



Roadmap for Nova Scotia Kelp Farming

May 2023

Nova Scotia is well positioned to gain a significant share of the \$200M North American regional market for products containing kelp and kelp-based ingredients, making significant contributions to the local economy while delivering environmental benefits. The market for seaweed-based products continues to grow and Nova Scotia can help accelerate that growth and steer it to favor Nova Scotian farmers, businesses, and products.

That is the conclusion of a market assessment conducted by the consultancy Changing Tastes. This memorandum provides insights into this promising new industry and a roadmap for our province to support and benefit from it. Developing and expanding the province’s kelp industry will:



By making smart choices about how to enter the market, Nova Scotia can maximize the value created in the province while reducing risk and investment needs. Diffusing these benefits throughout the provincial economy comes by pairing production and allied activities with the needs of reliable end markets.

This memorandum reviews Nova Scotia’s potential growth within the North American market and provides path forward for developing the sector and making a significant contribution to the provincial economy by producing and selling ±\$38 million* in farmed kelp and kelp ingredients into established markets within the next several years.

Nova Scotia is well positioned to secure substantial market share both from geographical advantage as well as from having an established seafood industry that provides much of what is needed for the kelp industry and while diversifying revenue sources.

We also provide guidance for how to expand kelp farming and processing and drive market growth while minimizing risk by relying on the continued success of established companies and brands working in North America and helping them reduce risk and increase their speed to market by tailoring ingredients and prototyping products for them.

Nova Scotia has the ability to double or triple the market for kelp by 2030 in two ways. The province can quickly establish kelp farming and processing ahead of other regions and then maintain a lead in introducing new varieties and more effective farming methods. The province and industry also can work together to innovate new ingredients and products that can help companies in food, personal care, nutraceuticals, and more expand their use of kelp.

*All values are in Canadian dollars based on an exchange rate of CAN\$1.37:US\$1 for consumer products and retail sales.

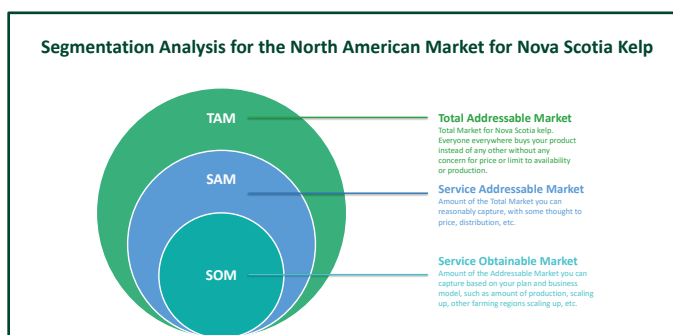
The North American Market for Kelp

The North American market for products made with kelp is established and growing and will be worth about \$200M in the next year or two.

Kelp and ingredients made from kelp are already used to make food and personal care products. This includes a host of popular foods like sushi, salad, soups and broths, and increasingly popular seaweed snacks and seasonings with new food products coming into the market regularly.

Ingredients made from a variety of seaweeds are also commonly used in food products like sauces, yogurts, puddings and gelatins, ice cream and other frozen desserts, and beverages, as well as many personal care products like body cream, hair care, soaps, and lotions — along with animal feed and fertilizer. The number of food and personal care brands products that contain kelp is increasing rapidly.

Not all products use kelp in the same amounts. A package of frozen or dried kelp is almost entirely made of kelp, while snacks and condiments may be half kelp and half packaging. Kelp in personal care products, ready to cook foods, frozen desserts, and beverages may be less than 2% of total ingredients.



The addressable markets in North America are significant. There are also different dynamics between the domestic Canadian market where Nova Scotia would be a preferred source, and in the United States, where Nova Scotia would be one of several regions competing to supply the market but can have the advantage of being in the market ahead of others. Together, the two are substantial and can consume over 53.3 million kilograms of farmed kelp per year.

