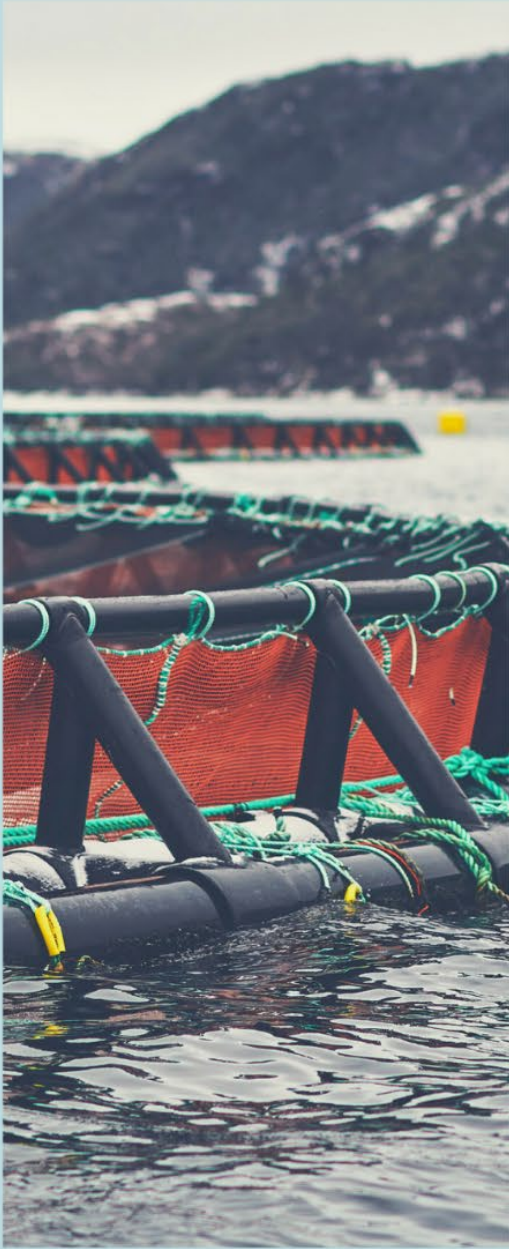




THE STATE OF FARMED SEAFOOD IN CANADA 2020

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Report Highlights

Solid Production, Revenues, and Exports in 2019

- Total farmed seafood production and revenues have not increased significantly over the past 17 years in Canada, and farm gate value fell 1.7% to \$1.23 billion in 2019.
- Farmed seafood production was 187,026 tonnes in 2019, down from 190,184 2018 levels.
- Exports of Canadian farmed seafood increased by 2.8% in 2019, to \$1 billion.

A Diverse Sector...

- Farmed seafood takes place in all provinces as well as the Yukon.
- Finfish represents the largest component of the farmed seafood sector, with 27 different species such as salmon, trout, sturgeon, sablefish, and Arctic char, commercially grown in Canada - in both marine and freshwater environments.
- Shellfish is also an important part of the farmed seafood sector on both coasts with 20 different species of shellfish cultured, such as mussels, oysters, clams, and scallops.
- Other species such as sea urchins, crayfish, and sea cucumber are commercially produced in small amounts.
- Aquatic plants represent a small, but growing part of the sector, with nine species of kelp, sea lettuce, and Irish moss commercially cultivated in Canada.

...that Delivers Significant Economic Benefits to Canadians

- Our sector's farming and fish processing activities deliver significant economic benefits in Canada – mainly within rural and coastal communities where well-paying, full-time jobs are greatly in need. Our farming and fish processing activities generated an estimated \$5.2 billion in economic activity, \$2.1 billion in GDP, and full-time jobs for 21,300 Canadians earning an estimated \$970 million in wages in 2019.

An Environmentally Sustainable Sector...

- Our industry implements science-based practices that minimize stress, maintain a healthy aquatic environment, reduce disease risks, and prevent the spread of diseases when they do occur.
- Our industry works to minimize environmental interactions through measures such as proper siting, management of habitat impacts, and escape prevention measures - - compliant with international standards for social, environmental and food safety responsibilities.
- Our environmental practices are supported by federal and provincial regulations, international requirements and third-party sustainability certifications.
- Farmed seafood is a very efficient food protein source, in terms of resource use (energy, water, land utilization, and feed). And the footprint of Canada's farmed seafood sector is considerably smaller than in other competing countries.

...that is Socially Responsible

- Farmed seafood in Canada is a world-leader in terms of programs and standards for seafood safety, with sophisticated traceability and stringent independent third-party certification systems in place.
- The Canadian farmed seafood sector generates an estimated 21,300 full-time jobs related to production and processing, with most of these activities taking place within rural and coastal communities across Canada. These communities have seen how farmed seafood companies and their employees make a positive impact by supporting local events and investing in communities through corporate giving, volunteering, jobs, and infrastructure.
- More than 40 Indigenous communities are directly or indirectly involved in farming seafood across Canada; this involvement occurs in nine of the ten Canadian provinces. In addition to those Indigenous communities already participating in farming seafood, there are many others whose traditional territories have the biophysical capacity to support farmed seafood development.

Introduction

The need for sustainable farmed seafood is increasingly clear. About 71% of planet is covered by water. Global demand for seafood is rising rapidly and is expected to double by 2050, and farmed seafood production has already surpassed 50% of global supply of consumed seafood. At the same time, wild seafood stocks are facing serious pressures, with the United Nations in 2016 saying that over 90% of the world's fish stocks are either over- or fully exploited. Human innovation can and must be applied to raising seafood in smart and responsible ways. Sustainable farmed seafood is a critical answer to the world's food and ocean conservation needs, as well as to making major contributions to reducing the environmental footprint and to enable Canada to meet its international climate change obligations.

Canada can and must play a leading role in the further development and supply of sustainable farmed seafood products. The combination of the world's longest coastline, high biophysical farmed seafood potential, a skilled workforce, and dedication to science and innovation, positions Canada for future success. Currently, Canada stands 26th in the world in terms of total global farmed seafood production, and fourth in the world for salmon production. We can do much more, and we can do it increasingly well.

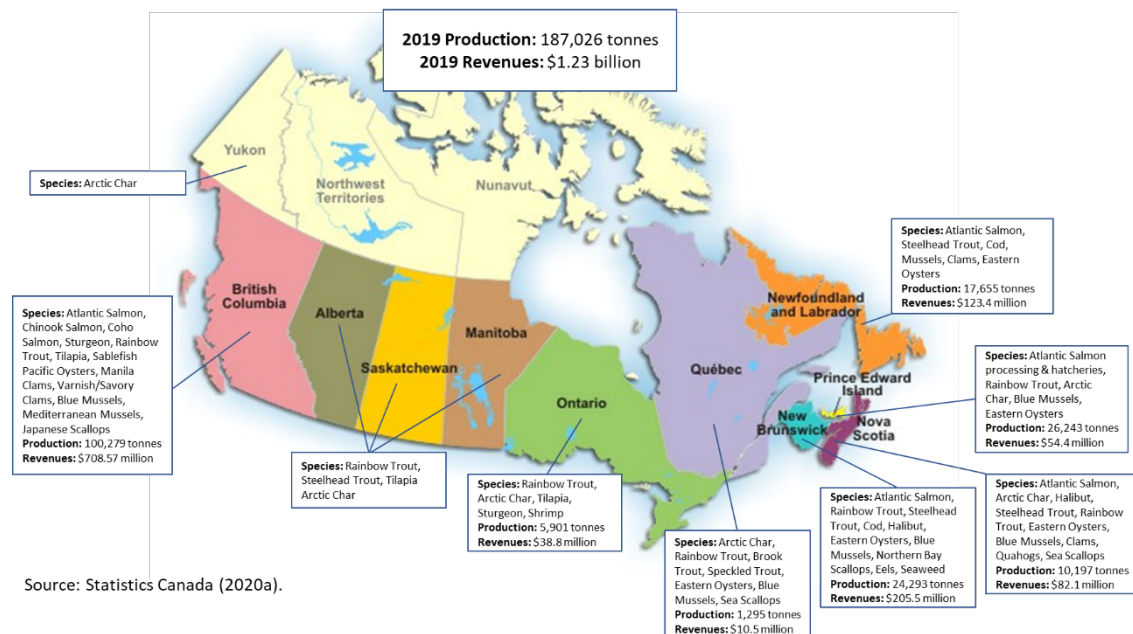
Seafood farming is practiced in many different forms the world over from large scale, vertically integrated commercial operations serving international markets to backyard recirculation tanks raising trout for family and local consumption. Some of the earliest historical roots of seafood farming trace back thousands of years in China, and archeological evidence from British Columbia suggests that Indigenous peoples were also cultivating shellfish species thousands of years ago.

