

The Arctic as a Food Producing Region

Phase 1: Current status in five Arctic countries

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Report

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<p><i>Summary:</i> The aim of the "Arctic as a food producing region" - project is to assess the potential for increased production and added value of food from the Arctic region, with the overarching aim of improving economic and social conditions of Arctic communities. This report is the output from the first phase of the project, providing a description of the main food production and examples of conditions for food production in the Arctic areas of the countries involved. This will form the basis for further analysis of opportunities, driving forces and barriers for further development of arctic food production, in the next phase of the project. The project has participation from Canada, Denmark, Greenland, Iceland, Norway and Russia, and is endorsed by the Arctic Council Sustainable Development Working Group (SDWG).</p>	
<p><i>Summary in Norwegian:</i> Målet med "Arktisk mat"-prosjektet er å undersøke potensialet for økt produksjon og verdiskaping av mat produsert i arktiske strøk. Det overordnede målet er å bidra til økonomisk utvikling i arktiske samfunn. Prosjektet har deltakelse fra Canada, Danmark, Grønland, Island, Norge og Russland og er innlemmet i Arktisk råds prosjektportefølje under arbeidsgruppen om bærekraftig utvikling (SDWG). Rapporten er resultatet av første fase av prosjektet, hvor vi gir en oversikt over utvalgte produksjoner i deltakerlandene. Dette vil danne utgangspunkt for videre analyse av muligheter, drivkrefter og barrierer for videreutvikling av arktisk matproduksjon.</p>	

Preface

The "Arctic as a food producing region" is a project funded by the Nordic Council of Ministries, the Canadian Arctic Council office, the University of Saskatchewan (Canada), the Norwegian Ministry of Foreign Affairs and Nofima – Norwegian Institute of Food, fisheries and Aquaculture Research, the Icelandic Foreign Ministry, and endorsed by the Arctic Council Sustainable Development Working Group (SDWG). The project has participation from Canada, Denmark, Greenland, Iceland, Norway and Russia. The aim of the "Arctic as a food producing region" - project is to assess the potential for increased production and added value of food from the Arctic region, with the overarching aim of improving economic and social conditions of Arctic communities. This report is the output from the first phase of the project, providing a description of the main food production and examples of conditions for food production in the Arctic areas of the countries involved.

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1 Arctic as a food producing region

The Arctic or northern areas are today important as a food producing region, producing food from both marine and terrestrial resources. The region, however, has a potential to become an even bigger food producer. The aim of the "Arctic as a food producing region - project is to assess the potential for increased production and added value of food from the Arctic region, with the overarching aim of improving economic and social conditions of Arctic communities.

Consumers generally prefer food that is healthy, with good taste and produced in a sustainable manner, and increasingly they prefer food with a unique story. Food from the Arctic may score high on all these properties, especially with marketing based on properties highlighting the characteristics of Arctic food. The unique climatic northern growth conditions with long days and low temperatures, may affect the quality of food and fodder products differently from other climates. Increased harvesting and production of marine, agricultural and wildlife resources is therefore an exciting development opportunity.

Within the Arctic region, there is considerable variation in production and capabilities. Food is produced for both local consumption and national and export markets. Some areas in the North are experiencing food insecurity. As to the different food sectors, fisheries and aquaculture are often large-scale and export-oriented, while agriculture is quite marginal compared to farming in more favorable locations further south. Meat production from these areas provide local communities with local and culturally appropriate food as well as high valued meat in national markets. Some regions have potential for better utilization and value adding from hunting/gathering and herding. All countries are however producing both commodities and high value niche products and are producing for both local and external markets.

The "Arctic as a Food Producing Region"- project will examine the possibility for increased harvesting and production in this area of marine, agricultural, and wild life resources that are produced locally. Satisfying the demand for safe, healthy and nutritious foods for both local and southern markets could be a unique economic opportunity.

Food production in this region is however associated with some challenges. The food producers are often faced with challenging environmental conditions, poor and/or costly infrastructure, limited entrepreneurial capacity and qualified labor and long distance to export markets. Climate change is also creating additional uncertainties for commercial and subsistence food production systems. Climate change is stated to be a driving force for increased food production in the Arctic, but climate change does not in itself cause increase in food production or value-adding. It just provides the opportunity for development. The effects of climate change must therefore be assessed together with other driving forces like market conditions and infrastructure, as well as the social and business conditions for the industries or productions.



Fisheries and agricultural village in Lofoten, Norway ©Nofima

A comparative project involving the Arctic states can provide useful insight into common challenges as well as examples of successful product developments of foodstuff/species. The questions we raise are:

1. What is the status and what is the potential for various food productions in the Arctic?
2. What are the added value of these products when marketed by their special qualities and unique origin?
3. What conditions are important to further develop the Arctic as a food producing region?
 - a. How can production be increased and how can new species and products be developed?
 - b. How are the market conditions for adding value or branding the "Arctic" at local, national and international markets?
 - c. What role does industry structure, infrastructure and organization of different value chains and industry policy play for the potential development?
 - d. What role do local cultural values have for the development of new food products and new local markets?

Based on knowledge of the present production and established "Arctic" niche products the project will explore and describe possible paths of development for arctic food production. Food production in and for indigenous communities will be emphasized in the areas/countries where this is relevant.

The project will operate at two levels of analysis. On a macro level we will study the driving forces affecting the food-producing actors and industries (biological, business, cultural and market conditions). At a micro-level we will study selected successful cases to highlight possibilities and challenges, with a special focus on production for local consumption and on products marketed by "Arctic origin". This report is the output from the first phase of the project, where we have examined the status of various food production systems in the Arctic countries.

1.1 Organization of the report

We have decided to focus on the primary industries: fisheries/aquaculture and agriculture, including herding, hunting and gathering, which is significant in some areas. Each partner has selected a number of food value chains in their respective country, highlighting the most important and characteristic products from their regions.

In the presentation, we distinguish between primary-, secondary- and tertiary production. *Primary production* is used to denote fishing, hunting and gathering, as well as production, farming and growing of raw material including harvesting, milking and livestock production before slaughter. The main character of the product is not changed. *Secondary processing* includes slaughtering, processing, packing and transport of a product/ raw material from primary production. This includes adding some conservatives (salt, sugar), drying, freezing etc. It includes production of a raw-material for a more value added product. *Tertiary production* is used to denote processing that significantly changes the product, by adding other ingredients and produce a consumer ready- and value added product. See Figure 1 for an illustration of the food value chain.

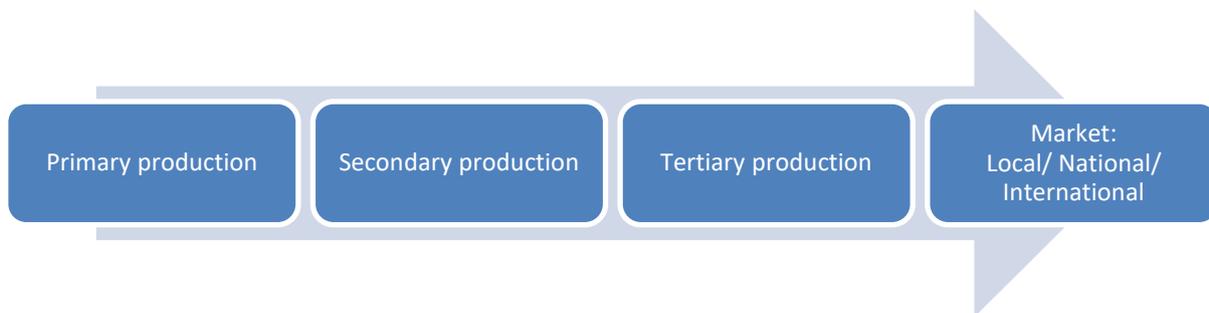


Figure 1 The food value chain

The report provides a description of the main food production and conditions for food production in the Arctic areas of the countries involved. The project includes Canada, Iceland, Greenland, Norway, and Russia. Each partner has delimited their study area according to what seems relevant to the discussion of Arctic food production in their country and resources at hand. Hence, Canada includes their northernmost provinces (Yukon, Northwest Territories, Nunavur, Labrador and the northern part of Quebec), Norway includes the three northernmost counties (Nordland, Troms and Finnmark), Russia includes the Yamalo-Nenets Autonomous Okrug, while Greenland and Iceland include the entire countries.

For each country the industry structure with key figures of production and prices, as well as value creation is described for selected food segments or productions, indicting the importance for the local communities or region. When available, information about local consumption is provided, as well as information about production for national and international markets. Further, the logistics to the different markets are accounted for. The report also considers key strengths, main opportunities and challenges for future development of selected productions. The information is provided in templates, followed by an explanatory text for each production.

2 Food production in Greenland

Greenland, Kalaallit Nunaat, is the World's 12th largest country. With its more than 2 600 kilometers from north to south it corresponds to the distance between Copenhagen and Istanbul. As 81% of the country is covered with ice, only the coastal area is habitable. This huge country is thus divided into a mere 5 municipalities, which is home to less than 56 000 people in total. Approximately 80–90% of Greenland's population is Greenlandic Inuit (Kalaallit), while the rest is Danish or other. Due to declining birth rates and emigration, primarily to Denmark, the population is slowly but steadily declining. A prognosis has predicted that the number of inhabitants in Greenland will be only 54 000 in 2040. Today, almost 18 000 people live in the Capital of Nuuk. The rest of the population live in towns and villages or settlements, mainly along the west coast.

Rules and regulations

Along with the Faroe Islands, Greenland is part of the Danish Realm and the Danish monetary and exchange union. The country has its own national flag and Greenlandic is the official language with close to 90% of the population being people born in Greenland. In this respect, Greenland differs from other countries/territories in the Arctic, since it does not have an indigenous population. In 1979, Greenland achieved home rule, and 30 years later in June 2009, a bill on self-government was passed. Since then, Greenland has taken over the jurisdiction of areas, including health, education, resource management, as well as legislation pertaining to food production for the Greenlandic national market. Greenland is not part of the EU as it withdrew from the union in 1985 following a referendum in 1982. The GDP is approximately 2 billion Euros.