North American Addressable Market			
	Farmgate Sales	Processing Ingredients	Manufactured Products (wholesale)
North America	\$83,334,235	\$349,903.863	\$1,364,014,680
<i>Canada</i>	\$11,283,255	\$45,399,663	\$142,900,800
<i>U.S.A.</i>	\$71,050,980	\$304,504,200	\$1,221,113,80

The near-term market demand for kelp in Canada and the U.S. is built upon a granular evaluation of the common types of consumer food and personal care products that include kelp or where Nova Scotian kelp could easily replace another ingredient.

To build this assessment, we evaluated the average amount of kelp as a share of ingredients in each type of product and the number of units sold each year in each country based on industry data about the number of units, pricing, and revenue for a wide assortment of food and personal care products. Again, Nova Scotia's position in the domestic market is distinct, including the ability to supply fresh markets and replace existing imports of fresh, frozen, and dried kelp. Also, because of Nova Scotia's improved standing with Canadian manufacturers, we see a better opportunity to replace other varieties of seaweed and related ingredients and have a larger share of the market that contains kelp rather than other ingredients.

Canadian Serviceable Market								
wholesale valuation								
	<u>Market Size</u>	<u>Seaweed Segment</u>	<u>Potential</u>	<u>% Seaweed</u>	<u>Dry Seaweed</u>	<u>Wet Seaweed</u>	<u>Farmed Value</u>	<u>Processed Value</u>
	<u>Revenue</u>	<u>SOM</u>	<u>Revenue</u>	<u>in Product</u>	<u>KG</u>	<u>KG</u>	<u>at \$1.54 /KG</u>	<u>at \$6.60 /KG</u>
Body Lotion	\$ 328,500,000	1.5%	\$ 4,927,500	1.0%	4,106	41,063	\$ 63,236	
Bar and Body Wash	\$ 542,000,000	1.5%	\$ 8,130,000	1.0%	6,775	67,750	\$ 104,335	
Facial Cream	\$ 1,300,000,000	1.5%	\$ 19,500,000	1.0%	4,063	40,625	\$ 62,563	
Sunscreen	\$ 116,500,000	1.5%	\$ 1,747,500	1.0%	546	5,461	\$ 8,410	
Total Skin Care	\$ 2,287,000,000		\$ 34,305,000		15,490	154,898	\$ 238,544	\$ 1,022,330
Total Hair Care	\$ 1,537,000,000	1.0%	\$ 15,370,000	1.0%	9,606	96,063	\$ 147,936	\$ 634,013
Bouillon	\$ 50,000,000	1.0%	\$ 500,000	2.0%	833	8,333	\$ 12,833	
Side Dishes (dry)	\$ 100,000,000	2.0%	\$ 2,000,000	5.0%	12,500	125,000	\$ 192,500	
Sauces and Dressings	\$ 352,000,000	2.0%	\$ 7,040,000	5.0%	66,000	660,000	\$ 1,016,400	
Soups	\$ 1,080,000,000	2.0%	\$ 21,600,000	5.0%	180,000	1,800,000	\$ 2,772,000	
Seasonings, Spices	\$ 980,000,000	1.0%	\$ 9,800,000	5.0%	9,800	98,000	\$ 150,920	
Bread	\$ 5,886,000,000	0.5%	\$ 29,430,000	2.0%	58,860	588,600	\$ 906,444	
Pasta	\$ 1,512,000,000	1.0%	\$ 15,120,000	2.0%	50,400	504,000	\$ 776,160	
Cereals, Bars	\$ 2,000,000,000	1.0%	\$ 20,000,000	2.0%	40,000	400,000	\$ 616,000	
Dog Food	\$ 2,841,000,000	0.5%	\$ 14,205,000	5.0%	118,375	1,183,750	\$ 1,822,975	
Dried for Asian markets			\$ 250,000.00	100%	16,197	161,970	\$ 250,000	\$ 250,000
Fresh Seaweed			\$ 500,000.00	100%	32,394	323,939	\$ 500,000	\$ 500,000
Total Food	\$ 14,801,000,000		\$ 120,445,000		585,359	5,853,592	\$ 9,016,232	\$ 36,176,710
Total Canada Market Opportunity Retail			\$ 170,120,000		610,455	6,104,553	\$ 9,402,712	\$ 37,833,052
Total Canada Market Opportunity with B2B			\$ 204,144,000		732,546	7,325,464	\$ 11,283,255	\$ 45,399,663