Seafood farming in Canada occurs in every province and the Yukon Territory. Currently, about 56 different species of finfish, shellfish and aquatic plants are commercially cultivated. They are raised in marine environments, in freshwater lakes and rivers, in land-based ponds, and in tank facilities. Farmed seafood production varies across the country depending upon the species being farmed, the environment within which it takes place, (marine, freshwater), the conditions of the ocean, lake or river floor (sand, rock), and the culture technologies used. Canada's farmed seafood sector:

- delivers a wide range of safe, healthy, and sustainable seafood products to domestic and international markets,
- operates in a sustainable manner within both freshwater and marine environments,
- continually improves efficiencies, and
- conducts leading edge, internationally recognized research based on peer-reviewed science.

A Diverse Sector with Great Opportunity

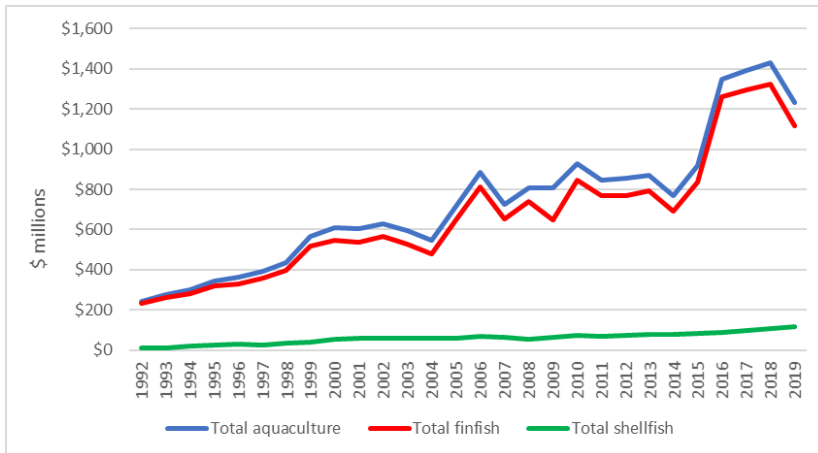
Figure 1: Canadian Farmed Seafood – Diversity and Economic Benefits Across Canada (2019)



Production and Revenues Fell in 2019

Farm gate value fell to \$1.23 billion in 2019, a 14% decrease over the 2018 value of \$1.43 billion.

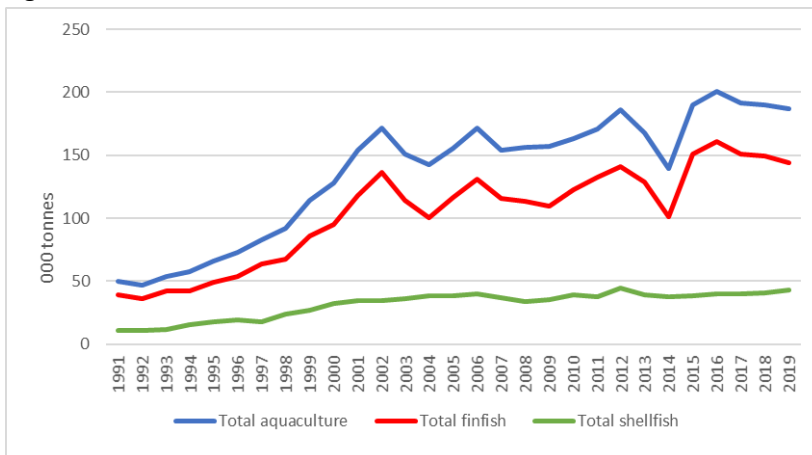
Figure 2: Farmed Seafood Revenues, 1991 to 2019



Source: Statistics Canada (2020a).

Overall production decreased in 2019 to 187,026 tonnes.

Figure 3: Farmed Seafood Production, 1991 to 2019

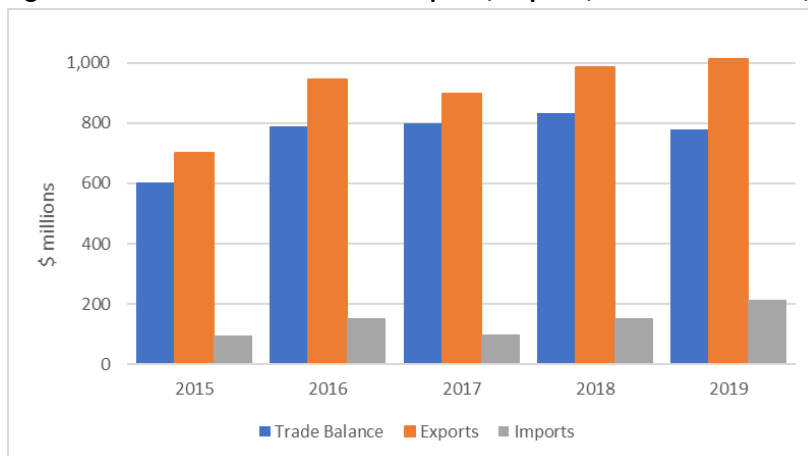


Source: Statistics Canada (2020a).

Trade

In 2019, Canada's farmed seafood exports were just over \$1 billion, an increase of 2.8% over 2018 export values. Canada's farmed seafood sector is strongly dependent on exports: around 70% of Canada's farmed seafood production is exported, almost all of it to the U.S.

Figure 4: Canadian Farmed Seafood Exports, Imports, and Trade Balance, 2015 to 2019

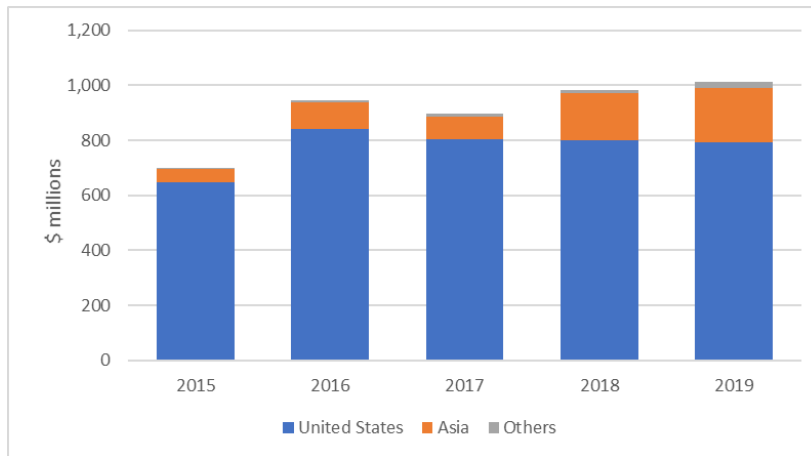


Source: Statistics Canada, CATSNET Analytics.

Canada imported over \$212 million of farmed seafood products in 2019, an increase of 39% over 2018. Almost 40% of aquaculture imports come from the U.S.