Main food producing industry

The largest industry in Greenland is the fishing industry; 90% of the country's export arriving from fish. Excluding the public sector, it is the industry in Greenland that employs the most people. Fishing is divided into off-shore and coastal fisheries. The coastal catch is landed in Greenland in local factories situated in many towns (but not all) towns and villages, particularly on the west coast. Off-shore catch is processed on board the large vessels and shipped directly for export via Denmark. Greenland has the legislative power with regard to the fisheries sector. Fishing for Polar prawn and Greenlandic halibut and other species is regulated by quota and license regulations determined by the government on the advice of the Greenlandic Institute of Natural Resources, located in Nuuk.

Greenland has a select number of bilateral agreements that relate to fisheries with neighbouring countries. The European Union Partnership Agreement is a fisheries agreement in which the EU provides ca. EUR 17 847 000 for the right to fish in limited amounts within the EEZ of Greenland. In addition, Greenland has several joint agreements with Iceland, Norway, Russia and the Faroe Islands to exchange quotas. For example, Norway is granted access to fish cod in Greenland, as well as Greenland halibut and capelin and in exchange Greenland is authorized a quota for cod, saithe and haddock, which are customarily fished in the Barents Sea. No international fishing agreements exist between neighbouring North American countries such as the United States and Canada. However, Canadian vessels are authorized to offload catches in Greenland for export to EU markets by way of Denmark.

Greenland is also a member of the North Atlantic Fisheries Organization (NAFO), the International Committee for the Exploration of the Sea (ICES) and North East Atlantic Fisheries Commission (NEAFC). Additional government-affiliated intuitions that are involved in fisheries sector of Greenland

include the Greenland Institute of Natural Resources (described above) and the Greenland Fisheries and License Control (GFLK). GFLK is responsible for the regulation, enforcement and surveillance of Greenland's inshore and offshore fisheries. Its regulations are built upon the Danish system and largely mirrors EU regulatory frameworks and practices, with few exceptions.

Food security

Subsistence hunting and fishing activities continue to play a crucial role in the procurement of local food resources throughout Greenland; the fishing industry mainly providing the economic viability of the villages and households to do so. Defined here by Availability, Access and Utilization, the level of food security is generally high, although it should be noted, in different ways. Not all areas in Greenland have access to the same kind and amount of food; this is particularly the case with locally and traditionally sourced foods. In some areas (especially the capital and the larger towns cities) access to food relies heavily on import, mainly from Iceland and Denmark. In recent years, the case has been made that food security in the Arctic should include a fourth leg: knowledge; which relates to traditional means of the procurement and treatment of food, as well as to knowledge about the weather, and navigating the landscape, all of which are intertwined with identity and the fabric of society. Others have raised concerns that food security should focus on health issues relating to the quality of food; the extent to which imported foods are actually nutritious and healthy, and conversely, the extent to which arctic sea mammals (crucial to the Inuit diet), are polluted.

On the national level, there are rather strict rules regarding veterinarian and hygiene control. Among the challenges regarding food production is the lack of infrastructure. There are no roads connecting the towns and cities of Greenland and this means, that all goods must be transported by boat or airplane. Considering the harsh climatic conditions and huge distances between populated areas, the lack of infrastructure could pose a threat in the future as Greenland moves towards food sovereignty.

Public and private support to develop food production and industries

The public sector in Greenland is large, even compared to the Scandinavian countries. Out of a total of 26 000 people employed in Greenland, more than 10.000 were employed in the public sector in 2015. In order to secure the provision of basic services to the people living in remote areas, the Self Rule government owns and runs almost all large companies in Greenland, including air transport, shipping and food production.

The largest food producing company – Royal Greenland – is owned by the Government and provides approximately 1 400 jobs in Greenland. Another major player in the food industry is Kalaallit Niuerfiat (KNI A/S) – the trade company owned by the Government. This company provides 1 000 jobs in total in Greenland and the company tends to both food shops in all of the Greenlandic villages as well as the slaughtering/processing company, Neqi A/S and several other non-food companies.

The Self Rule Government also supports private business developing and has created the business developing units *Greenland Business* (GB) and *Venture Greenland* (VG), designed to support entrepreneurship within all sectors. GB provides general business guidance and financial support or guidance in order to transform innovative ideas into reality. GB administrates the Government of Greenland's innovation funds. In 2016, *SIUA Inuvation* (SI) was established as a 3-year initiative from the Ministry of Business, Labour and Trade. SI is an incubator which helps both aspiring and established companies in all areas, including the food producing sector. SI offers mentoring, seminars, workshops

and individual counselling. In addition to these initiatives, the Government has also commissioned a number of research reports on the development of new food producing initiatives.

The Business councils of the Municipalities are also active in developing the food sector. Among the initiatives are yearly food festivals in Nuuk and South Greenland. Together with the University of Greenland and other partners the Business Council of Sermersooq (the largest Municipality in Greenland) is planning to establish a test-kitchen to be used by food entrepreneurs and a national food-cluster is also well on the way. Being a part of the Kingdom of Denmark, Greenlandic companies are also invited to participate in export initiatives initiated by the Danish Government.

Main possibilities and challenges

The possibilities and challenges for the development of the Greenlandic food sector are closely intertwined. The two dominating challenges are the poor infrastructure and the lack of skilled labour which makes it difficult to increase the volume of production and also impacts the prices because both national and international logistics is expensive. However, even though the amount of food produced (other than non-processed fish) remains relatively small, the quality is often high and the storytelling about pure and sustainable production of food with an almost 100% focus on wild food resources holds a potential. Even though exports might be challenging, an increase in tourism with a focus on Arctic gastronomy might increase sales and the value of locally produced quality food - simply by bringing people to the food instead of the other way around.

The movement of resources also poses a challenge, especially to the economy of the local communities where the disappearance of a fish resource, means closure of the fish factory, and subsequent depopulation. In recent years, the decrease in exports of halibut and prawn, fortunately has been offset by the international increase in prices, thus not causing harm to the Greenlandic economy.

2.1 Halibut from Greenland

Industry description

Primary: Dominated by 2 large international companies - Polar Seafood, Royal Greenland - and 1 smaller, locally based company - Halibut Greenland - who also exports to the international market. Five off-shore vessels and a wide range of smaller coastal vessels.

Secondary: 7 land based factories are processing halibut in Greenland. Mainly frozen filets and J-cut.

Tertiary: Smoked. Very little, local production. Currently no export. Smoked halibut is produced and sold in/from Denmark in relatively small amounts.

Key figures

34 431 tons landed in Greenland
Living weight

First hand value of
631 million DKK

42 019 tons caught in total
Living weight

A volume of 39 thousand tons is exported, with a value of 1 billion DKK

Accounts for ca. 30% of all of Greenland's export

Average price per kg in 2016:
149 DKK

Key strengths

High production and market share. Royal Greenland alone sits on 25% of the world market on halibut - Greenland production of halibut constitutes 1/3 of the world production.

Sustainable production - the halibut fishery is MSC certified.

No aqua farming. Wild catch means no antibiotics.

Massive interest from the Asian market. Few substitutes for halibut.

Local

Local value/value creation

3 500 employed in the fishing sector

2 100 employees in large fishing companies

Approx. 1000 employees directly occupied in processing

Tertiary processing is mainly done outside of Greenland.

Customer segments/markets

National and international market. Most of the whole, frozen halibut goes to countries outside of the EU (85% – 2016).

China, Vietnam and Taiwan were largest consumers. The 3 countries thus equaled 75% of the export value and 80% of the amount.

Logistics

Almost all halibut is sold as frozen fish and transported by boat. All export goes through Denmark.

Locally snowmobiles and dogsleds are used for ice-fishing (long-line) and transports in the north.

Main challenges

Declining halibut stocks and quotas are larger than advised by researchers.

The fish is typically sold as whole and frozen fish due to logistical/infrastructural challenges and lack of labor.

Long distance to high-paying markets in Asia.

Main Opportunities

Higher education, making local processing possible. Bettering of the infrastructure will increase possibilities of freight of fresh fish to the global market.

Marketing and branding of the special Greenlandic long-line fishery by dog-sled might add value.

Halibut accounted for 29% of the total exports in 2015². Fisheries accounts for 95% of all export. The countries importing the most Greenland halibut are China and Japan. In Asia, the fish is considered a delicacy and Japan especially uses special cuts for sushi, including frills – the meat located just above the fins. Exports to China mainly consist of whole fish, but also heads, tails and frames, which are valued soup ingredients. One of the main markets for fillets and loins is France, whereas the Greenland halibut is mostly consumed smoked in Scandinavia and the Benelux countries, especially in Belgium where it is a part of a popular regional dish. A lot of Greenland halibut is also imported by Germany, which has a lot of smokehouses. The high fat content of the Greenland halibut makes it great for smoking, as the fat absorbs the smoke flavour well and makes sure that the fish does not go dry.

The fishing and processing of halibut is dominated by three companies: Royal Greenland, owned by the Government of Greenland and privately owned Polar Seafood and Halibut Greenland. The latter was established in 2008 and is based in Ilullissat, in the northern part of Greenland. The company employs 71 people in Greenland³. Polar Seafood, established in 1984, employs 900 people in several countries with two land based factories in Greenland. Royal Greenland owns 6 halibut processing factories along the West coast of Greenland. The factories employ approximately 350 people during the high season.