United States Serviceable Market								
wholesale valuation								
	<u>Market Size</u>	<u>Seaweed Segment</u>	<u>Potential</u>	<u>% Seaweed</u>	<u>Dry Seaweed</u>	<u>Wet Seaweed</u>	<u>Farmed Value</u>	<u>Processed Value</u>
	<u>Revenue</u>	<u>SOM</u>	<u>Revenue</u>	<u>in Product</u>	<u>KG</u>	<u>KG</u>	<u>at \$1.54 /KG</u>	<u>at \$6.60 /KG</u>
Skin Care	\$ 17,500,000,000	1.0%	\$ 175,000,000	1.0%	87,500	875,000	\$ 1,347,500	\$ 5,775,000
Hair Care	\$ 13,440,000,000	1.0%	\$ 134,400,000	1.0%	84,000	840,000	\$ 1,293,600	\$ 5,544,000
Bouillon	\$ 120,000,000	1.0%	\$ 1,200,000	2.0%	2,000	20,000	\$ 30,800	
Side Dishes (dry)	\$ 1,100,000,000	2.0%	\$ 22,000,000	5.0%	137,500	1,375,000	\$ 2,117,500	
Sauces and Dressings	\$ 3,900,000,000	2.0%	\$ 78,000,000	5.0%	731,250	7,312,500	\$ 11,261,250	
Soups	\$ 6,825,000,000	2.0%	\$ 136,500,000	5.0%	1,137,500	11,375,000	\$ 17,517,500	
Seasonings, Spices, Herbs	\$ 7,500,000,000	1.0%	\$ 75,000,000	5.0%	75,000	750,000	\$ 1,155,000	
Bread	\$ 14,000,000,000	0.5%	\$ 70,000,000	2.0%	140,000	1,400,000	\$ 2,156,000	
Pasta	\$ 5,900,000,000	1.0%	\$ 59,000,000	2.0%	196,667	1,966,667	\$ 3,028,667	
Cereals, Bars	\$ 21,000,000,000	1.0%	\$ 210,000,000	2.0%	420,000	4,200,000	\$ 6,468,000	
Dog Food	\$ 20,000,000,000	0.5%	\$ 100,000,000	5.0%	833,333	8,333,333	\$ 12,833,333	
Total Food	\$ 80,345,000,000	0.0%	\$ 751,700,000		3,673,250	36,732,500	\$ 56,568,050	\$ 242,434,500
Total U.S. Market Opportunity Retail			\$ 1,061,100,000		3,844,750	38,447,500	\$ 59,209,150	\$ 253,753,500
Total U.S. Market Opportunity with B2B			\$ 1,273,320,000		4,613,700	46,137,000	\$ 71,050,980	\$ 304,504,200
Conversion to Cda\$			\$ 1,744,448,400					

We further looked at how much value is created in the main steps in the value chain between kelp farm and sale of consumer products to consumer-facing retail businesses, which are:

- Farmgate sales, or revenue by farmers from selling harvested kelp, with the assumption that prices will remain stable as both demand and supply increase at the same time, and Nova Scotia displaces lower priced Asian imports.
- The sales of processed kelp and ingredients made from kelp which may include frozen kelp, kelp purees, dried kelp leaves, granules and powders, and higher value ingredients derived from processing or fractionating kelp plants that may be tailored to specific uses.
- The market value of the kelp inside consumer products as a share of the final sale wholesale purchase by retailers.
- And for the maritime Canadian market, we considered a new local market for fresh kelp as well as replacing imported dried kombu (kelp) in regional ethnic grocery stores.

We did not consider:

- Fertilizer and animal feed which are low value markets and serving the substantially reduce per pound value from farming and perhaps make the citing of new farms not economically viable. Rather, we see that kelp farmers will always benefit from selling kelp into higher value markets for human consumption or as value added ingredients or a wider set of uses.
- Tourism which may be modest and mostly additive to existing businesses.
- The value of carbon credits, if any, as the extent of sequestration and value of carbon credits remain uncertain, as does the more nascent market for biodiversity credits.
- Supplying Asian markets that have longstanding preferences for other varieties as well as lower cost, regional suppliers.