Over the past few years demand from China has grown steadily, and in recent years exports of farmed seafood products to Asia account for between 10% to 19% of the total. Several trade agreements – including the Canada-European Union Comprehensive Economic and Trade Agreement, the Canada-UK Trade Continuity Agreement and the Canada-Korea Free Trade Agreement - could continue to expand opportunities in Asia, the EU and the U.K.

Figure 5: Value of Canadian Farmed Seafood Exports by Destination, 2015 to 2019



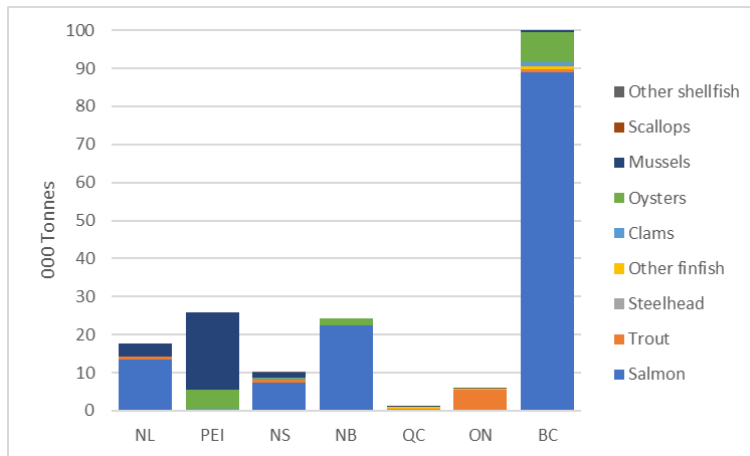
Source: Statistics Canada, CATSNET Analytics.

Diversity of Farmed Seafood Across Canada

Finfish represents the largest component of the farmed seafood sector, with 27 different species such as salmon, trout, sturgeon, sablefish, and Arctic char, commercially grown in all regions in Canada - in both marine and freshwater environments.

Shellfish is also an important part of the farmed seafood sector on both coasts with 20 different species of shellfish cultured, such as mussels, oysters, clams, and scallops. Other species such as sea urchins, crayfish, and sea cucumber are commercially produced in small amounts. Aquatic plants represent a small, but growing part of the sector, with nine species of kelp, sea lettuce and Irish moss commercially cultivated in Canada. The diversity of species in all sectors is expected to grow in the coming years.

Figure 6: Farmed Seafood Production, by Province and Species, 2019



Source: Statistics Canada (2020a).

Newfoundland and Labrador

Newfoundland and Labrador ranked fourth among the provinces in production in 2019, at 17,655 tonnes of farmed seafood. While farmed seafood production stagnated over the past 18 years in most provinces, production in Newfoundland and Labrador has increased five-fold since 2002.

The province's primary farmed seafood species are Atlantic salmon, steelhead trout, and blue mussels. Ninety percent of the province's farmed salmon production is concentrated in the Bay d'Espoir and Fortune Bay region, and 85% of shellfish farming is in the area of Notre Dame Bay and Green Bay.

Prince Edward Island

Prince Edward Island ranked third in farmed seafood production with a total of 26,243 tonnes in 2019, almost all of it shellfish.

The province grows the majority (67%) of the shellfish produced in Canada, including 78% of the mussels (specifically, blue mussels). Mussels take 12 to 24 months to grow large enough for harvesting and commercial sale. They are farmed mainly along the island's northern and eastern shores.

Prince Edward Island is also the country's second-largest oyster producer (33% of Canadian production). The predominant species is the American oyster, which takes between five and seven years to reach market size.

Prince Edward Island produces a small amount of rainbow trout, Atlantic salmon, fish eggs, fry and smolts, and halibut, mainly in the eastern part of the province.

Nova Scotia

Nova Scotia produced 10,197 tonnes of farmed seafood in 2019.

About 7,360 tonnes of Atlantic salmon was farmed along the eastern shore of Nova Scotia from the Strait of Canso to Halifax, on the south shore from Halifax to Yarmouth, and in Cape Breton. Almost 2,000 tonnes of blue mussel, oyster and clam production took place primarily in the Bras d'Or Lakes area, the Annapolis Basin, Shelburne Harbour and parts of St. Margaret's Bay. About 840 tonnes of rainbow trout was also farmed in Nova Scotia in 2019.

New Brunswick

New Brunswick was the third-ranked farmed seafood producer in Canada in 2019, with about 24,290 tonnes of production. Its main product is Atlantic salmon (92%) with oysters accounting for the remaining 8%. In fact, New Brunswick is where salmon farming first started in Canada in 1979.

Quebec

In Quebec, farmed seafood production totaled almost 1,300 tonnes in 2019. The industry began with freshwater aquaculture in 1857 and then expanded into marine aquaculture; the two types account for 70% and 30% of production respectively. Freshwater aquaculture consists primarily in farming brook trout and rainbow trout, while the main species in marine aquaculture is blue mussels, as well as urchin, clams, oysters, and scallops.

While Quebec makes a modest contribution to Canada's total production, the farmed seafood sector has a significant impact in the Magdalen Islands, the Lower North Shore, Gaspé, the Eastern Townships, the Laurentians, the Outaouais, and Central Quebec.

Ontario

The majority of Canada's freshwater production comes from Ontario-based farmed seafood operations. The main species farmed in Ontario is rainbow trout, with most operations clustered largely in the Great Lakes, where the availability of high quality (ground and surface) water, suitable climate conditions, and a developed infrastructure for goods and services present conditions favourable to sector development. Net pen operations represent about three-quarters of total production capacity.

Production amounted to 5,900 tonnes, and total farm gate value associated with land based and net pen farmed seafood production in 2019 was \$38.8 million from about 100 operations.

Manitoba

Fish farming in Manitoba is largely a cottage industry operated by about 600 people who grow rainbow trout, Arctic char, or other trout species. Most fish farming is done in farm dugouts and small ponds.

Annually in Manitoba, there are between 25 and 30 licensed commercial operators who raise fish for sale. They primarily farm private waters, although a few are licensed to use Crown waters.

While Manitoba has a small farmed seafood sector characterized by part-time owner-operator ventures, the province does have considerable potential to further develop the freshwater aquaculture sector due to the availability of large quantities of high quality ground water, an inherent culture to develop and support farming and proximity to major U.S. markets.

Saskatchewan

Saskatchewan's farmed seafood sector consists of about eleven hatcheries and eighty production units at a commercial level. The most important farmed seafood species in Saskatchewan is rainbow trout. Commercial production of rainbow trout is almost entirely limited to one producer/processor on Lake Diefenbaker.

While Saskatchewan farmed seafood production is relatively small, the province may have a larger impact on the international farmed seafood sector as a supplier of specialty feed ingredients. Saskatchewan crops such as canola and peas have been shown to be excellent sources of protein for the replacement of fish meal in farmed seafood diets; several Saskatchewan companies are developing protein concentrates of peas and canola that further improve the nutritional value of these products as fish meal replacements.

Alberta

According to the Alberta Ministry of Agriculture and Forestry, the aquaculture industry in Alberta has revenues of about \$10 million, of which about \$6 million in revenue is for retail sales, predominately rainbow trout and tilapia, and \$4 million in revenue is derived from fingerling sales, including u-fishing opportunities, government contracts, private pond stocking and grass carp for biological vegetation control.

British Columbia

Farmed seafood operations in British Columbia produce salmon, other finfish and shellfish year-round, with total production of over 100,000 tonnes in 2019, representing more than half the total farmed seafood production in Canada. Salmon farming is the province's largest agricultural export and the weight and value of the harvest is greater than the wild salmon fishery harvest.