There are three main obstacles to growth for the halibut market. Lack of stable and skilled labour constitutes a substantial challenge for growth. The fish factories of both Royal Greenland, Halibut Greenland and Polar Seafood regularly suffers from lack of stable labour⁴. Especially for the smaller factories this means, that they are not able to do anything but primary processing of the fish i.e. cutting off the head and the tail. The consequence is that the potential added value of processing the fish locally is lost. The second impediment to growth is the risk of over-fishing. Biologists' at the Greenland Institute of Natural Resources has recently warned about the risk of over-fishing in-shore. The biologists' have noted, that the halibut in the in-shore fishing areas is getting smaller and this indicates a possible over-fishing. The third substantial challenge to growth is the lack of infrastructure. Trade takes place almost exclusively through Denmark, namely through the port of Aalborg, where Royal Arctic Line, the Government-owned shipping monopoly has its Danish port. All goods coming in and out of Greenland that travel by ship must be carried by Royal Arctic Line. Greenland's capacity to expand trade is thus currently limited by the shipping monopoly, despite markets for its fish products being strong in nearby countries. It is national policy to increase taxes levied on unprocessed fish that is exported, the goal of which is to augment employment opportunities on land and in turn to grow the country's post-harvest sector⁵.

² Greenland Economic Council 2015, <http://naalakkersuisut.gl/~media/Nanoq/Files/Attached%20Files/Finans/DK/Oekonomisk%20raad/GØR%202017%20rapport%20DK.pdf>

³ Numbers from 2016. Source: The Danish Database of Industry (BiQ).

⁴ Regularly reported through Greenlandic media, <https://knr.gl/da/nyheder/38-kinesere-rykker-ind-p%C3%A5-fiskefabrikker>

⁵ Food and Agriculture Organization of the United Nations, Fisheries and aquaculture department, <http://www.fao.org/fishery/facp/GRL/en>

2.2 Cod from Greenland

Industry description

Primary:

Dominated by 2 large international companies, Polar Seafood and Royal Greenland. Both own their own cod-fishing vessels and operate in Greenland waters as well as the Barents Sea.

Secondary:

5 land based factories are processing cod in Greenland. Mainly frozen fish and filets.

Tertiary:

A wide range of products and product development for both individual customers and restaurants. Both development and processing is mainly done outside Greenland.

Key figures

40 340 tons landed

Living weight

First hand value of

196 million DKK

56 340 tons caught in total

Living weight

A volume of 23 thousand tons is

exported, with a value of 384

million DKK

Average price per kg in 2016:

135 DKK

Key strengths

No aqua farming. Wild catch means no antibiotics.

The cod is a lean fish and thus "healthier" than salmon.

The slow growth-rate of the cod, due to the cold climate makes the fish firm and tastier than other types of cod.

Cod caught in the Barents Sea has been MSC certified since 2015 (but not the Greenlandic part).

Local value/value creation

3 500 employed in the fishing sector

2 100 employees in large fishing companies

Secondary:

App. 200 employees. Much of the cod is processed on board the vessels.

Tertiary:

Salted cod is produced in Greenland for the Icelandic and Spanish market.

Customer segments/markets

Sold all over the world. Great Britain, USA, Spain, Portugal and Sweden are the largest markets.

Logistics

Small boats catch fish every day. Most cod are caught close to land by smaller boats. The fish is landed at factories on the West Coast of Greenland. Transport to markets mainly by boat.

Main challenges

The prices for cod are lower than for halibut. The biomass is still far from the level of the '60'ies.

Main Opportunities

Nutaaq Cod is processed in Maniitsoq in West Greenland. It is a new production method, bringing live cod to the factory and constitutes an example of successful product development.

More local processing and branding of geography like the shrimp market.

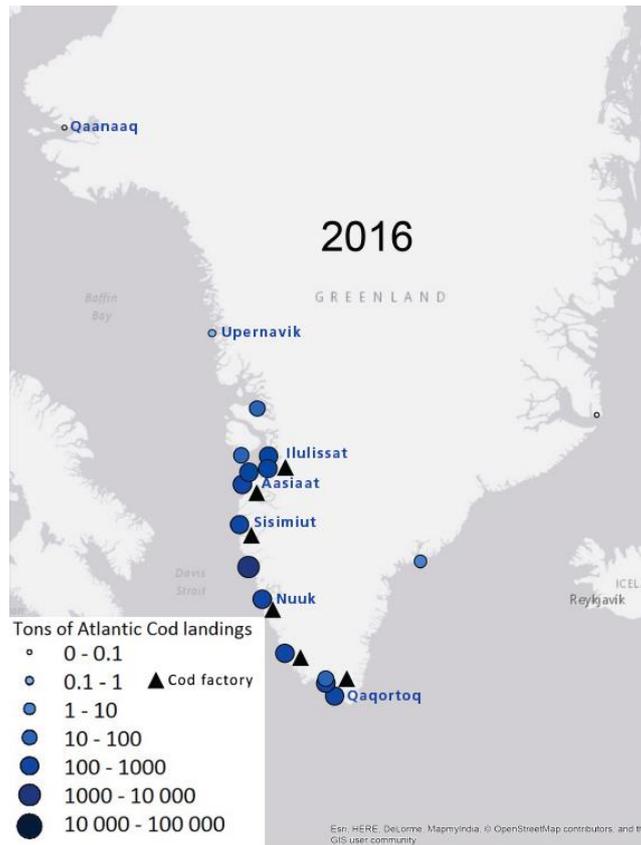


Figure 3 Landings of cod and cod processing factories

Atlantic Cod

The Greenlandic cod is known for its taste and quality. There is no aqua-farming in Greenland and all fish from Greenlandic waters can thus be marketed as clean and free from any medical treatments.

During the 1950'es and 1960'ies the cod fishery in Greenland experienced an absolute high with 300 000–400 000 tons of cod fished every year⁶. However, due to over-fishing and climatic changes, the cod almost disappeared during the 1970'ies. Since then, the cod fishery has been carried out at a relatively low level. In the 2000's the cod fishery has picked up and reached a somewhat stable level of 10–15 000 tons a year in average. In 2016, the level peaked so far with a production of 40 000 tons. The Greenlandic cod is sold all over the World. Great Britain, USA, Spain, Portugal and Sweden are the largest markets.

The cod fishery and production is dominated by 2 large international companies: Polar Seafood which is a quite large, private company and Royal Greenland which is owned by the Government of Greenland. Both companies own their own cod-fishing vessels and operate in Greenlandic waters as well as the Barents Sea. Large vessels, of which there are few, catch cod, haddock and saithe in the Barents Sea. A number of smaller vessels do their cod fishing in the Barents Sea as well. This catch is processed in Norway. Fishing is done both close to the coast and as off shore sea-fishing. Although subsistence, small-scale fishing vessels are not counted as part of national fleet statistics, the regulatory body, Greenland Fisheries and License Control (GFLK), estimate the fleet size of small-scale

⁶ Statistics Greenland, Statistical E-book, 2017.

fishing vessels to be approximately 1 500 and growing. With conservative estimates, the small-scale fishing fleet of Greenland is over five times the number of the registered vessels⁷.

The processing of cod takes place both off shore, internationally and at 5 land based factories employing approximately 200 employees in Greenland. The factories based in Greenland mainly produces frozen fish and filets and only a limited amount of processing is taking place within Greenland⁸. Much of the cod is processed directly on the vessels or abroad. Today, much of the current product development for both individual customers and restaurants is taking place outside Greenland. This poses an obstacle to growth and the added value that would come from processing the fish in Greenland.

There are three realistic ways to increase profits from the cod: Product development, further processing within Greenland in order to create more jobs and an increase in the use of waste products from the cod.

Some product development is already taking place and Royal Greenland is especially active in trying to develop new and commercially interesting products. An example is the production of the so-called *Nutaaq* (in Greenlandic, nutaaq means new) Cod which is processed in Maniitsoq in West Greenland. The Nutaaq Cod is a new production method, where the local fishermen set their nets and transport the live cod to the factory without taking the fish out of the water. Once at the factory, the net is opened and the cod swims into a basin, where they are kept in a stress-free environment until the factory is ready to process them. This shortens the delay from time of the catch to the processing of the fish. The fish is processed and turned into fillets within a maximum of 2 hours and this method ensures the preservation of the fresh taste of the meat.

The main challenge for growth regarding further processing and product development is the lack of a stable and skilled work force⁹. In Greenland, the law requires Greenlandic labour to be used unless there are documented and valid reasons not to¹⁰. Even though the large companies have their own training programs, in recent years, both Royal Greenland and Polar Seafood has resorted to hiring labour from other countries for their fish factories in Greenland because they are not able to find enough skilled labour locally¹¹. Regarding the use of waste and bi-products, an ongoing research effort to minimize waste and thus optimize profit is also taking place under the auspices of both Royal Greenland and Polar Seafood¹².

⁷ Food and Agriculture Organization of the United Nations, Fisheries and aquaculture department, <http://www.fao.org/fishery/facp/GRL/en>

⁸ Based on information from Royal Greenland and Polar Seafood websites.

⁹ <http://sermitsiaq.ag/flere-udlaendinge-vej-fiskefabrikkerne>

¹⁰ <http://lovgivning.gi/lov?rid={4A9A8F73-839E-428C-B004-A515468B4603}>

¹¹ <http://www.fiskerforum.dk/erhvervsnyt/a/groenlandsk-fiskeindustri-efterlyser-udenlandsk-arbejdskraft-07032018>

¹² <https://www.royalgreenland.com/royal-greenland/sustainability/planet/> and "Nordic Bioeconomy. 25 cases for sustainable change".

2.3 Prawn from Greenland

Industry description

Primary:

Dominated by 2 large international companies, Polar Seafood and Royal Greenland.

Royal Greenland owns 3 large prawn trawlers and 2 smaller trawlers. Polar Seafood also owns trawlers.

Secondary and tertiary:

4 land based factories. Prawns are cooked, peeled and frozen. Parts of labelling and repacking takes place at factories in Denmark. One factory in Ilulissat produces flour made of prawn for human consumption.