We also made some assumptions:

- Kelp and other seaweeds would remain a modest share of ingredients in consumer food and personal care products (1-5% for many common products).
- Products containing kelp will continue to have a modest market share over the next several years ($\frac{1}{2}$ - 2% depending on product type).
- Current supply chains will be used for sales and distribution, and actors in them will not offer favorable treatment such as discounts and incentives.
- New brands and product launches would achieve conventional success (0.5%-1%) of established consumer product categories and a bit better in local markets, but not substantially more.
- Different categories of food and personal care products (beverages, shampoo, etc.) will not substantially or suddenly grow or shrink overall.
- Seaweed pricing would remain in the current range, with both demand and supply increasing over the next 3-5 years (\$1.54/kg or 70¢/lb.).

The Market for Nova Scotian Kelp

Nova Scotia can secure substantial value from kelp production within just a few years if the province can move fast enough to establish farms and organize processing, including working with the seafood industry and supporting businesses to use existing and excess capacity.

The market for North American kelp is substantial. It is being served by kelp farmers and harvesters from many countries as well as by a small but growing group of domestic farmers. Nova Scotia will be one of several regions competing to supply the market, but has significant advantages that can help it secure and then expand its market share.

These include both the natural advantage of extensive coastline as well as favorable location served by shipping and transport that already serve all of Canada’s population centers including the eastern half of the United States.

Perhaps most important in a rapidly growing market served by an emerging group of producers, Nova Scotia has the advantage of moving faster to establish its kelp farming and production sector. The province’s substantial seafood industry can further accelerate growth by providing readily available infrastructure, capacity, and services that are also needed to support ocean farming.

With that, it can secure buyers quickly and maintain a lead over other sources in developing more efficient farming methods along with introducing new varieties while other regions are still working on establishing initial production and processing.

We believe that Nova Scotia can secure a very modest share of the serviceable market for kelp in North America including 5% of the United States and 35% in Canada, where Nova Scotia will have strong preference as a supplier. In both countries, Nova Scotia has advantages in import taxes and transportation compared to other suppliers.

Within 3-5 years Nova Scotia’s kelp sector can produce and supply 5.4M kg of harvested kelp which represents more than 432,000M of line production (a common measurement for kelp farming) occupying 1,080 hectares of farmed ocean. This will generate ±\$38 million in new revenue and an additional ±\$20M in additional local economic activity from the purchase of goods and services, increased tourism, new jobs, and wage creation.

Nova Scotia Market Share in 3-5 Years

	Farmgate Sales	Processing Ingredients	Manufactured Products (wholesale)
North America	\$7,501,688	\$31,115,092	\$110,070,974
Canada	\$3,949,139	\$15,889,882	\$50,015,280
U.S.A.	\$3,552,549	\$15,225,210	\$61,055,694

Kelp farming and the sector overall will benefit from a mix of farms of different sizes. This will allow the sector to nimbly adjust to market demand, trial new growing methods, and quickly scale new varieties. The mix also will provide diverse income benefits to individuals and small businesses in the seafood industry, larger seafood and maritime operators, and investors who can speed the siting of the first farms.

One of the critical choices is to ensure that processing seaweed

into more useful ingredients and products occurs in the province, which is the most substantial opportunity for creating value while benefiting farms and reducing risk. Processing kelp near ocean farms reduces product weight by up to 90% while increasing value by more than four times while also allowing for higher volume, reduced perishability, and lower cost shipping.

Ensuring local processing capacity (freezing, drying, and milling) is critical. Existing local mills and seafood processing can meet most initial processing needs while gaining new revenue and utilizing excess or dormant capacity. The capital needs for specific additional processing are also modest including ~\$10million per line for dry processing and ~\$2-5M per line for blanching and freezing.

This compares favorably to capital needed to manufacture consumer products installing entirely new production lines or building new factories, with investment of \$50-\$500M largely for conventional production unrelated to kelp farming. It also can require the import of packaging and other ingredients which further erodes the economic and environmental advantage of the province.

