w

Stevant, P., Rebours, C. and Chapman, A. 2021. Aquaculture International. Seaweed Aquaculture in Norway: Recent Industrial Developments and Future Perspectives
https://www.researchgate.net/publication/313331392_Seaweed_aquaculture_in_Norway_recent_industrial_developments_and_future_perspectives/link/5fbcc866299bf104cf6ede2f/download

Van den Burg, S., Selnes, T., Alves, L., Giesbers, E., Daniel, A. 2020. Prospects for Upgrading by the European Kelp Sector. https://link.springer.com/article/10.1007/s10811-020-02320-z

Vincent, S. and Ring, J. Seaweed for Europe. 2020. Hidden Champion of the Ocean: Seaweed as a Growth Engine for a Sustainable European Future. https://www.seaweedeurope.com

World Bank Group. 2016. Seaweed Aquaculture for Food Security, Income Generation and Environmental Health. https://elibrary.worldbank.org/doi/epdf/10.1596/24919

## APPENDIX 2: Seaweed-Related Education & Training

| Program Title | Industry | Area of Focus | Training Provider | Mode(s) of delivery | Fees | Certification (if any) | Relevance to Seaweed |
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| Fisheries and Aquaculture | Food (mostly fish), various other inudstries. | Harvesting/processing | VIU https://scitech.viu.ca/fisheries-aquaculture | Classroom | ~ $7000 per year | 2-year diploma post-degree diploma BSc, Minor in Aquaculture BA, Minor in Aquaculture | Some algae/sea flora courses are part of the curriculum. Many transferrable skills between shellfish farming and seaweed farming. |
| Aquaculture Technician | Food (mostly fish) | | North Island College https://calendar.nic.bc.ca/preview_program.php?catoid=7&poid=925 | Classroom | | Certificate and diploma programs both exist | Courses focus entirely on fish, but NIC does research on seaweed processing (presumably for grad programs) https://www.nic.bc.ca/about-us/research/carti/projects/seaweed-processing/ |
| Aquaculture Technician Diploma | Food (mostly fish/shellfish) | Cultivating/harvesting - mostly salmon-focused | Excel Career College https://www.excelcareercollege.com/aquaculture-technician | Classroom | ~ $10,000 | Technician Certificate | Focuses heavily on salmon. Shellfish farming is included in the program and has many transferrable skills with seaweed farming. |
| Graduate Certificate in Aquaculture | Food | Harvesting/processing | UBC https://aqua.landfood.ubc.ca/ | Classroom | Not listed | Graduate certificate | Focused on fish farming, but some transferrable skills are included. |
| Algae Cultivation Extension Short-course (ACES) | General use | Cultivating, harvesting, processing | Algae Technology Educational Consortium https://algaefoundationatec.org/aces_intro.html | Hybrid - mostly online | Free? | None | This course is referenced by several seaweed associations, institutes, etc. as their training program of choice. |

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| Seaweed Academy UK | General use | Cultivating, harvesting, processing | SAMS Enterprise https://seaweedacademy.co.uk/ | Classroom | £193-£825 | One week course<br>One day course<br>Two day course - Licensing<br>Two day course - Farming | Entirely focused on seaweed aquaculture. Based in the UK.<br><br>Several other organizations refer to this training program in the UK. |
| Certificate in Sustainable Marine Seaweed Farming | General use | Cultivating, harvesting, processing | Maine Seaweed Exchange, LLC https://uploads.strikinglycdn.com/files/183d2e9a-600f-4b24-b6de-4ad04eb4e805/MSE%20Course.pdf?id=3392540 | Hybrid - 13 Zoom modules, and 1-3/4 day in-person site visit (remote due to COVID)<br><br>*Prices in USD | Zoom $475 per session<br>Site visit $775 per person<br>In-depth session $1800 per day or $295/hr | Certificate | Based in Maine, USA. Focuses on basic knowledge for seaweed farming. |
| Certificate in Aquaculture and the Environment | General use | Cultivating, harvesting, processing | Dalhousie University https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=111&chapterid=6964&topicgroupid=30490&loaduseredits=False | Classroom | Not listed | Certificate | Program contains two courses on algae species. Several other transferable skills. |
| Aquaculture | General use | Cultivating, harvesting, processing | Dalhousie University https://www.dal.ca/academics/programs/undergraduate/aquaculture.html | Classroom | Not listed | BSc (Agr) | Focuses mainly on fish, but several transferable skills. |
| Aquatic Resources | General Use | Cultivating, harvesting, processing | St Francis Xavier University https://www.stfx.ca/academics/science/aqu | Classroom | Not listed | BA or BSc | Several courses talk about seaweed. More general concepts and fewer hard skills in seaweed farming. |