Key figures

42 600 tons landed

Living weight

First hand value of
400 million DKK

75 000 tons caught in total

Living weight

A volume of 50 thousand tons is exported, with a value of 1,5 billion DKK

Export of prawn accounts for 45% of the value of all fish export

Average price per kg: 202 DKK

Key strengths

High production and market share. 20% of the world market on cold water shrimp.

Sustainable production - the shrimp fishery is MSC certified.

High standards of hygienic control and quality control.

No aqua-farming. Wild catch means no antibiotics.

High demand.

Local value/value creation

3 500 employed in the fishing sector
2 100 employees in large fishing companies.

Royal Greenland: 5 prawn trawlers (ca 100 employees). Polar Seafood: Ca 20 large and small vessels in total.

A minimum of 25% of the catch must be processed in Greenlandic factories.

Tertiary processing mainly outside of Greenland.

Customer segments/markets

Sold all over the world. Main market is the EU with app. 65%. Export goes through Denmark.

Logistics

The prawns are either processed, frozen and shipped directly from the trawlers or they are processed at the land based factories. From there they are shipped to Denmark, where they are either repacked at Danish factories or directly re-exported.

Main challenges

The shrimp fishery has been challenged by a fluctuating world market.

Lack of skilled labor in Greenland poses a problem.

Main Opportunities

Bettering of the infrastructure will increase possibilities of freight of fresh fish to the global market.

Royal Greenland is now marketing shrimps from specified localities in Greenland. This type of geographical segmentation could be one way to add value to the product.



Figure 4 Landings of prawn by the ton and location of prawn processing factories in Greenland

Prawn

The prawn is by far the most important species and source of revenue in the Greenlandic food producing system. In the beginning of the 1970'es the Greenlandic prawn fishery was at a relatively stable level with landings of between 8 000–10 000 ton. Mid 1970'es the off-shore prawn fishery began and since then the catch of prawn has steadily increased, taking over the role of the cod as the most important resource. In 2016, the total catch of prawn including both coastal and off-shore fishery was around 81 000 ton. Landings of prawn in Greenland was at 42 600 tons, in 2017 a bit less.

The biomass of prawn is increasing and as a consequence the TAC (total allowed catch) was raised in 2018 from 90 000 tons to 101 250 tons.

The prawn production is dominated by two large, international companies: Polar Seafood which is a privately-owned company and Royal Greenland, owned by the Government of Greenland. Royal Greenland owns three large prawn trawlers occupying a total of 75 employees and two smaller trawlers occupying a total of 20 employees. Polar Seafood also owns trawlers. Most of the processing of prawn is done on board the large vessels. Here the prawns are cooked and exported directly via Denmark. A proportion of prawn product is sold raw with minimal processing to high-end markets in Japan and some for human consumption as well as for industrial purposes in overseas markets. Capacity of some of the largest vessels can exceed 10 000 tons¹³.

¹³ Food and Agriculture Organization of the United Nations, Fisheries and aquaculture department, <http://www.fao.org/fishery/facp/GRL/en>

In 2015 prawn accounted for 43% of the total exports of fish products¹⁴. The prawns are sold all over the World. The biggest market is the EU - accounting for approximately 65% of the sales. Sweden, Norway, Great Britain and Italy are among the main markets.

There are four land-based prawn factories along the Greenlandic West coast, employing xx people. Here, the prawns are cooked, peeled and frozen. Parts of labelling and repacking takes place at factories in Denmark. One factory in Ilulissat produces flour made of prawn for human consumption.

Among the challenges for growth are the lack of infrastructure and lack of skilled labour. The fish factories of both Royal Greenland, Halibut Greenland and Polar Seafood regularly suffers from lack of stable labour. Trade takes place almost exclusively through Denmark, namely through the port of Aalborg, where Royal Arctic Line, the Government-owned shipping monopoly has its Danish port. All goods coming in and out of Greenland that travel by ship must be carried by Royal Arctic Line. Greenland's capacity to expand trade is thus currently limited by the shipping monopoly, despite markets for its fish products being strong in nearby countries. It is national policy to increase taxes levied on unprocessed fish that is exported, the goal of which is to augment employment opportunities on land and in turn to grow the country's post-harvest sector¹⁵.

¹⁴ The Greenlandic Economic Council Report 2017, <http://naalakkersuisut.gl/~media/Nanoq/Files/Attached%20Files/Finans/DK/Oekonomisk%20raad/GØR%202017%20rapport%20DK.pdf>

¹⁵ Food and Agriculture Organization of the United Nations, Fisheries and aquaculture department, <http://www.fao.org/fishery/facp/GRL/en>

2.4 Musk Ox from Greenland

Industry description

Small industry based on catch of wild musk ox. Catch is fluctuating. In 2017 no meat was sent to neither Lilleholm or Neqi A/S for slaughtering.

Primary and secondary:
2 main slaughtering/processing companies: Neqi and Lilleholm.

Tertiary: 4 companies with a total of 15 localities.
Smoked, consumer packed, sausages, pizzas. Small segment/volume processed by Brugseni, Pissifik and Lilleholm. Mainly for domestic market. Restaurants and hotels are takers of musk ox meat when available.

Key figures

Reported catch of 2 000–2 500 animals per year
46 tons slaughtered at Neqi
Slaughtered weight

Value of 1,2 million DKK
First hand value

Exact export figures are unknown. Extensive subsistency hunt. Some sale "on the side" via webpages and mouth-to-ear.

Tertiary production:
Mainly for domestic market. Sale for restaurants.

Key strengths

Low feed factor

Sustainable production:
Strict quotas.

Organic - no use of antibiotics

High quality meat with a touch of "exotic".

During the latest years, the company Lilleholm has developed a popular range of high quality processed musk ox products (sausages, dried meat, pizzas)

Local value/value creation

App. 150 employees in slaughter facilities.

2106 commercial hunters' licenses. Related to the tourism industry and restaurants.

Customer segments/markets

Mainly domestic and door-to-door sale for tourists/Greenlanders visiting and wishing to bring home meat (up to 10 kg allowed).
High-end national restaurants.

Logistics

By boat to the bigger cities.
ATV's are used to transport the meat from the hunting area but it is not allowed to use them during the hunt.

Main challenges

Lack of infrastructure.
High taxes on electrify for Neqi
Small amounts of meat make production and processing unprofitable.
Unstable deliveries. Regulations on speed of ATV's poses a challenge to transportation of meat to slaughterhouse within 8 hours of the time of kill.

Main Opportunities

Room for development of gastronomic industry.
Local niche products for selected markets.
Farmed musk ox might be a possibility in Qeqqetta Kommunia if current plans to build a road between Sisimiut and Kangerlussuaq are carried out. The road will give access to the back-country and thus provide opportunities for growth.



Figure 5 Overview of main catch areas of musk ox and reindeer

Musk Ox

The Musk Ox has its natural habitat in North and North East Greenland and has always been hunted by the local population. It was introduced to West Greenland in 1962 when 27 calves were moved from East Greenland to Kangerlussuaq in West Greenland. Musk Ox is thus a rather new food resource in the more populated areas of Greenland.

The meat is renowned for its taste and high quality. It is popular both for local consumption and as part of the repertoire at the high-end restaurants in Greenland. The musk ox meat is thus also related to the tourism industry and is marketed as a Greenlandic specialty. This market could probably be further developed as many tourists are keen on trying out Greenlandic food specialties and many also wish to buy meat and take it home. This is currently not possible - or at least difficult - as it is often not possible to buy musk ox meat in Kangerlussuaq where the international airport is located. Some processed musk ox products such as dried meat and sausages can be bought at the supermarkets in Nuuk, but fresh or frozen meat is difficult to find and - if available - it is not packaged in a "tourist friendly" manner. There might be a potential in advertising sales of musk ox meat to tourists, but it requires official selling points at the international airport and a stable delivery of meat, which is currently not in place.

The export of meat in general is currently very limited (500 000 DKK in 2016) but outside the official export a private export is also taking place. It is currently allowed to export 10 kg of Greenlandic food for non-commercial consumption to a recipient outside of Greenland. Quite a few hunters sell the meat directly to the consumers or to the restaurants. This makes it difficult to know the exact local value of the hunters' direct income from meat sales which are most likely somewhat higher than the official number which was estimated to be 1,2 million DKK in 2016.

There are no domesticated Musk Ox in Greenland. All meat comes from hunt of wild animals, mainly in the area of Kangerlussuaq and Sisimiut (see map). The meat production is fully organic and the quotas are set from a conservative estimate to keep the hunt sustainable. Hunt for commercial food production is carried out by professional hunters but there are also a substantial number of hunters holding a leisure hunt license, providing themselves, family and friends with meat.

As for lamb, sheep and reindeer, the slaughtering and processing of musk ox meat takes place at Neqi A/S which is owned by the Government of Greenland. Some processing also takes place at the company Lilleholm - a private company which has been quite successful in making new food products based on musk ox meat. Sausages for barbecuing, frozen pizzas, burgers and dried meat are among the delicacies produced by Lilleholm. The supermarkets - Brugseni and Pisiffik both distribute and process musk ox meat in small volumes. The meat will often be smoked or dried.

Landings of musk ox meat has been very fluctuating due to the fact that it has not always been possible for the production facilities to obtain a license. In 2017, no meat was landed at Lilleholm and this will also be the case in 2018. There are several reasons behind this decision: The elevated prices of freight are an important factor. It is also a challenge that electricity prices are much higher for production of land mammals than fish. Electricity for fish production is subsidized by the Government whereas electricity for land mammal production facilities is not. This contributes to a distortion of the competition between fish production and land mammal production. Third, there is a logistical/veterinarian challenge: Today, when a musk ox has been shot, it is transported by ATV to the slaughterhouse. Historically this was done by dog sleds and, more recently, by snow mobile, but climate change has made this type of transport very difficult. The snow cover in the hunting areas is often not enough and very unstable. According to Danish legislation, ATV's are not allowed to go by more than 30 kilometers per hour. Given the large distances and the huge hunting areas these rules make it next to impossible to comply with the veterinarian rules, saying that the musk ox meat should be landed at a slaughterhouse within 8 hours after killing the animal.