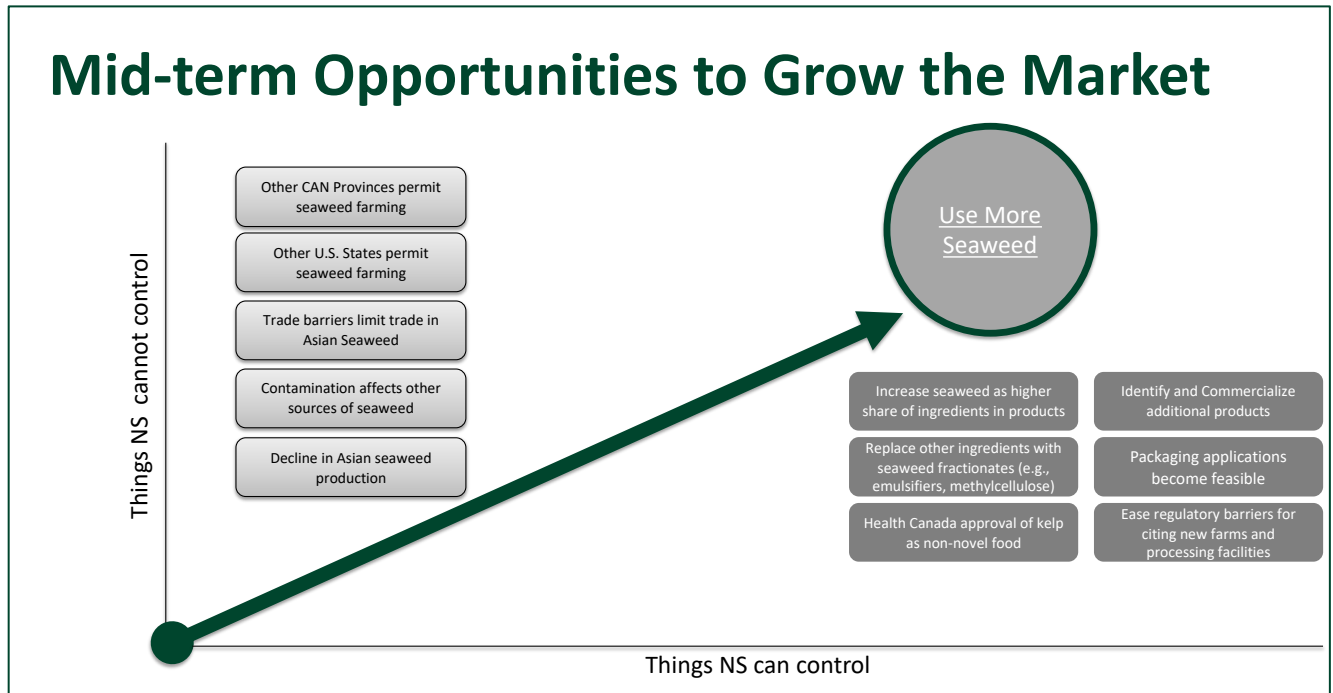
Importantly, there is a substantial upside for Nova Scotia in this rapidly developing sector which could grow two- to three-fold in just a few years. This comes from:

- A 3x increase by achieving a higher inclusion rate — or increasing kelp as a share of all ingredients — in new formulations of common consumer food and personal care products. Given that kelp makes up a very small share of ingredients in the types of products sold in very high volumes from soup to facial cream, an increase of just ½ to 1% in a few mainstream products could substantially boost the entire sector.
- A 2-3x potential increase if competing sources in Canada and parts of the U.S. develop slower than Nova Scotia.

There are an even larger set of factors that could increase the market for Nova Scotian kelp in the next several years.

Nova Scotia Kelp Farming in 3-5 Years

Farm Size	%	Hectares	# of Farms
2 HA	21%	230	115
15 HA	41%	443	30
20 HA additions to Shellfish leases	19%	204	10
100 HA	19%	204	2
		1,080	157



Specifically, there are a set of actions that the provincial government can take to give an early boost and long-term advantage to the kelp sector. These are:

- Provincial regulatory support to quickly approve and increase kelp farms of all sizes and farmed acreage on the water.
- Provincial fast tracking for processing and approving licenses and permits for kelp processing facilities.
- Health Canada’s approval for domestic kelp as non-novel food being offered the same status as imported kelp products.
- Provincial Financing and Incentives for Private Sector Investment in farming, processing, and manufacturing.
- Technical assistance for (sea)agriculture farming to increase yields and expand varieties.
- Funding and trade support to promote the use of Nova Scotian kelp products and also to demonstrate and prototype products to reduce risk and speed adoption, plus continue to develop new uses, ingredients, and product applications.