Yukon

Yukon, the Northwest Territories, and Nunavut have a small farmed seafood sector composed of pothole-lake fish farms, where fish are stocked and grown in closed-system pothole lakes, and tank farm operations that raise and export Arctic char and Arctic char eggs.

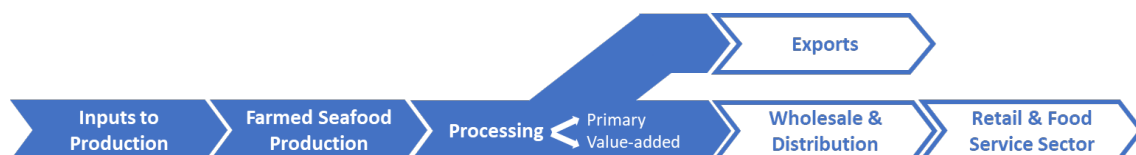
Yukon's farmed seafood sector has two very different components. The first involves the stocking of fish under licence into pothole lakes, growing them for sale. There are currently 16 fish farm licenses issued on 23 pothole lakes, but not all are active. The second component of Yukon's farmed seafood sector involves the raising of fish in tank farms and hatcheries. There are two such facilities in Yukon and both of these raise Arctic char. The output from these facilities is about one million eggs annually and approximately 30,000 kilograms of dressed Arctic char for Canadian markets and export.

Delivering Economic Benefits to All Canadians

Farmed seafood delivers year-round, living-wage jobs centered in coastal, rural communities. Primary farmed seafood operations support working waterfronts and the same infrastructure and skills as does capture fisheries such as docks, boat yards, and processing plants. The involvement of these suppliers in Canada's farmed seafood sector varies by species.

Figure 7 demonstrates the full economic benefits that farmed seafood generates across the seafood supply chain, from inputs, to production, to processing, to wholesale and distribution, and finally to retail and food services.

Figure 7: The Farmed Seafood Value Chain



Source: Adapted from DFO (2013) Aquaculture in Canada 2012: A Report on Aquaculture Sustainability.

The economic impacts of Canadian farmed seafood in Canada are shown in Table 1.

Table 1: Total Direct, Indirect and Induced Economic Impacts of Farmed Seafood in Canada, 2019

	Inputs to Production	Farmed Seafood Production	Value-Added Processing	Total
Total Economic Activity (\$M)	\$1,740	\$3,760	\$1,470	\$5,230
GDP (\$M)	\$640	\$1,510	\$610	\$2,120
Wages (\$M)	\$360	\$710	\$270	\$980
Employment (PYs)*	6,610	13,180	8,120	21,300

Source: RIAS Inc. estimates based on data from Statistics Canada Table 32-10-0107-01 Aquaculture, production and value, and Table 36-10-0595-01 Input-output multipliers, provincial and territorial, detail level

* "PYs" refers to person-years, the equivalent of one year of full-time employment for one person.

Table 1 shows the significant economic benefits that our sector's farming and processing activities alone deliver to Canadians – mainly within rural and coastal communities where well-paying, full-time jobs are greatly in need. Our farming and fish processing activities generated an estimated \$5.2 billion in economic activity, \$2.1 billion in GDP, and full-time jobs for more than 21,300 Canadians earning an estimated \$980 million in wages in 2019. For more details on the economic impacts of the farmed seafood sector in Canada, please see Appendix I.

An Environmentally Sustainable Sector

Maintaining Animal Health and Welfare

Our industry implements science-based practices that minimize stress, maintain a healthy aquatic environment, reduce disease risks, and prevent the spread of diseases when they do occur. These practices are supported by federal and provincial regulations, international requirements and third-party sustainability certifications.

Reducing Disease Risks

In a shared aquatic environment, strong protocols must be in place to minimize the risk of introducing pathogens. All farmed seafood stock must be certified disease free before it enters the marine farming environment. Controlling the spread of disease, disease agents, parasites, toxins or contaminants, within the site or from one site to another is achieved

through strict biosecurity measures. These include controlled harvesting methods, and developing bay-management systems requiring rotation of sites to allow for fallowing and year-class separation. These measures are applied mainly through provincial veterinary and regulatory programs, as well as associated industry standard operating procedures.

As with any food production sector, disease outbreaks (e.g., bacteria, viruses, parasites) can happen in farmed seafood operations. However, scientific assessments demonstrate that the risk of disease transfer from farm to wild is low, particularly when good biosecurity and fish health management practices are in place. The National Aquatic Animal Health Program of the Canadian Food Inspection Agency (CFIA) reduces the risk of introducing new pathogens and ensures robust rapid response mechanisms if disease outbreaks occur despite prevention measures. And provincial regulatory measures require key biosecurity and fish health management practices including monitoring for disease; no transfer of diseased fish; and rapid response to disease outbreaks.

Managing Diseases and Pests

Providing optimal care for their animals is a priority for finfish and shellfish farmers. This means taking steps to prevent disease through providing a healthy rearing environment that meets all the life needs of the fish and reduces susceptibility to pathogens and pests; using vaccines to prevent disease; and treating diseases that might occur quickly and efficiently. Also, all treatment products must be authorized for sale by Health Canada and prescribed by a licensed veterinarian, and farmers are diligent in minimizing drug use. It is important to note that no growth promoters or other hormones are used in the Canadian farmed seafood sector.

Health Canada has strict rules governing the use of treatment products on animals grown for food. Health Canada sets maximum residue limits in harvested fish, and there must be appropriate time after the treatment before the fish can be harvested. The CFIA monitors fish at federally registered processing plants and tests for the presence of therapeutants in fish to ensure they do not exceed the levels set by Health Canada.

Sea lice are small external fish parasites that occur naturally in the ocean environment. Sea lice graze on the skin of their hosts. These parasites have existed on wild salmon and other marine fish species for thousands of years. Farmers must manage sea lice to low levels on their salmon to protect their stock's health, and to reduce the risk of the lice becoming an additional source of infection to juvenile wild fish. Canadian farmers successfully manage sea lice by:

- Regular monitoring and reporting,
- Choosing sites with appropriate water currents through environmental surveys,
- Site fallowing (rotating periods of inactivity),
- Using mechanical, non-chemical means of control,
- Using veterinarian-directed therapeutants and pesticides to treat affected fish, and
- Other husbandry approaches.

Industry is making significant investments in the development of alternative, green technology to reduce reliance on chemical products. These include the use of “cleaner fish” (usually a member of the *wrasse* family), lice traps, the development of an eco-bath closed delivery system, and the use of full tarps for all net-pen therapeutant applications. With support from federal agencies, industry has invested in well boats to deliver treatments, supporting the use of hydrogen peroxide and reducing the quantities of all medicines required for treatments.

Under the federal Aquaculture Activities Regulations, our industry reports on all use of drugs and pest control products.

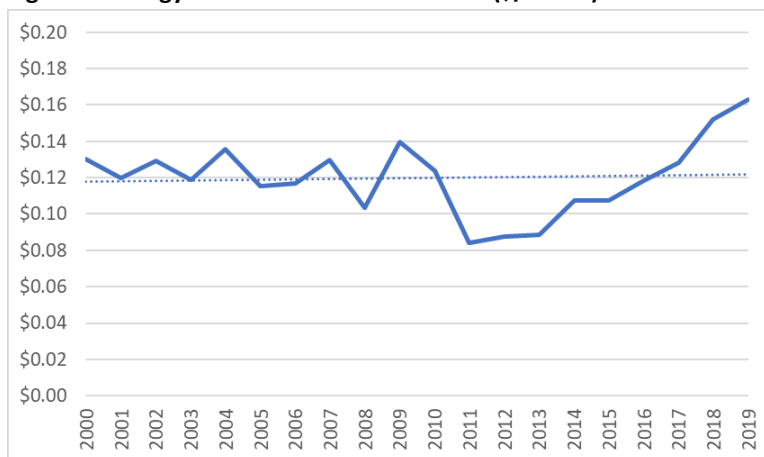
Using Resources Efficiently

Energy Use

Statistics Canada data for the farmed seafood sector in Canada, covering both finish and shellfish production, shows the trend in expenditures on energy used in production has risen in recent years on a \$/tonne of production basis, as outlined in Figure 8 below.