A way to secure stable delivery and solve the problems related to the hunt of wild animals in terms of veterinarian rules and infrastructural problems might be musk ox farms. A group of people in Sisimiut has been looking into the possibility of establishing a musk ox farm in the area. This would be made possible if the Municipality's plans of constructing a road between Sisimiut and Kangerlussuaq are carried out. The road would open up the back-country and it would make it easier and faster to transport meat to Kangerlussuaq and thus make it realistic and feasible to sell fresh, frozen and processed meat to the international guests going out of Greenland and even to export meat to restaurants in other countries.

2.5 Reindeer from Greenland

Industry description

A small and rather local industry, based mainly on wild reindeer. A lot of local trade and many leisure hunters.

Primary and secondary:
3 main companies: Neqi, the slaughterhouse, Lilleholm (private company) and Isortoq Reindeer Farm in South Greenland.

Tertiary: 4 companies (a total of 15 localities) produce smoked, sausages, dried meat processed by Lilleholm, 7 Brugseni and 6 Pissifik.

Key figures

350 tons caught:
2 tons wild
25–30 tons farmed
Slaughtered weight

Rather large and underreported catch and sale of wild reindeer for private consumption is taking place.

First hand value of 144 thousand DKK

A total volume of 20–25 tons
Estimated exported

Tertiary production:
Mainly for domestic market.

Key strengths

For wild reindeer:
Low feed factor
Low use of antibiotics
Renowned for its taste.

Local value/value creation

App. 150 employees in slaughter facilities.

2106 commercial hunters' licenses. Related to the tourism industry and restaurants.

5077 leisure hunting licenses.

Many license holders sell directly to restaurants and hotels. This is not officially registered.

Customer segments/markets

Export to Canada, Iceland and EU of farmed reindeer meat.
Small export to EU countries.

Private export of meat to friends and relatives in Denmark (up to 10 kg per sending is allowed)
A large national market of non-registered trade.

Logistics

By boat to the bigger cities.

ATV's are used to transport the meat from the hunting area.

Main challenges

Lack of infrastructure. High taxes on electricity for Neqi compared to fish factories.

Vet-rules on smoked meat is a barrier to product development.

Insecurities about the actual number of wild reindeer due to under-reporting from hunters.

Unstable supply.

Main Opportunities

Local niche products for selected markets.

The combination with an increasing tourism industry holds possibilities for sale of processed meat and for the restaurants.

Development of exports possible but requires more systematic approach and stable supply.



Figure 6 Overview of main areas for hunting and farming of reindeer

Reindeer

Production of reindeer-meat in Greenland is mainly based on catch of wild reindeer. The meat and processed products are almost solely for domestic consumption. There is little to no export of wild reindeer meat. The number of leisure hunters is rather high and there is a substantial amount of subsistence hunting and local trade going on. The official numbers regarding local value creation are probably underestimated and the number of wild animals being killed is underreported. The quotas are thus based on a very conservative estimate.

In the past, there has been reindeer farming close to Nuuk but today the only reindeer farm - the Isortoq Reindeer Farm - is located in South Greenland. The farm produces approximately 20–25 tons of meat per year. The meat is exported to mainly Canada and Iceland. There is also a small export to the EU countries.

As for lamb, sheep and musk ox, the slaughtering and processing of wild reindeer meat takes place at Neqi A/S which is owned by the Government of Greenland. The farmed meat is slaughtered and processed by Isortoq Reindeer Farms' own facilities. Some processing also takes place at the company Lilleholm. The supermarkets - Brugseni and Pisiffik both distribute and process reindeer meat in small volumes. The meat will often be smoked or dried.

Among the challenges are the elevated prices of freight. It is also a challenge that electricity prices are much higher for production of land mammals than fish. Electricity for fish production is subsidized by the Government whereas electricity for land mammal production facilities is not. This contributes to a

distortion of the competition between fish production and land mammal production. Third, there is a logistical/veterinarian challenge: Today, when the reindeer has been shot, it is transported by ATV to the slaughterhouse. Historically this was done by dog sleds and, more recently, by snow mobile, but climate change has made this type of transport very difficult. The snow cover in the hunting areas is often not enough and very unstable. According to Danish legislation, ATV's are not allowed to go by more than 30 kilometers per hour. Given the large distances and the huge hunting areas these rules make it next to impossible to comply with the veterinarian rules, saying that the reindeer meat should be landed at a slaughterhouse within 8 hours after killing the animal.

The Greenlandic reindeer meat is renowned for its taste and high quality. It is popular both for local consumption and as part of the repertoire at the high-end restaurants in Greenland. The reindeer meat is thus also related to the tourism industry and is marketed as a Greenlandic specialty. This market could probably be further developed as many tourists are keen on trying out Greenlandic food specialties and many also wish to buy meat and take it home. This is currently not possible - or at least difficult - as it is often not possible to buy reindeer meat in Kangerlussuaq where the international airport is located. Some processed reindeer products such as dried meat and sausages can be bought at the supermarkets in Nuuk, but fresh or frozen meat is difficult to find and - if available - it is not packaged in a "tourist friendly" manner. There might be a potential in advertising sales of reindeer meat to tourists, but it requires official selling points at the international airport and a stable delivery of meat, which is currently not in place.

2.6 Potatoes from Greenland

Industry description

Very small production in South Greenland. Mainly family driven farms. There are 37 farms and approximately 8 are growing potatoes.

Primary and secondary:
A total of 1 100 ha is available for agriculture and to be shared with other crops.

Potatoes are sold directly to the distributors or to the distribution company Neqi A/S.

Key figures

100–111 tons produced/year
Corresponding to 10 ha

No current export.

Solely for domestic market:
2 kg/person/year on average.

No tertiary production.

In 2017 the potatoes were sold by the producers to Neqi A/S at 10 DKK/kg.

Key strengths

Low disease rate - potato-fields can be reused year after year without being infected by potato blight.

Organic production - no pesticides.

Taste and high quality.

Local value/value creation

8 farmers
1 living solely from potatoes.

It is more often combined with sheep farming. Fluctuating yield means fluctuating income.

The current yield corresponds to 5-8% of Greenlandic consumption.

Customer segments/markets

Local, Greenlandic market.

The high-end Greenlandic restaurants aiming for tourists.

Logistics

By boat along the coast to the bigger cities

Main challenges

Packing, storage and lack of infrastructure.
Imported potatoes are cheaper
High taxes on electricity for Neqi
Changes in weather leads to unstable supply.
Intensive focus on quantity can be detrimental to the quality of the product.

Main Opportunities

Expansion of land
Technology: Growing potatoes in a container
Sale of blight free potatoes
Neqi A/S is planning for better distribution and growth optimizing plans.
Gastro-tourism might also be a source of added value.



Figure 7 Overview of areas of potato and sheep farming (many sheep farmers are also potato farmers)

Potatoes

The Greenlandic potato production is very small. It is however still an interesting crop, being one of the only farmed crops for human consumption in Greenland to date. Potatoes has been grown in South Greenland for several decades. Thus, the potato represents both an actual value as a locally produced vegetable and a cultural/political value, since the potato represent the hope of being able to establish an actual production of vegetables, which might lead to less dependency on imports from Denmark.

Its slow growth due to the cold climate has so far guaranteed a better taste than the faster growing potatoes in other parts of the world. Additionally, the Greenlandic potato does not need crop rotation. It can be grown in the same soil every year without contracting any of the common potato-diseases, such as potato blight, which haunts most potato farmers in other countries. The Greenlandic potato production does not use any form of pesticides and is thus 100% organic.

The potato harvest amounts to an average of 110–111 tons per year. Over the years, the yield has been quite fluctuating but now seems to be stabilized. The harvest is sold mostly to Neqi A/S, which is the official slaughterhouse and landing place for vegetables. Neqi A/S is a sub-company to KNI (Kalaallit Niuerfiat), the Greenlandic Trade Company that supply the people of Greenland with groceries and also owns the supermarket Pilersuisoq. The company is owned by the Government of Greenlandic but is based on customer-driven requirements and local influence.

The amount of potatoes produced in Greenland corresponds to an average of 2 kilos per person per year and corresponds to 5–8% of the Greenlandic consumption. The Greenlandic potato is grown in South Greenland by approximately 8 farmers. So far only one farmer grows potatoes as sole

occupation. The rest of the potato-farming is done at the sheep-farms in the area. The farmed area is quite small but climate change and rising temperatures might make it possible to expand the potato farming area in the future. There is currently no export of potatoes, but it has occasionally been discussed whether export of the crop as disease free seed potatoes could become an interesting source of revenue for potato-farmers.

Currently, all of the Greenlandic potato harvest is sold at the domestic market. Some high-end restaurants in Greenland uses the local potato as an added value and part of the branding of their food.

As goes for all food production in Greenland, infrastructure and logistics poses a substantial challenge to the potato farmers. The potato harvest must be transported from South Greenland to other parts of the country by boat. In addition to the natural relatively higher cost of producing small amounts of potatoes it means that the cost of the locally grown crop is often higher than the cost of importing from Denmark. It is also a challenge to the market that Neqi A/S does not receive the same kind of subsidies on electricity as the fish factories. The means that the price of electricity adds to the price level.

A new type of challenge that the potato farmers have been facing is, that an intensive focus on volume has proven to impact the quality of the potato negatively. It has been claimed that the Greenlandic potato is losing its trademark taste and quality which makes it difficult to compete with the cheaper, foreign potatoes.