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| Sustainable Seaweed Farming Practices | General use | Cultivating, harvesting, processing | GeniAlg https://genialgproject.eu/e-learning-course/ | Online | Free | None | Based in Europe. Specifically focuses on seaweed farming. |
| Seaweed Farming 101 | General use | Cultivating, harvesting, processing | Cascadia Seaweed https://www.seaweeddays.com/seaweed-farming-101 | Online | $125 | None | BC-based seaweed farming short virtual training. |
| Manual on Seaweed Farming | General use | Cultivating, harvesting, processing | ASEAN/UNDP/FAO Regional Small-Scale Coastal Fisheries Development Project https://www.fao.org/3/ac416e/ac416e00.htm | Self-paced (manual) | Public access | None | Philippines-based seaweed farming manual. May be used as a resource for other places. |
| Alaska Seaweed Farm Start-Up Training Program | General use | Cultivating, harvesting, processing | AFDF (Alaska Fisheries Development Foundation) https://www.afdf.org/seaweed-farm-start-ups-application-for-training/ | Online | Not listed | None | This course is referenced by several seaweed associations, institutes, etc. as their training program of choice. |
| Seaweed Processing and Handling Workshop | General use | Processing | Sea Grant Alaska https://alaskaseagrant.org/2022/05/24/seaweed-processing-and-handling-workshop-provides-workforce-training/ | Classroom | Not listed | None | Alaska program that focuses on processing and handling more than farming. |
| Seaweed Therapeutics | Food, herbal medicine | Processing, consumer uses | Wild Rose College of Herbal Medicine https://wildrosecollege.com/product/seaweed-therapeutics/ | Online | $147 | Certificate of Completion | Seaweed ID and herbal medicinal uses. |

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| Macroalgae (Seaweed) Farming | General use | Cultivating, harvesting, processing | UC San Diego | Online | Free | Certificate of completion | US- based free seaweed farming online learning |
| Seaweeds of the West Coast 2022 | General use | Identification, uses | Raincoast Education Society https://raincoasteducation.org/calendar-event/seaweeds-of-the-west-coast-2022/ | Field | $250 | None | Ucluelet based seaweed ID course - provides general info and ID |
| Collecting & Identifying Seaweeds 2022 | General use | Identification, harvesting | British Phycological Society, University of Plymouth, Marine Biological Association of the UK http://marinesseen.com/seaweed-course/ | Classroom/ field | Intro £170 Advanced £260 | None | UK-based ID and harvest short course |
| Seaweed Workshops with Amanda Swinimer | general use | ID, cultivation, harvest, processing | Dakini Tidal Wilds https://www.dakinitidalwilds.com/seaweed-workshop | Classroom | Not listed | None | ID, cultivation, harvesting, and some processing/practical use. In-person one-time workshop style. |
| Coastal Fisheries Training 5.2 - Seaweed Farming in Pacific Island Countries | General use | Cultivation, harvest, processing | Pacific-European Union Marine Partnership Programme (PEUMP) https://www.peump.dev/resource/coastal-fisheries-training-52-seaweed-farming-pacific-island-countries | Online | Free | None | Pacific European Union - very little information but focuses on seaweed farming in Pacific Island countries. |