Increased energy use could reflect the shift to growing larger smolts in hatcheries, which is more energy-intensive than transferring smaller smolts to net pens for grow-out.

Figure 8: Energy Use Per Unit of Production (\$/tonne)*



Source: Statistics Canada (2020a), Statistics Canada (2020b).

*Real expenditures on energy per tonne of production, in 2016 constant dollars.

Land Use

In 2019, CAIA prepared an update to the physical footprint of our sector which showed that only 1% of water area that could be used for farming seafood is in use in Canada, as shown in Table 2 below. British Columbia, despite being Canada's largest farmed seafood producer, has a leased water area for seafood farming covering only 0.8% of the biophysically suitable coastal waters. Even Prince Edward Island, with its major farmed mussel and oyster operations, farmed seafood production occupies only 3% of the marine area available for production.

Table 2: Current Leased Area vs. Total Available Area

Current Leased Area (ha)	Total Available Area (ha)	% of Available Area	
Newfoundland and Labrador	6,492	575,000	1.13%
Prince Edward Island	7,802	250,000	3.12%
Nova Scotia	5,622	265,000	2.12%
New Brunswick	4,307	695,000	0.62%
Quebec	5,461	200,000	2.73%
Ontario	30	465,000	0.01%
British Columbia	8,172	985,000	0.83%
Canada	37,886	3,795,000	1.00%

Source: CAIA Briefing Note: Aquaculture Footprint in Canada – 2019 update.

The total footprint of finfish farms across Canada is very small:

- The area of finfish farms in British Columbia could be encompassed within Stanley Park in Vancouver.
- On the south coast Newfoundland and Labrador, leased area represents 0.5% of waters.
- In southwest New Brunswick, leased area represents 4.4% of waters.

Shellfish farms have a more significant footprint in some areas:

- Mussel farms occupy extensive areas of in-shore waters in Prince Edward Island with corridors providing for boating access.
- Oyster on-bottom culture occupies foreshore areas in parts of the Maritimes and local areas in British Columbia. This is a relatively non-intensive culture technique and these areas have had extensive leases for wild oyster harvesting for decades.

The total footprint of seafood farms across Canada is very small compared to other countries. Table 3 compares Canada's production per available coastline to our main competitors.

Table 3: International Comparison of Coastline and Aquaculture Production

	Marine coastline (km)	Marine Aquaculture 2017 (tonnes)	Tonnes per km of coastline
Chile	6,435	1,216,564	189.1
Norway	25,148	1,308,537	52.0
Ireland	1,448	44,786	30.9
United Kingdom	19,717	211,701	10.7
United States	19,924	190,225	9.5
New Zealand	15,134	114,874	7.6
Australia	25,760	83,731	3.3
Canada*	79,562	180,986	2.3

Source: FAO Global Aquaculture Statistics, CIA Factbook.

*Only considers provinces with marine coastline suitable for aquaculture (excludes all three Prairie provinces, Ontario, and Canada's three territories).

With about 80,000 km of coastline, Canada produces about 2.3 tonnes per km. In contrast, the world's 2 largest Atlantic salmon producers have much greater production per km of coastline as Canada: Chile produces 189.1 tonnes per km (80 times Canada's output/km) while Norway produces 52 tonnes per km of coastline (20 times Canada's output/km).

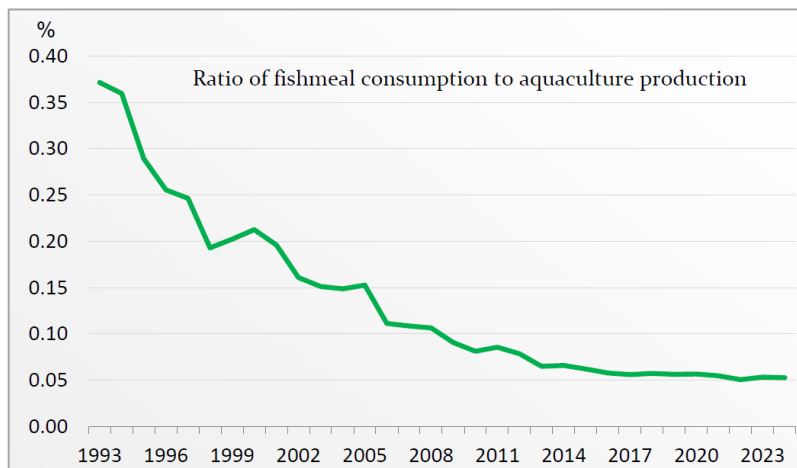
Feed Use, Type and Efficiency

The main input into farmed finfish production is fish feed. In 2019, Canadian seafood farmers spent \$415 million on feed or about 40% of total product expenses. On the other hand, farmed shellfish requires no feed input at all. The mussels, oysters or other shellfish get their nutrients directly from the water environment in which they are situated.

Feed Conversion Ratios (FCR): A key element in assessing the sustainability of food animal production systems is the feed conversion ratio, or FCR. FCR measures the efficiency of food production in terms of the amount of feed an animal requires to gain a kilogram of body weight. Canada's farmed finfish feed conversion ratio is about 1.2:1. This means 1.2 kg of feed is needed to produce 1 kg of fish. This ratio has improved dramatically from previous decades, and is significantly lower than the FCRs for other sources of food protein: poultry (1.7:1 to 1.9:1), pork (2.8:1 to 2.9:1) and beef (6:1 to 9.1:1). In terms of FCR, farm-raised finfish are more efficient than most other commercially raised farm-fed animals. Farmed shellfish are the most efficient.

Fish In – Fish Out (FIFO): Another aspect of the sustainability is the amount of wild fish meal and fish oil used in feed. Since 1990 the ratio of marine protein to produce 1 kg of finfish protein has dropped from 3.8 kg of fish meal and 2.8 kg of fish oil to only 0.7 kg of fish meal and 0.5 kg of fish oil, a reduction of more than 81% and 82% respectively. These improvements are projected to continue in the future, as illustrated by UN FAO projections in Figure 9 below:

Figure 9: Use of Fishmeal in Aquaculture



Source: UN FAO - Fish Outlook 2015-2024 and 2030

Other sustainability measures, such as forage fish dependency ratios (FFDR), are being adopted worldwide by groups such as the Aquaculture Stewardship Council (ASC). FFDR is the amount of wild caught fish used to produce the amount of fish meal and fish oil required to produce 1 kg of salmon. The average FFDRs have decreased over time, and are well below the standards set by the Aquaculture Stewardship Council, indicating a continuing shift away from reliance upon wild marine resources in feed.

Maintaining Healthy and Productive Ecosystems

Our industry works to minimize environmental interactions through measures such as proper siting, management of habitat impacts, and escapes prevention measures.

Habitat

Sound habitat management is achieved in part by siting processes and the analysis of potential environmental outcomes. Siting is important to help ensure that the aquatic ecosystems in which seafood farming is undertaken remain productive, not just for the cultured species but also for other aquatic species that use those areas. This work can involve as many as 17 federal agencies and a range of provincial and territorial governments.

Farm siting is an important element of minimizing impact of excess feed on the ecosystem. Marine and freshwater environments have varied capacity to absorb or assimilate organic materials. Locating marine farms strategically in areas of deeper water and strong currents, combined with mitigation measures such as site fallowing, help to minimize deposition from farms. Under federal and provincial regulations finfish farms are monitored for changes to the seabed.