Growing potatoes in Greenland also holds opportunities. If the growth area is expanded as a result of climate change, the harvest could be augmented. Equally, research has suggested that new watering methods might be able to enhance the yield and technological development such as potato-growing in containers might also be a way to expand the harvest. Container-growing do however require access to cheap electricity. In the Nuuk area where electricity is relatively cheaper and there is access to hydropower, this should be a real possibility.

A better planning of the distribution also holds possibilities. Neqi A/S is focusing on this matter and the company expect to be able to optimize distribution in 2018 for the benefit of both local consumers and the potato farmers.

Finally, the use of the Greenlandic potato by Greenlandic high-end restaurants has a potential of added value. In 2017 restaurants in Nuuk, Ilulissat and Kangerlussuaq had a focus on local produce and these restaurants have proven to be able to attract the gastronomy-interested segment of both tourists and business tourists.

3 Food production in Iceland

The population of Iceland in January 2018 was 348 450 inhabitants. The capital, Reykjavík, and the surrounding areas in the southwest of the country are home to over two-thirds of the population. The northern regions of the country are sparsely populated and the population has been shrinking in the last few decades. Continued food production is a key to increasing job opportunities and fighting the decline of inhabitants in these areas. The northern regions offer many opportunities for increased regional food production and tourism, supporting the goal of increased sustainability and a reduced carbon footprint.

Main production

Food production in Iceland includes fish, meat, dairy products, eggs and vegetables. A portion of the vegetables and meat consumed in Iceland is imported. Fruits and cereals are imported, however a small amount of domestic barley is used for food.

Renewable energy sources, i.e. geothermal and hydropower, effectively provide all of Iceland's electricity. Geothermal energy is the basis of the production of greenhouse vegetables in Iceland. Electricity is used for illumination through the dark winter months and the 24-hour daylight during mid-summer is very important for vegetable production.

Export of fish and fish products are by far the most important export items from Iceland and are a considerable part of the economy. Cod is the most important species with a total catch of 260 thousand tons in 2016. Small amounts of lamb meat and skyr are exported as well. Meat, dairy products and fish are the key foods in the diet of Icelanders. The consumption of fish has decreased in Iceland over the last decades.

Challenge for food security

Iceland is mostly self-sufficient with dairy products and meat. However, the increasing number of tourists increases the demand for food. To satisfy this demand, Iceland must import food products. The tourism industry provides an opportunity for food producers to increase production and develop new products. Regional products are of particular interest to tourists and also help to increase sustainability and support local farmers. Vegetable production could be increased considerably, however there is import competition. Barley production in the country is 10–16 thousand tons per year. Only about 2% of the barley is used for food but this proportion could be increased.

Support to develop food production

There is a considerable interest among Icelanders to develop regional food products. This is obvious from responses when public support for product development has been announced. Matís – Icelandic Food and Biotech R & D, has established several food innovation centres at various locations in the country. Support from regional innovation centres has been a successful strategy for small-scale product development. The intention is to improve regional food production further and the Icelandic government is expected to increase funding for local and regional innovation all around Iceland. This is important, as small scale local and regional food producers and entrepreneurs need financial assistance in the early stages of food innovation.

3.1 Farmed Arctic char from Iceland

Industry description

Land-based farming at 25 companies.

Dominated by one company, Íslandsbleikja, producing about 3 000 tons.

3 companies are producing from 70–400 tons per year each.

The rest of the companies (21) are farms that have char farming as a by-occupation, aside other activities, producing 10–30 tons per year.

One specialized processing plant (Íslandsbleikja). Other producers either filet their production themselves or it is fileted at fish processing plants.

Key figures

4 000 tons produced per year.

Living weight

First hand value of 3 200 million ISK per year based on 800 ISK/kg

Living weight

Export volume of 3 400 tons.

Total value 2 400 million ISK
Chilled filets 590 tons of value 885 million ISK.

Product weight

Export prices and domestic prices 1 500 ISK/kg fillet.

Domestic consumption 1,8 kg per capita and year.

product weight

Key strengths

Plenty of water.

Optimal water temperature

Cost effective production.

Effective feed conversion to fish flesh.

Animal welfare and disease control.

Low use of antibiotics.

Cheap electricity.

Airport nearby.

Developed land based technology.

Availability of educated and experienced people.

Local value/value creation

70–80 people employed within farming per year.

30–40 people employed within processing per year.

Advantages for local community:
Rural job creation
Supporting industries

Customer segments/markets

Most of the production is exported as chilled filets. Largest markets are USA, UK & Norway for fresh whole fish but Poland for frozen fish. For fresh fillets the largest markets are USA, Switzerland and Germany.

The domestic market is also important, particularly for the small companies.

Logistics

Mainly transported by air, but part of the products shipped by sea (Europe).

Main challenges

Limited marketing in new markets.

High cost of investment in new land based production facilities.

Raw material availability for feed production.

Main opportunities

Opportunities for increased production in the Northern Regions.

Increased demand for seafood.

Local niche products for selected markets.



Figure 8 Locations of Arctic Char farming in Iceland

Arctic char farming in Iceland

The various arctic char farming operations are situated at different locations around Iceland (see Figure 8). All operations are land-based and use water that, according to EU's water framework, is classified as being of unique quality extracted from springs, boreholes and wells. One of the advantages of land-based farming is having control of the environment. Environmental factors such as oxygen levels, salinity, density and temperature are constantly monitored and adjusted to best fit the optimal living conditions of the fish at every stage. Feeding and oxygenation is controlled and monitored. Another benefit of land-based farming is that it almost eliminates the risk of escapes. Fish meal and fish oil used as feed for arctic char come from sustainable managed fish stocks in the Icelandic waters. Other raw materials used in the feed, are non-GMO and sourced from sustainable sources. Little or no antibiotics are added to the feed and only natural pigments are used. Iceland has adapted EU Directive 2009/28/EC, which has the main objective to promote the use of energy from renewable sources across Europe.

Arctic char needs plenty of cold water for development. Iceland is therefore suitable for arctic char production. Educated and experienced people are working in the arctic char farming. Feed conversion to flesh is efficient compared to animals. Animal welfare is considered and diseases are inspected. According to The Icelandic Food and Veterinary Authority (MAST) a serious disease of viral origin has never been identified in aquaculture in Iceland.

Market and logistics

Iceland is the largest exporter of arctic char in the world. Most of the production is exported as chilled filets and sold in a limited part of USA (New England) and Europe. The products are luxury, high-end foods. The products are mostly transported by air, but a part of the products is shipped to Europe. Gutted arctic char and filets are popular foods at domestic markets.



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Challenges and opportunities

It is costly to invest in new land based production facilities. Qualified human resources are important to allow for the production of high quality fresh and frozen filets, portions and whole fish products that meet the highest standards of the market. Marketing in new markets needs considerable resources.

There should be opportunities for increased production in the Northern Regions since there is increased demand for high quality seafood. Local niche products are needed for specialized markets.¹⁶

¹⁶ Sources: Samherji hf. Fish Farming. Retrieved on 13.03.2018 from: <http://www.samherji.is/en/operations-in-iceland/fishfarming> Matis. Iceland Arctic Charr. Retrieved on 13.03.2018 from: <http://old.matis.is/english/iceland-arctic-charr/>

3.2 Cod from Iceland (small vessels)

Industry description

829 small vessels, shorter than 15 m and less than 30 gross tons.

The cod catch is landed at about 50 harbors around the coastline.

Products can vary, whole round fresh, fresh or frozen fillets and fillet portions, salted, dried etc. Packed in 1kg packs up to 450 kg.

Key figures

264 000 tons caught in total
Living weight

70 000 tons caught by small vessels
Living weight

First hand value of in total 58 000 million ISK, the share of small vessels was 15 000 million ISK.

Export quantity in total is 135 756 tons for 100 000 million ISK. Estimated export small vessels:
35 300 tons and value 26 000 million ISK.

Key strengths

The small vessels land the catch every day, they usually deliver very fresh raw material and apply environmental friendly catching methods.

They can deliver products that meet the demands of the high-end markets.

Fisheries based on small vessels can be more sustainable than the productive big trawlers.

Local value/value creation

Active fishermen 4 000 for all vessels. Staff at processing 3 600.

The catch is landed at towns all around the island and sailing routs are short.

This creates jobs where there are no large fishing industries.

Customer segments/markets

The small vessel catch is very well suited for increasing fish export to markets paying the highest prices. Consumers regard the cod as an environmental and sustainable product caught with environmental friendly methods. The most important markets are in Europe and North America.

Logistics

The cod from small vessels is often used for production of fresh products, which are transported by air to Europe and North America. A small share is also transported in containers by sea to markets in Europe and North America.

Main challenges

Small vessels can enjoy a special position in the future by employing reasonable fisheries and careful treatment of fish. Then the products will meet all the requirements of high end markets.

Main opportunities

Small vessels can meet market demands for traceability, sustainability and environmental respect. The image of small vessels compares favorably to the big trawlers. The products from the small vessels can therefore meet the demand of high-end markets, given that the quality of the products are guaranteed.



Figure 9 Harbors where cod is landed by small vessels

The role of small vessels in the cod catch

Coastal fishing is based on a management system established in 2009. One of the aims of the system was to open the fisheries up for newcomers. This is an open access fishing for four months and is open for all small vessels with a fishing licence. The catch under this system is mostly cod.

Total cod catch in 2016 was 264 154 tons, thereof 70 000 tons were caught by small vessels, or 26,5%. The small vessels land the catch every day, the sailing routes are short and they usually deliver very fresh raw material and apply environmental friendly catching methods. They can deliver products that meet the demands of the high-end markets. Fisheries based on small vessels can be more sustainable than the productive big trawlers. The small vessels are important to create jobs where there are no large fishing industries.