With that, Nova Scotia’s share of the kelp market can grow to over 16.5M kg of harvested kelp produced by more than 400 farms covering 3,300 hectares by 2030 or sooner driven by new formulations of common products that now use a higher share of kelp, new products and uses for kelp, new ingredients made from kelp, new varieties, and faster scaling up of production relative to competing regions.

There is a clear path forward and specific choices that can help achieve all this sooner and with less risk.

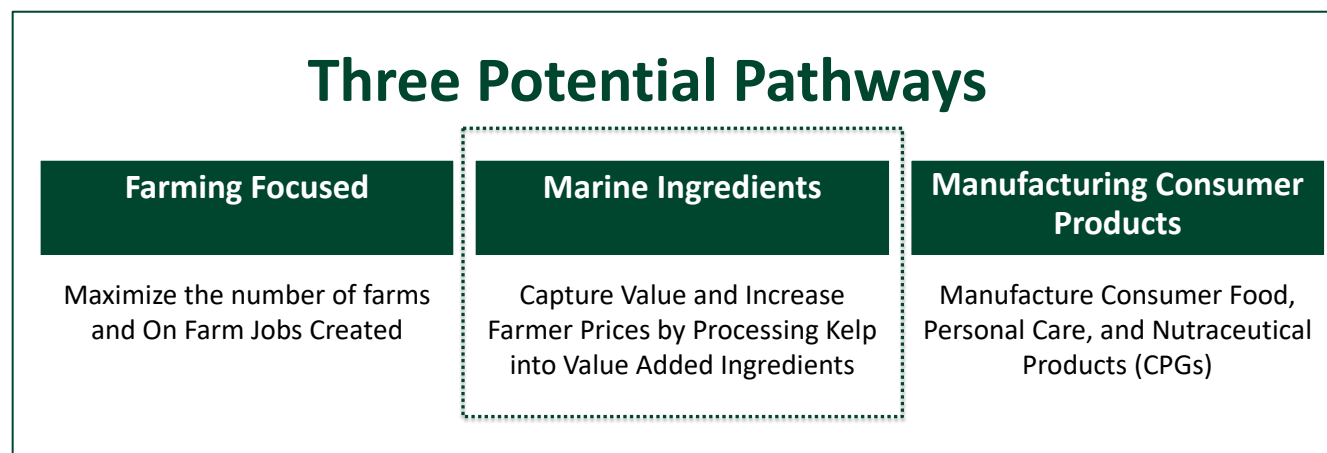
Choosing the Right Path

The way forward for Nova Scotia’s provincial government, economic develop agencies, and members of today’s kelp industry is both clear and promising. It begins with a choice about what activities in addition to kelp farming will occur in the province, along with the permissions, investment, and incentives to encourage them.

There is also an essential set of additional activities that must be in Nova Scotia which include seed propagation (seeding of lines to be planted on farms), production of lines and other gear, technical assistance to farmers including researching and evaluating new gear and production methods, and initial post-harvest processing to ready kelp for its next stop in the value chain. Locating activities like seed propagation in Nova Scotia are critical to ensuring that native varieties are planted and help restore marine habitats while production of gear and other support services can directly benefit the seafood sector and its allied businesses.

There is an additional set of activities that will capture a tremendous increase in the value added to kelp if they occur in Nova Scotia that include further processing of kelp into useful ingredients and ready-to-use formats, as well as refinement and fractionating into ingredients tailored to specific uses and industries. Conducting more activities in Nova Scotia also increases local economic activity even more as dollars recirculate (or multiply) especially when this does not involve the import of ingredients and packaging.

When we consider the three potential pathways forward, and which parts of the value chain to develop in Nova Scotia as part of the kelp sector, the choices are clear.