Regulatory measures are in place across Canada to ensure that no significant amount of organic matter accumulates beyond the edge of the net pens. Siting assessments ensure that areas of significant accumulation do not occur over ecologically sensitive habitat. Over the past 20 years, aquaculture management practices and technologies have improved to reduce excess release of feed. Advancements in feed have meant that less feed is needed and wasted, and more vegetable-based proteins are being used. Today, federal and provincial regulations are designed to minimize the impact that excess feed from fish farms may have by limiting it to a specified area of the farm and immediately surrounding waters. Where matter does accumulate, the environment reverts naturally to its regular levels in a short period of time when farmed fish are removed (i.e., after harvest; before restocking).

The use of chemicals in farming seafood is strictly regulated to ensure no harmful effects on the environment. Pesticides used in farming seafood are evaluated by the Pest Management Regulatory Agency with strict environmental protection measures in place under the Pest Control Products Act. All treatment events are reported to the regulator. Also, good fish health management practices reduce volumes of therapeutants used, and research is ongoing to identify non-chemical treatments and means to reduce outbreaks.

Biodiversity

Recent studies reveal that farming shellfish can improve species abundance and diversity, have beneficial impacts on pelagic fish around farm sites, reduce pressure on wild stocks, and play an important role in stocking programs to replace depleted wild stocks. Shellfish beds provide critical ecosystem functions by creating structure and habitat for other species such as crabs, worms, and juvenile fish, that provide a food source for fish and other marine species. The shells and farm structures provide habitat for juvenile fish, crabs and other organisms.

Water Quality

Shellfish feed on phytoplankton, but can also filter marine biotoxins, chemical contaminants, and pathogenic microorganisms, such as bacteria and viruses, effectively removing them from the water column. Farmed shellfish improve water quality and clarity by removing particulates, excess nutrients, organic material, viruses, and bacteria from the water column. Improved water clarity enhances habitat for sea grasses such as eelgrass and other submerged aquatic vegetation. A single oyster can clear over 50 litres a day, retaining particles as small as 2 microns – even a small oyster farm can clean more than 350 million litres each day, reducing turbidity, increasing light penetration, improving water quality, and reducing anoxia (low oxygen). One kilogram of live mussels can remove up to 12g of nitrogen, 0.8g of phosphorous, and 50g of carbon.

Escapes

Preventing the escape of farmed fish is a priority for the farmed seafood sector, federal, provincial, and territorial governments, commercial and recreational fishermen, and environmental groups. Governments and industry collaborate to put regulatory and operational measures in place to manage the incidents of escapes through more robust nets and containment structures as well as improved inspection, training, maintenance and husbandry procedures, and reporting. The implementation of these escape prevention initiatives has allowed finfish production to increase while reducing the number of annual escape events. Table 4 shows the number of escapes of farmed finfish by province over the past five years.

Table 4: DFO Reported Escapes of Farmed Finfish by Province (2013-2017)

	BC	NB	NS	NL	Total
2014	0	0	0	0	0
2015	3	40000	0	0	40003
2016	22	0	0	0	22
2017	9	0	644	0	653
2018	13	--	--	--	13
Total	47	40,000	644	0	40,678
Average/year	9.4	8,000	129	0.0	8,136

Source: DFO (2018).

Notes: "--" data not yet available

In British Columbia, almost all farm-raised salmon are Atlantic salmon, and they do not inter-breed with Pacific salmon. In the east, science has identified low risks related to competition for prey and other inputs. Farm-raised salmon, as farm animals, become used to feeding by pellets and are not known to compete effectively with wild salmon in the wild.

A Socially Responsible Sector

All companies investing in farmed seafood understand the importance of ensuring that the values of local communities are reflected in their day-to-day business operations. A 2014 report prepared for CAIA, "Social Licence and the Aquaculture Industry in Canada" examines

the various measures of social license, presents evidence against those accepted measures, and concludes that the farmed seafood sector maintains an “approval” level in Canada, as the majority of Canadians feel the industry is well regulated and operating sustainably.

Ensuring Safe and Healthy Products

World-Leading Programs and Standards for Seafood Safety

Canada’s food safety system is recognized as one of the best in the world. This system is built upon strong laws. The CFIA enforces policies and standards, set by Health Canada, governing the safety and nutritional quality of all food sold in Canada. The CFIA partners with Health Canada to not only set standards for food safety but enforces these standards.

All establishments processing fish and seafood for export or inter-provincial trade must be federally registered and must develop and implement a Hazard Analysis Critical Control Point- based *Quality Management Program*. A processing establishment's *Quality Management Program* outlines the controls implemented by the processor to ensure that all seafood products are processed under sanitary conditions, and that the resulting products are safe and meet all regulatory requirements.

For shellfish, the protocols established through the *Canadian Shellfish Sanitation Program* are essential to ensuring that only safe product makes it to the marketplace.

Health Canada's Veterinary Drugs Directorate (VDD) is responsible for ensuring the safety of foods produced in Canada from farm-raised fish and other food-producing animals that have been treated with veterinary drugs. To accomplish this, VDD conducts comprehensive scientific reviews of veterinary drugs before they are approved for sale in this country—and also sets maximum residue limits (MRLs) in the tissues and food products derived from such food-producing animals.

Following antibiotic use, Canadian aquafarmers must follow a VDD-imposed regulated withdrawal period and testing program to ensure that the active compounds within the treated fish fall below the MRL before they are sold as food.

Sophisticated Traceability Systems

All information regarding a farmed seafood product's history is well documented. The ability to follow the history of a product is known as *traceability*. Through membership on the International Standardization Organization (ISO) TC234 Fisheries and Aquaculture Committee, Canada has been involved in the development of new international standards to create a common global platform for documenting traceability.

The CFIA's *Quality Management Program* and *Canadian Shellfish Sanitation Program* form the foundation of a strong traceability system for Canadian farmed seafood products. In addition to meeting Canadian traceability regulations, Canadian finfish companies have implemented sophisticated traceability systems that track finfish from egg to juvenile to adult fish (and feed), through to the marketplace. Shellfish companies have also implemented traceability systems to track their products from larvae to seed to final sale.

Nutrition

Seafood is an important part of a healthy and balanced diet, so ensuring that the products of seafood farming are healthy and safe to eat is essential.

- Seafood contains nutrients that play a well-established role in normal growth and development, energy metabolism, building and repairing body tissues, formation and maintenance of bones and teeth, formation of red blood cells, immune system health, and the prevention of heart disease. For more detailed information, see [Farmed Seafood and Canadian Health: How Higher Seafood Consumption Can Save Lives](#).
- Growth or other hormones are not used in Canadian farmed seafood, and antibiotic use has fallen significantly over the years. Health Canada's requirements for withdrawal periods between treatment and harvest, and the CFIA's food safety programs ensure farmed fish are safe to eat.
- Testing by the CFIA shows PCB and other pollutants are no higher than in wild fish or other farmed animals.

Third-Party Certification

Independent third-party farmed seafood certification is a trusted “stamp of approval” validating that farmed seafood products meet comprehensive and stringent food safety, environmental and social standards.

Many Canadian farmed seafood companies meet the standards for at least one certification program. Some companies participate in multiple programs.

Companies opting to be certified undergo an intensive third-party audit to establish their compliance. Their farmed seafood products therefore meet or exceed the stringent global food safety, environmental, and social standards.

Canadian farmed seafood companies will continue to refine and improve their food safety, environmental, and social responsibility practices to meet the ever-evolving standards of certification programs.