Market and logistics

The small vessel catch is very well suited for increasing fish export to markets paying the highest prices. Consumers regard the cod as an environmental and sustainable product caught with environmental friendly methods. The most important markets are in Europe and North America.

The cod caught by small vessels is landed at about 50 harbours around the coast line as can be seen in Figure 3. The cod is delivered to auction markets which are crucial for the value chain of cod. The auction markets were established in 1987, resulting in market driven approach providing market information to the fishermen and certain transparency in the price determination. The markets help to maintain competition within fish processing and help to balance short run catch variations, for

example for species and sizes. They serve as a channel for by-catch species and undersized fish, allowing small quantities from many suppliers to be bought by few specialized processors.

The auction markets make the transport of cod by trucks to processing facilities economical. Cod from small vessels is most often used for production of fresh products which are transported by air freight to Europe and North America. A part of the fresh products is transported in containers by sea route to markets in Europe and North America. The products are sold to supermarkets and restaurants.



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Challenges and opportunities

Small vessels can by different methods meet market demands for traceability, sustainability and environmental respect. The image of small vessels compares favourably to the big trawlers. The products from the small vessels can therefore meet the demand of high-end markets if the quality of the products is guaranteed.

Small vessels can enjoy a special position in the future by employing reasonable fisheries and careful treatment of fish. Then the products will meet all the requirements of high-end markets.¹⁷

¹⁷ Sources: National Association of Small Boat Owners (Landssamband smábátaeigenda). www.ls.is
Statistics Iceland (Hagstofa Íslands). www.statice.is

3.3 Lumpfish from Iceland

Industry description

250–330 small vessels, shorter than 15 m and less than 30 gross tons.

Only female lumpfish is included. The catch of male lumpfish is limited.

20 companies work on cutting, freezing and salting for about 3 months per year.

Production of block frozen lumpfish, salted roes and caviar.

4 companies producing caviar, final products for the consumer markets.

Key figures

5 540 tons landed 2016
Living weight

Export value in total 2 084 million ISK, (509 million ISK for lumpfish, 686 million ISK for salted roes and 889 million ISK for caviar).

2 700 tons frozen lumpfish blocks, 731 tons salted roes and 669 tons caviar.
Product weight

Key strengths

Extremely important for small coastal communities and remote farmers.

Good income where needed the most.

Only three countries fishing lumpfish, easier to control demand and supply.

Works well with costal jig fishing.

Local value/value creation

550 fishermen working for about 3 months per year.
100 employees working in production (cutting, freezing and salting) for about 3 months per year.

Supporting fish plants in small fishing communities.

Extra value creation for low-income fishers and farmers.

Provides jobs for workers at fishing plants.

Customer segments/markets

Extremely narrow/limited market.
For roes (raw material), the main markets are in Germany, Denmark and Sweden.
For caviar, the main market is France.
Markets at Christmas and Easter are important.

Logistics

Landed lumpfish is trucked to a nearby fish factory and processed as roe in barrels and frozen fish with skin in blocks.
Roe is exported in refrigerated sea-route containers.

Main challenges

At present the supply and demand are balanced and there are limited possibilities for growth

Main opportunities

New products could be developed from lumpfish. This includes caviar products and products to meet the requirements of the Chinese market.



Figure 10 Locations of lumpfish landings above 100 tons

The importance of lumpfish in Iceland

The lumpfish (*Cyclopterus lumpus*) industry is very important for small coastal communities around Iceland. Many sheep farmers rely on lumpfish as a secondary income for the farm. The roes are the primary product but the fish itself is frozen as a by-product. The catch of male lumpfish is limited. There are 440 vessels with lumpfish license in Iceland. Lumpfish are landed at many harbors, Figure 10 indicates 21 harbors with landings above 100 tons. Annually between 250 and 330 vessels utilize their license and harvest on average five thousand tons a year (around 40–60% of the world catch), giving around 10 000 barrels of lumpfish roes for production of caviar or for export. Lumpfish is caught in coastal waters of Iceland, Norway, Greenland and Canada. More than 500 fishermen are fishing lumpfish in Iceland in early spring until middle summer. Around 100 people work in fish plants on gutting, packing and freezing lumpfish and salting roes in barrels for export.

Market and logistics

In 2016, 669 tons caviar, 731 tons salted roes and 2 700 tons frozen lumpfish blocks were exported from Iceland, worth of 889 million ISK , 686 million ISK and 509 million ISK, respectively, a total of 2 084 million ISK.

According to regulation, it is required that whole lumpfish are brought ashore. Consequently a new market was developed in China for frozen lumpfish blocks. It should be noted that the roes are only about 30% of the total weight of lumpfish, with head, tail and viscera about 70% of its total weight. Lumpfish is now almost fully utilized. Landed lumpfish is trucked to a nearby fish factory for gutting and collection of roes. The roes are salted in barrels – 105 kg of roes, but the lumpfish is block frozen in 15 kg blocks for the Chinese market. Roes and lumpfish are shipped in sea containers to markets. Around half of the supply is sold as salted roes and half is processed as caviar in Iceland.

The salted roes are processed as caviar and sold in France, Sweden and Germany. Around 80% of the market for Icelandic caviar is in France. It used to be a Christmas and Easter market, but has changed to a around year market during the last few years. The caviar market is extremely vulnerable to raw material supply. A small change of supply (fishing) can have great impact on prices of lumpfish roes.



©Jón Baldur Hlíðberg

Challenges and opportunities

Today the supply chain is in balance. The supply from the four countries is in line with the demand of the market. There is not foreseen a large growth in supply of lumpfish in the North Atlantic. A larger market with more products to meet fluctuations in supply is important for the future. The Chinese market is promising, demand and prices have been increasing. The lumpfish is a new product on the market and there is nothing similar to it and no substitute products. The salmon aquaculture business is using lumpfish juveniles to prevent lice epidemic. This epidemic costs the salmon industry a vast of money every year, but lumpfish juveniles are used to eat the lice of the salmon. A new recipe for a lumpfish caviar has been developed in Iceland, with less salinity and healthier colour. The product has been introduced to several markets.¹⁸

¹⁸ The National Association of Small Boat Owners (Landssamband smábátæigenda). www.ls.is

3.4 Lamb meat from Iceland

Industry description

Sheep farming is particularly important in the northern part of the country.

5 large slaughterhouses (90–100)
3 medium size (30–100)
2 small (<30)
(Size measured in thousands carcasses per season)

All include a processing unit. Some prepare products in packages for consumer markets.

The processing industry is located in Reykjavík (south-west), Hvolsvöllur (south) and Akureyri (north). Several farmers in different parts of the country have started small-scale meat processing.

Key figures

560 500 lambs slaughtered.
Average weight per carcass: 16,5 kg

9 200 tons produced.

Consumer market value of 6 200 million ISK.

A total volume of 4 100 tons lamb meat were exported 2017.
Product weight

Annual Consumption of lamb meat 2015 was about 19,5 kg per capita.
Product weight

Key strengths

Iceland is very well suited for sheep farming with plentiful grasslands.

Lambs graze in the highlands until slaughtered in September or October.

The grazing areas are regarded as very little polluted which brings the image of uncontaminated products to the lamb meat.

Local value/value creation

3 250 sheep farmers in all regions.

Sheep farms are located all around the country and are very important for the inhabited regions. Considerable parts of North Iceland suffer from shrinking population and continued farming is a key to fight this change.

Customer segments/markets

The domestic market is by far the most important. There is a long tradition for the consumption of lamb. However, the consumption of lamb has decreased over the last decades due to lower price of chicken and pork.

Icelandic lamb has been exported on a small scale to USA and Norway but the future of those markets is uncertain.

Logistics

Most of the lamb carcasses are frozen at the slaughterhouses. The products are transported by road to processing plants, supermarkets, restaurants or to farmers for local production.

Main challenges

Many sheep farmers have another job outside the farm to have sufficient income. Competition from other meat sectors are a continuing threat. It is uncertain how the market share of lamb meat will develop.

Main opportunities

Lamb products can be marketed as quality products. Sustainability can be increased. Lamb products should be of interest to tourists. Increased production of lamb products at farms can increase the income of farmers. Grazing of lambs should be controlled, providing sustainability and good image.

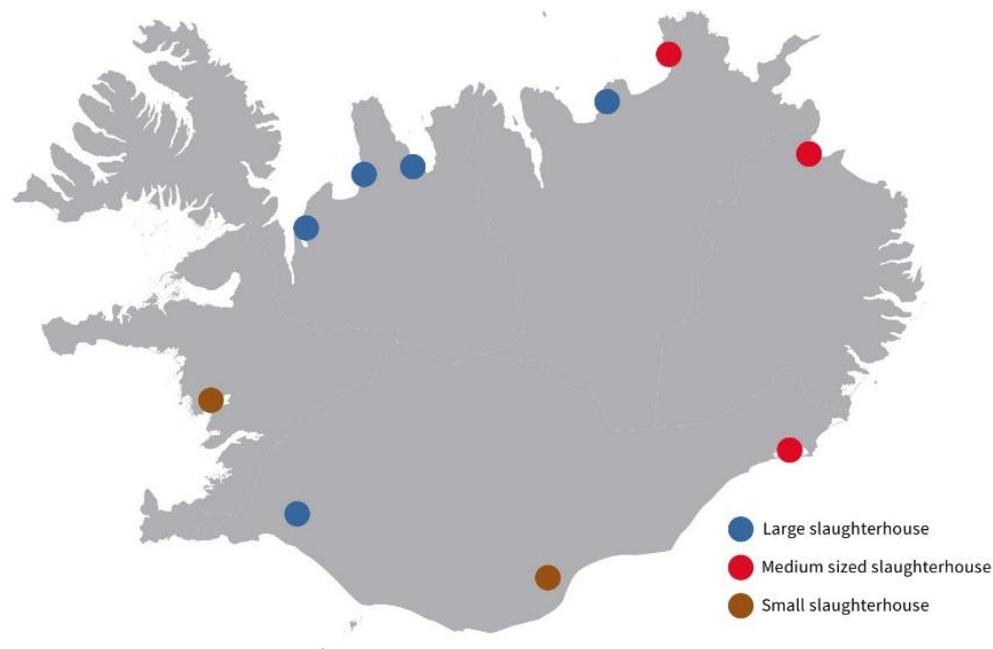


Figure 11 Location of slaughterhouses for sheep

Sheep farming and lamb meat production

Sheep farmers are well over 3 000, the farms are small and family-owned. The sheep farming is as old as the human settlement of Iceland. Still sheep farming is based on traditions which include various foods made from the animals. Iceland is very well suited for sheep farming with plentiful grasslands and highland pastures. Lambs graze in the highlands until slaughtered in the autumn. The grazing areas are regarded as very little polluted which brings the image of uncontaminated products to the lamb meat.