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| Ecological Adaptations of Seaweeds | General use | ID, harvest, processing, uses | Bamfield Marine Sciences Centre (BMSC) https://bamfieldmsc.com/education/prospective-students/courses/detail/ecological-adaptations-of-seaweeds | Classroom/ field/lab | Not listed | This course is part of Marine Biology undergrad/ masters programs at various universities (Uvic, University of Calgary, U of A, UBC, SFU) | Based largely on seaweed biology, nothing specific about farming. |
| Tools, Community, and Marketplace for Farmers: Training | General use | Cultivating, harvesting, processing | Greenwave Regenerative Ocean Farming Hub: https://www.greenwave.org/hub | Online (videos) | Membership fee - not listed | None | Training course for the GreenWave membership. Online how-to videos for all steps of the farming process. |
| Project ASCO/Schoodic Institute | General use | ID, cultivation, harvest, processing | Maine Seaweed Council https://www.seaweedcouncil.org/ | Classroom/ field | Not listed | none | Maine-based. Focuses on rockweed. No specific reference to farming. |
| Training Course on Aquaculture Technologies for Seaweed and Oyster | General use | Cultivating, harvesting, processing | NFR: http://nfr.ph/wp-content/uploads/2016/11/Training-on-Aquaculture-Technologies-for-Seaweeds-Oyster.pdf | Classroom/ field | Not listed | None | Seaweed and oyster aquaculture - Unsure where NFR is based. |
| Seaweed Discovery Workshops | General use | ID, cultivation, harvest, processing | Atlantic Irish Seaweed: https://www.atlanticirishseaweed.com/ | Classroom/ field | Not listed | None | Ireland-based seaweed harvest, processing, and some use. Workshop-based. |
| Phycology Short Course | General use | ID, cultivation, harvest | CLME https://clmeplus.marinetraining.org/node/4442 | Online | Free | None | Caribbean-based seaweed course for industry professionals, scientists, policy makers |
| Seaweeds of the West Coast | General Information | ID, biodiversity, | West Coast Nest https://www.westcoastnest.o | Classroom/ field | $240 | None | Workshop-style seaweed ID and biology course in Tofino, BC |

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| | | | rg/courses/seaweeds-of-the-west-coast | | | | |
| Seaweed Foraging Courses | General use | ID, harvest, some processing/use | Rachel Lambert https://www.wildwalks-southwest.co.uk/seaweed-foraging-course-cornwall/ | Classroom/ field | Not listed | None | Workshop style. UK-based |
| The Edible Seaweed Online Course | General use | ID, harvest, some processing/use | Eatweeds https://community.eatweeds.co.uk/edible-seaweed-course | Online | £25 | None | Workshop-style, UK-based |
| Seaweed Food Safety Program | Food | Processing, storage, distribution | Integrity Compliance Solutions (ICS) https://www.integritycompliance.com.au/course/information-of-seaweed-food-safety-program | Online | Free | None | Australia-based food safety course specific to seaweed. |

## APPENDIX 3: DRAFT PROJECT GOVERNANCE COMMITTEE TERMS OF REFERENCE

**PSIA LMP Seaweed Engagement Project**
**Sector Labour Market Partnerships (SLMP) Program**
**Ministry of Advanced Education and Skills Training**

**Towards a B.C. Seaweed Workforce Strategy**

***Approved at 2 December, 2022 Committee meeting***

### Background

The seaweed sector represents an opportunity to diversify B.C.'s economy and to be an important part of B. C's growing aquaculture sector, along with shellfish and finfish. At present there is a need to engage the sector to learn more about its labour market needs, including understanding in demand skills, career paths into and within the sector, transferable skills from other sectors, and skills training requirements. This will enable the sector to develop an understanding of key in-demand skills and occupations (current and future) and implications for recruitment and retention to support the continued development of the seaweed sector in B.C.

With the funding provided from the B.C. Ministry of Post-Secondary Education and Future Skills (Sector Labour Market Partnerships Program), the Pacific Seaweed Industry Association (PSIA) will engage seaweed stakeholders and First Nations across B.C. to develop preliminary insights into labour market development needs. Engagement activities will include a survey, interviews, and focus groups to discuss themes and determine priorities as well as the establishment of a Project Governance Committee.

The PSIA is a non-profit, member-driven, industry association that works to develop awareness around the benefits and diverse uses for seaweed.

The seaweed sector primarily operates in rural areas and represents a key opportunity for reconciliation and economic development within coastal Indigenous communities who have long-standing traditional knowledge and have been early adopters in seaweed cultivation and production.

### Purpose

The Governance Committee's purpose is to provide project oversight and input, support project activities and endorse deliverables and outcomes of the project as the PSIA works to complete necessary labour market research, further engagement and develops a Seaweed Sector Workforce Strategy.

This program is funded by the Government of Canada
and the Province of British Columbia.