Partnerships with Indigenous Peoples

Indigenous peoples operate farmed seafood facilities in many regions of Canada. The growing interest in farmed seafood reflects its acceptance by communities that are seeking economic development opportunities that are a fit for their people and their lands and waters. Changes in the legal landscape are also enhancing the appeal of farmed seafood production for Indigenous communities. These changes are leading our sector to take a fresh approach to relationships with Indigenous communities. Rather than carrying out limited consultation and accommodation negotiations, our members now seek to build cooperative relationships based on mutually beneficial partnerships. As an example, in British Columbia, salmon farming operates under 20 agreements with First Nations communities that covers close to 75% of total production.

As Indigenous communities become more involved in economic development, the demand for suitable investment opportunities is also increasing. Supported by entrepreneurial leadership and a development-friendly agenda, more and more communities are looking for opportunities to become business owners, and for support to help them along that path.

While the main activity associated with farming seafood is the grow-out of fish and shellfish in marine and freshwater, other activities in the farmed seafood value chain can provide opportunities for Indigenous people. The range of activities means that there are opportunities to suit different skill sets and capacities for investment and partnership.

Year-Round Jobs for Canadians

The Canadian farmed seafood sector provides an estimated 21,300 full time jobs in farm operations, supply sectors and processing. Many of these jobs are in the rural and coastal communities where farm and processing operations are located. Many of these workers are under the age of 35.

In its recent report, “Aquaculture Industry Labour Market Forecast to 2025”, the Canadian Agricultural Human Resource Council (CAHRC) expects that growing market demand for seafood will boost the demand for labour in the farmed seafood sector in Canada. CARHC finds that farmed seafood faces these unique challenges in finding enough workers:

- Operations tend to be remote: rural depopulation and worker transportation issues affect this industry’s ability to find and retain workers.
- The aquaculture industry can not access foreign workers through seasonal and temporary foreign worker programs because it is not on the National Commodities List. The National Commodities List grants employers access to foreign workers through the Seasonal Agricultural Worker Program (SAWP) and the Agricultural Stream of the Temporary Foreign Worker Program (TFWP).

The CARHC report also finds that the industry benefits from the following advantages:

- The industry is less affected by seasonality and variability in its hours of operation, which makes it a more stable, attractive employment option.
- The farmed seafood sector has a younger-than-average workforce, so the effects of retirement will be felt less here than in other industries with older workers.
- Farmed seafood generally faces more positive perception than some other agricultural commodities.

Community Development

Communities have seen how farmed seafood can revitalize their economies, especially in light of declines in other natural resource sectors. In turn, the industry has benefited from a skilled and stable workforce. Providing good jobs in a safe working environment with the possibility of advancement through appropriate training is a responsibility that farmed seafood operators take seriously.

Furthermore, communities across the country have seen how farmed seafood companies and their employees make a positive impact locally through their active involvement in volunteerism where they live and work. By supporting local events and investing in communities through corporate giving, volunteering, jobs and infrastructure, the farmed seafood sector improves the quality of life for all residents.

The farmed seafood sector supports wild salmon conservation projects, beach cleanup activities and other community events. Many operators directly support and lead wild-fishery enhancement projects working in cooperation with local fish and game clubs, and in conjunction with regulatory authorities. Financial donations to high schools, trade and university scholarships, school projects and community organizations, as well as product donations to fundraisers, food banks and many more initiatives show the industry's commitment to their communities.

Future Directions

Addressing the Need for Food Security

The production capacity of the traditional food producing sectors is unable to keep pace with the demand of food:

- Many capture fisheries are already near maximum sustainable output.
- Most of the earth's arable land is already under cultivation.
- Terrestrial farm animals are relatively inefficient converters of the earth's resources into high quality protein.

The predicted continued growth of the human population (9.77 billion by 2050, according to the most recent UN estimates) will only exacerbate the imperative to not only increase food production—but to do it as efficiently as possible. Farmed seafood has the potential to play the primary role in meeting this imperative. For example:

- Vast areas of the marine environment are available for expanded farmed seafood production.
- One third of all farmed fish require no feed inputs e.g. oysters, mussels, clams, and scallops; they simply feed on materials that occur naturally.
- Species—such as carp and tilapia—can be raised on plankton alone, which develops through fertilizing the water with waste product from other agricultural sectors.
- Farmed seafood species that do require feed are becoming much more efficient over time. For example, between 2000-2008, global farmed seafood production grew by 60%, whereas over the same period demand for feeds decreased by 16%. Moreover, these feed-requiring species—e.g. Atlantic salmon—utilize the earth’s diminishing resources more efficiently than terrestrial food-producing animals.

With its extensive coastline and vast marine and freshwater resources—together with its environmental responsibility, technological innovation, and strong knowledge base—Canada has an opportunity to assume a lead role in the expansion of sustainable farmed seafood production necessary to meet the growing demand for food.

Opportunities for Indigenous Peoples

Much of the future expansion of Canadian near-shore farmed seafood will necessarily take place on the traditional territories of Canada’s Indigenous peoples. Many Indigenous communities are already directly or indirectly involved in farmed seafood; this involvement occurs in nine of the ten Canadian provinces. In addition to those Indigenous peoples already participating in farmed seafood production, there are many others whose traditional territories have the biophysical capacities to support farmed seafood development.

The increased involvement of Indigenous peoples in Canadian farmed seafood offers the opportunity for a significant increase in the productive capacity of Canadian farmed seafood and the potential for significant economic benefit to Indigenous peoples. Assuming the continued expansion of Indigenous peoples' involvement in farmed seafood—together with continued industry growth—the potential gains for Indigenous peoples in terms of additional jobs and income could be significant: an estimated 8,230 additional jobs earning over \$410 million if the industry doubled production from 2015 levels.

Species Diversification

The technological sophistication of the Canadian farmed seafood industry—together with its extensive experience and knowledge base—has created the capacity to diversify production beyond the primary farmed seafood species. Species diversification will allow Canada to access new market opportunities. While farming methods for relatively new farmed seafood species are still being refined and subsequently carry greater investment risks, potentially higher returns on investment are achievable for successful early entrants in these farm-raised species. Species considered to have (or already demonstrating) commercial potential include:

- Sablefish
- Arctic char
- Atlantic halibut
- Sturgeon
- Tilapia
- Geoduck
- Sea urchin
- Marine plants
- American eels
- Abalone
- Cockles
- Sea cucumber
- Spotted Wolffish
- Atlantic Wolffish

References

Advisory Council on Economic Growth (2017). Unleashing the Growth Potential of Key Sectors. February 6, 2017. <https://www.budget.gc.ca/aceg-ccce/pdf/key-sectors-secteurs-cles-eng.pdf>

Canadian Agricultural Human Resource Council (2016). Aquaculture Labour Market Forecast to 2025. May 2016. https://cahrc-ccrha.ca/sites/default/files/files/Labour-Employment/AQU_reportE.pdf

DFO (2013) Aquaculture in Canada 2012: A Report on Aquaculture Sustainability. <https://www.dfo-mpo.gc.ca/aquaculture/lib-bib/asri-irda/asri-irda-2012-eng.htm>

DFO (2014). Aquaculture in Canada. Presentation at the Canada-United States Working Meeting on Aquaculture. December 8, 2014

DFO (2020). Reporting escapes. <http://www.dfo-mpo.gc.ca/aquaculture/protect-protege/escape-prevention-evasions-eng.html>

Gardner Pinfold (2013). Socio-Economic Impact of Aquaculture in Canada - 2013 Edition. Prepared for Fisheries and Oceans Canada Aquaculture Management Directorate. February 2013. <https://www.dfo-mpo.gc.ca/aquaculture/sector-secteur/socio/index-eng.htm>

Mekonnen, M.M. and A.Y. Hoekstra (2010) The Green, Blue and Grey Water Footprint of Farm Animals and Animal Products. Volume 1: Main Report. UNESCO-IHE Institute for Water Education. December 2010. <http://waterfootprint.org/media/downloads/Report-48-WaterFootprint-AnimalProducts-Vol1.pdf>