Developing Nova Scotia’s kelp sector to produce value added ingredients to supply a host of North American companies, brands, and products both delivers the greatest benefit to Nova Scotia, provides the best price and market to kelp farmers, and presents the least risk.

As we have previously noted, there is a substantial increase in the value of kelp from further processing into ingredients in the province through local processors. Processing kelp in Nova Scotia and near where it is harvested initially can use existing seafood and food processing capacity while reducing weight, transport costs, and the carbon footprint.

This path forward is best suited to increase the use of kelp in mainstream food and personal care applications by innovating and tailoring ingredients to the needs of specific buyers and spreading the risk of success in the market across a very large number of product categories, brands, and companies.

Having processing occur in Nova Scotia also can supply kelp and kelp ingredients to local cottage industries and small businesses who can produce value-added products for the local market and are best suited to increase the presence of kelp in the local culinary community.

Developing a kelp sector that produces ingredients delivers a host of benefits:

- It makes Nova Scotia a unique supplier and less subject to global competition.
- It requires modest capital investment.
- It can occur on a relatively short timeline that is no longer than simply establishing farms.
- It creates a dependable market and the most revenue to farmers by establishing local buyers that make products only from Nova Scotian kelp.
- It is a straightforward way to implement and can utilize excess and dormant seafood industry capacity or including space for new processing lines and equipment.
- It requires provincial government or trade board commitment to innovating ingredients, demonstrating, and promoting their use to reduce risk for companies to start buying and using more kelp in their products.
- It spreads risk of growing the seaweed market across large numbers of product categories, brands, and companies that can buy and use kelp.

By comparison, this is a much lower risk approach than directly manufacturing consumer products where outcomes hinge on the market success of just a single company, brand, or product line and that could face challenges wholly unrelated to consumer interest in kelp. It also offers substantial advantages to only increasing farms and farmed acreage where Nova Scotian kelp would compete largely on price against kelp and seaweed from lower cost sources, and, its origin and species may not be considered points of differentiation.

The Way Forward for Developing Nova Scotia's Kelp Sector

As we have stated before, prompt action and quick entry to market provides long-term advantage. Within three years, Nova Scotia can achieve meaningful economic benefit and market share, and perhaps even exceed the forecasts in this memorandum.

To achieve this, the provincial government, trade, and economic development boards will need to provide a leadership role to support the early growth of the industry and fund Product Development and Promotion efforts to develop new ingredients and products, and promote increased use in existing products.

With that leadership and commitment, the way forward over the next three years is straightforward and readily achievable.

Starting Now: Regulatory and Business Initiation

- Permit farms of varying sizes
- Secure Health Canada's approval for Nova Scotian Kelp to be used as a non-novel ingredient, just as kelp and other seaweeds from other sources are treated.
- Set up a Cultivation and Technical Assistance Center to oversee selection of varieties and propagation of seed.
- Fund work to prototype products using Nova Scotian kelp to determine processing needs and markets and to provide tangible examples to key buyers to de-risk their initial purchases.

The Next Six Months: Establish Infrastructure

- Permit and establish processing capacity, organizing existing dormant and excess capacity in the seafood industry, and selectively building new processing capacity and facilities.
- Establish a farm financing vehicle to support initial planting and farm infrastructure.
- Expand the work of the Cultivation and Technical Assistance Center to supply seeded line.
- Begin planting.

The Next Year: First Harvest and Sale

- Organize local transport from dock to processing.
- Expand Cultivation / Technical Assistance to include improved farming and harvesting methods.
- Develop program to validate carbon sequestration credits and create addition income for farmers.

The Next 1-3 Years: Provincial Trade and Promotion

- Promote use of Nova Scotian kelp by industries in Canada and the United States.
- Continue to fund development of new ingredients, identify new processing methods and products for higher value uses utilizing Nova Scotian kelp.
- Continue to identify and propagate new varieties of kelp.
- Permit additional farms and farm acreage.

This simple roadmap leads to substantial economic benefit, diversification of the marine economy, and a host of environmental benefits. Farming and the ocean have both powered Nova Scotia over centuries and are poised to do so for many prosperous and sustainable decades and centuries to come.