**Membership**

The Governance Committee is comprised of the following proposed members (to be confirmed) (in alphabetical order):

1. Boddy, Matthew (ex-officio) - Ministry of Post-Secondary Education and Future Skills (ex-officio)
2. Frommel, Dr. Andrea - Assistant Professor and Chair in Sustainable Aquaculture, UBC
3. Johnson, Larry - President, Nuu-chah-nulth Seafood Limited Partnership
4. Martone, Dr. Patrick - Associate Professor, Phycology and Biomechanics, UBC
5. McLay, Cheryl (ex-officio) - Ministry of Jobs, Economic Development, and Innovation
6. O'Connell, Cheryl - Dean of Trades and Technology, North Island College
7. Rees, Rhianna - Seaweed Academy Coordinator, Scottish Association for Marine Sciences
8. Roth, Myron (ex-officio) - Team Lead, Aquaculture & Marine Fisheries · BC Ministry of Agriculture & Food
9. Smith, Mark - President & CEO and Board member, PSIA
10. Wallinger, Bruce - Director, Strategic Initiatives and Board member, PSIA
11. White, Jordan - Principal, Naas Foods

Should a representative be unable to attend, the organization should nominate an alternate attendee.

PSIA and the Governance Committee will be supported by Human Capital Strategies, the project manager and project development team.

**Responsibilities of the Membership**

The Governance Committee members will be vested with the following responsibilities:

- To review and provide comment on information and reports as requested by the Project Manager.
- To participate in conference calls or virtual meetings to provide input on reports.
- To share knowledge and expertise in their specific area of expertise and/or region; and,
- To share key project information through their networks and to respect confidentiality of specific topics.

**Responsibilities of the Chair**

The Chair of the Committee will:

- Guide the Committee in the fulfilment of its mandated purpose.
- Prepare meeting agendas in consultation with the Project Manager.
- Ensure agendas are provided to the Project Manager for distribution to all members at least 5 days prior to a meeting.
- Preside over committee meetings according to Robert's Rules of Order, including capturing decisions, noting action items, recording minutes, ensuring their circulation, approval of motions and documents.
- Build consensus and support respectful communication between members.
- Ensure meetings remain on time and on topic; and,
- Ensure effective and transparent process.
- Strive to be impartial and objective.

**Decision Making**

The Governance Committee will make decisions following a consensus model. This approach enables individuals holding different perspectives on issues of concern to find common ground and to develop and agree to support a decision in the best interest of the whole. If no consensus can be reached, a majority vote will take place.

**Working Groups**

The Governance Committee may create working groups or task forces to focus on work in certain areas during the project. For example, a working group of the PSIA and education, employment and training providers may be used to further engage with this sector; a working group of the PSIA, businesses and First Nations may be used to engage First Nations on the work of this project.

**Meetings and Term**

Meetings will take place virtually, with notice and a proposed agenda provided not less than 5 days in advance. Meetings will be called to review and approve specific documents, and to address specific decisions. Meeting minutes will be produced by the Project Manager and sent to all members.

The first Committee meeting will take place as soon as possible in November 2022 and the balance of meetings will occur at least quarterly for an average of two hours. A meeting schedule will be presented for approval at the first meeting.

Additional meetings may be scheduled as needed, with the consensus of the Governance Committee. In order to maximise members' time, as much as possible, review of material and decisions by the Committee will be done via email and other electronic platforms.

The term of appointment will be for the duration of the SLMP project. The project is projected to continue for at least one year. Should the Governance Committee members agree to participate in subsequent project extensions, the appointments may be extended.

**Governance Committee Principles**

The following principles will guide the work of the Governance Committee:

- Partnership and collaboration.
- Transparent decision making.
- Information sharing supported by technology.
- Disciplined project and scope management approach.
- Clear objectives, accountabilities, and roles and responsibilities; and
- Applying a small business lens

**Confidentiality**

Matters discussed at meetings and teleconferences are confidential and may not be discussed in public by members of the Governance Committee. The project's reports are similarly confidential prior to their public release.

Where feedback on documents is requested of Governance Committee members, these documents can be shared on an "as needed" basis within the member's organization, provided the individuals receiving the documents are able to maintain confidentiality. Reports on this project to member's organizations by members of the Governance Committee shall be in general terms only and shall be maintained in confidence by the member's organization.