RIAS Inc. (2013) Farmed Seafood and Canadian Health: How Higher Seafood Consumption Can Save Lives. Prepared for the Canadian Aquaculture Industry Alliance. November 2013

RIAS Inc. (2014) Canada's Aquaculture Industry: Potential Production Growth and Footprint. Prepared for the Canadian Aquaculture Industry Alliance. November 17, 2014

RIAS Inc. (2015). Economic Opportunities for Aboriginal Aquaculture in Canada. Prepared for Fisheries and Oceans Canada. March 31, 2015. <https://static1.squarespace.com/static/532c61f8e4b0d901d03ed249/t/5644f103e4b0e17eb49d2cf9/1447358723917/Economic+Opportunities+for+Aboriginal+Aquaculture+in+Canada+-+May+14+Final.pdf>

RIAS Inc. (2016). Comparing the Environmental Footprint of B.C.'s Farm-Raised Salmon to Other Food Protein Sources. Prepared for the BCSFA. September 9, 2016

Statistics Canada (2017). Provincial Input-Output Multipliers, 2013. Catalogue no. 15F0046XDB

Statistics Canada (2020a). Table 32-10-0107-01. Aquaculture, production and value..
<https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210010701>

Statistics Canada (2020b). Table 32-10-0108-01 Aquaculture economic statistics, value added account. <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210010801>

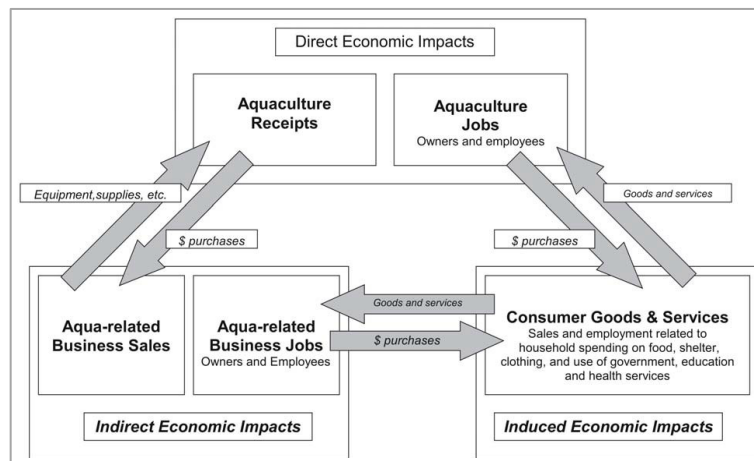
United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.

Appendix I: Economic Contribution of the Farmed Seafood Industry in Canada

Economic Impacts of Farmed Seafood Production

Figure 10 shows how fish farming generates direct, indirect, and induced economic impacts within the Canadian economy.

Figure 10: Measuring Economic Impacts of Farmed Seafood Production



Source: RIAS Inc. (2015). Economic Opportunities for Aboriginal Aquaculture in Canada.

The **Direct Economic Impacts** refers to farm gate receipts and employment associated with on-farm activities i.e. farmed fish and seafood production. However, the economic impact of the farmed seafood sector extends well beyond production by fish farmers.

Indirect Economic Impact refers to the sales and employment associated with the re-spending of the farm gate receipts on goods and services provided by aquaculture-related businesses. An aquaculture-related business is defined as a business that either sells products/services to farmed seafood operators or buys products/services from farmed seafood operators. Aquaculture-related businesses include companies that provide:

- feed supplies,
- seed/smolt/fingerlings
- nets/pens/cages/tank
- floatation systems and buildings
- electrical/plumbing products and services
- construction services
- safety devices
- electricity/fuel

- engines and mechanical supplies and services
- refrigeration and cooling
- processing and packaging
- transportation services
- insurance/finance/accounting services/legal services
- consulting and research services

Fish farming delivers year-round, living-wage jobs centered in coastal, rural communities. Primary farmed seafood operations support working waterfronts and the same infrastructure and skills as does capture fisheries such as docks, boat yards, and processing plants. The involvement of these suppliers in Canada's farmed seafood sector varies by species.

Finally, the jobholders on the farms and the aquaculture-related businesses contribute to an **Induced Economic Impact** through the spending of their wages on personal/consumer items including housing, clothing, food, and transportation. This is especially important in rural Canada where it has contributed to the revitalization of many coastal communities which depend on the wealth generated from year-round, well-paying jobs and by providing the critical economic activity necessary to stimulate infrastructure development and growth in secondary and tertiary businesses. They also support jobs in an array of government service sectors including health and education.

Economic Impacts Across the Value Chain

The farmed seafood sector also generates economic activity and employment throughout the seafood supply chain, from inputs, to production (as described above), but also through the processing, wholesale, retail and final consumption stages of the value chain, as shown in Figure 11 below.

Figure 11: The Farmed Seafood Value Chain



Source: Adapted from DFO (2013) Aquaculture in Canada 2012: A Report on Aquaculture Sustainability.

Total economic impacts across the full farmed seafood value chain are shown in Table 6 below. Farmed Seafood Production output (\$1.23 billion) is the farm-gate value reported by Statistics Canada (2020a). The aggregate value of final products sold into the wholesale market by Canada’s aquaculture companies includes primary processing (\$330 million in output, which involves dressing in the case of finfish, and washing and grading in the case of shellfish) and value-added processing (\$1.1 billion). This approach follows the methodology employed by Gardner Pinfold Consultants Inc. in their Socio-Economic Impact of Aquaculture in Canada report for DFO. See Appendix 1 of the study for a detailed explanation of their methodology (Gardner Pinfold, 2013).

Table 5: Economic Impacts of Canadian Farmed Seafood, 2019

		Farmed Seafood Production	Primary Processing	Value-added Processing**	Total
Direct	Output (\$M)	\$1,230	\$330	\$1,100	\$2,660
	GDP (\$M)	\$470	\$130	\$410	\$1,000
	Wages (\$M)	\$180	\$50	\$150	\$380
	Employment (PYs)*	3,180	860	5,430	9,470
Indirect	Output (\$M)	\$1,370	\$370	\$60	\$1,800
	GDP (\$M)	\$500	\$140	\$20	\$660
	Wages (\$M)	\$280	\$80	\$40	\$390
	Employment (PYs)*	5,200	1,410	830	7,440
Induced	Output (\$M)	\$360	\$100	\$310	\$770
	GDP (\$M)	\$210	\$60	\$180	\$450
	Wages (\$M)	\$90	\$30	\$80	\$200
	Employment (PYs)*	1,990	540	1,860	4,390
Total	Total Economic Activity (\$M)	\$2,960	\$800	\$1,470	\$5,230
	GDP (\$M)	\$1,180	\$330	\$610	\$2,110
	Wages (\$M)	\$550	\$160	\$270	\$970
	Employment (PYs)*	10,370	2,810	8,120	21,300

Source: RIAS Inc. estimates based on data from Statistics Canada Table 32-10-0107-01 Aquaculture, production and value, and Table 36-10-0595-01 Input-output multipliers, provincial and territorial, detail level.

* “PYs” refers to person-years, the equivalent of one year of full-time employment for one person.

** For the value-added processing level of the farmed seafood value chain, a portion of direct and indirect impacts generated at the farmed seafood production and primary processing levels have been subtracted from the indirect value-added processing impacts to avoid double-counting.

Table 6 shows that farmed seafood delivers significant economic benefits to Canadians. Our sector's farming and fish processing activities alone deliver significant economic benefits at a local, community level in Canada – mainly within rural and coastal communities where well-paying, full-time jobs are greatly in need. Our farming and fish processing activities generated an estimated \$5.2 billion in economic activity, \$2.1 billion in GDP, and full-time jobs for 21,300 Canadians earning an estimated \$970 million in wages in 2019.



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