As can be seen in Figure 11, there are 10 slaughterhouses for sheep in Iceland. The different capacities are shown in the figure. During the slaughter season 2017, 560 500 lambs were slaughtered. The average carcass weight was 16,5 kg and total production 9 200 tons lamb meat (carcasses). The value was 6 200 million ISK for lamb meat sold at the domestic market. The volume of exported lamb and sheep meat was 4 100 tons.

Sheep farming is located in all around the country and is very important for the residence, particularly in the sparsely populated regions of North Iceland. The future of sheep farming is therefore related to regional developments. Traditionally the consumption of lamb meat and lamb meat products has been very high in Iceland but the consumption has declined considerably over the last decades.

Market and logistics

The domestic market is by far the most important market for lamb and sheep products. Most of the lamb carcasses are frozen at the slaughterhouses. From there the products are transported by trucks to meat industry, supermarkets, restaurants or farmers that process the meat or sell to consumers. Icelandic lamb has been exported on small scale to USA and Norway but the future of those markets is uncertain.



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Challenges and opportunities

The challenges for sheep farmers are low income and the fact that another job is often needed for supporting families. The slaughterhouse industry has a strong position on the market and needs a considerable share of the market value. Sheep farming constantly faces the competition from other more profitable meat sectors. It has been discussed that sheep farmers could increase their income by processing lamb carcasses at the farm. This will maintain traditional craftsmanship and offer interesting local foods for the increasing number of tourists. Sheep farmers can thus contribute to increased sustainability required by agriculture and food industry.

Farmers can emphasize quality and origin of products. Marketing of sheep products could refer to the low level of environmental contamination. Icelandic lambs are reared entirely outdoors eating only wild plants. Icelandic lamb meat can therefore be regarded as close to venison. The use of hormones as growth promoters are strictly prohibited and antibiotics are banned as feed additives.¹⁹

¹⁹ Sources: Icelandic Food and Veterinary Authority (www.mast.is)
Statistics Iceland (www.statice.is)

3.5 Dairy product Skyr from Iceland

Industry description

Skyr is produced by four companies and three small scale producers (farms).

Production is dominated by one large company, MS.

The processing industry is located in Selfoss (south), Reykjavík (south west), Akureyri (north) and Ísafjörður (west). A few farms in different parts of the country produce skyr, several tons each.

Key figures

About 4 500 tons are produced annually.

Product weight

Of those, a total volume of about 1 300 tons are exported for a value of about 500 million ISK.

Product weight

The remaining 3 200 tons are sold on the domestic market.

Product weight

Key strengths

Skyr is becoming quite well known around the world.

It has a positive image connected to health due to low fat and high protein content.

Skyr is an important part of Icelandic culinary heritage and as such it has a strong market position within Iceland.

Local value/value creation

Rural job creation and increased income, e.g. related to tourism.

The dairy industry benefits from increased production, export and licences.

Customer segments/markets

Skyr has in the past been sold mainly within Iceland. Export has increased and accounts for close to one third of the annual domestic production. The export volume is limited mainly due to import quotas, therefore MS the largest producer and exporter of skyr established licence agreements with producers abroad. In 2016, MS and its cooperating companies sold about 13 thousand tons of skyr in Europe, 800 tons more than in 2015.

Logistics

Domestic freight by road. Export by flight.

Main challenges

Increased competition from other countries and well-known brands. Making it difficult to compete on the international market.

No control of the skyr brand

Main Opportunities

A clear definition of Skyr is needed. With that in place, producers could apply for protection/recognition within the European Union schemes of geographical indications and traditional specialties such as protected designation of origin (PDO), protected geographical indication (PGI), and/or traditional specialties guaranteed (TSG).

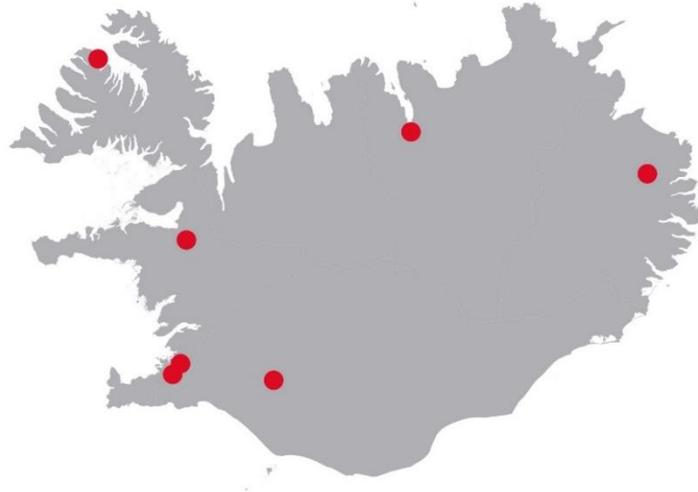


Figure 12 Location of skyr producers

Skyr and skyr production

Skyr has been a part of the Icelandic cuisine since settlement. The industrialization of skyr production started in the 1930s. Gradually domestic production of skyr decreased and by 2010 only a few farms were reported as skyr producers. In the last few years several farms have started to produce skyr according to the traditional methods and the products have been sold to customers.

Figure 12 shows locations of 7 well established skyr production facilities in Iceland. Four of them are full-scale dairy processing plants (two at the capital area South-West Iceland, one in the North and one in the North-West areas). The other facilities are at farms.

Market and logistics

Skyr has in the past been sold mainly within Iceland But in recent years skyr has been exported from Iceland. About 4 500 tons are produced annually. Of those, a total volume of about 1 300 tons are exported for a value of about 500 million ISK. The remaining 3 200 tons are sold on the domestic market.

MS exports or has sold production licence to several countries, including the United States of America, Denmark, Greenland, Norway, Finland, Sweden, Switzerland, United Kingdom, Ireland and Malta. In 2016, MS and its cooperating companies sold about 13 thousand tons of skyr in Europe, 800 tons more than in 2015.



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Challenges and opportunities

Becoming better known, large and small companies worldwide are starting to produce and market products under the name of skyr. Many of those are multinationals, which have a global market share for other dairy products, making it difficult for Icelandic companies to compete.

What is skyr, when does it become something else? There is no control over the use of the name as it is a common name. One way to keep and grow the market share of Icelandic skyr, is that Icelandic producers come to an agreement on what skyr is and market it accordingly. With that in place, producers could apply for protection/ recognition within the European Union schemes of geographical indications and traditional specialties such as protected designation of origin (PDO), protected geographical indication (PGI), and/or traditional specialties guaranteed (TSG).²⁰

²⁰ Source: Þóra Valsdóttir, Þórarinn E. Sveinsson, 2011. Uniqueness of traditional skyr (Sérstaða hefðbundins skyrs). Matis Report 10–11. (In Icelandic).

3.6 Vegetables, greenhouse production from Iceland

Industry description

About 100 farms are specialized in producing vegetables in greenhouses.

The most important vegetables grown in greenhouses are cucumbers, tomatoes and bell pepper.

Greenhouses are located in clusters in Iceland where geothermal energy is available.

Most of the greenhouse clusters are located in South Iceland, only about 200 km from the capital area.

Key figures

The total value of greenhouse and out-door vegetable production in Iceland was 3 800 million ISK 2016.

The value of greenhouse products is a considerable part of this, estimated to be about 1 500 million ISK (consumer market).

3 500 tons cucumbers, tomatoes and bell pepper produced
Several other vegetables, e.g. lettuce, Chinese cabbage and herbs, were produced in smaller quantities

Key strengths

Geothermal energy makes the production of vegetables in greenhouses possible. The availability of hydroelectric power for illumination is also important. These energy sources are key factors for maintaining sustainability.

The quality of domestic products should be superior to the imported products. Domestic vegetables benefit from lower carbon footprint compared to the imported products.

Local value/value creation

The number of employees in vegetable production was 237 (year 2008) and for related services 107 employees were involved (outdoor production included). The production of vegetables in greenhouses is important for local communities, creating jobs and economic activities.

Farmers and companies have started to produce vegetable products, creating added value products.

Customer segments/markets

The greenhouse vegetables are only sold in Iceland. A considerable part of the vegetables is sold through the Horticulturists' Sales Company (is. Sölufélag garðyrkjumanna). The company has been successful in marketing the vegetables as high quality products of Icelandic origin. Some farmers sell their products directly to supermarkets and restaurants.

Logistics

Vegetables can be harvested in the morning at the main production area in South Iceland and arrive at distribution centres or supermarkets at the biggest market, the capital area, in the afternoon the same day.

Main challenges

Low priced imported vegetables.
Supermarkets demand low price vegetables.
The price of electricity is a key factor. To be able to produce vegetables in greenhouses, farmers have to pay for electricity for illumination through the dark winter months.

Main Opportunities

Possibilities to add more vegetables to the list of greenhouse products.
Opportunity to start organic production replacing imported products.
More technically advanced greenhouses. Domestic vegetable production can aim for sustainability and low carbon footprint.

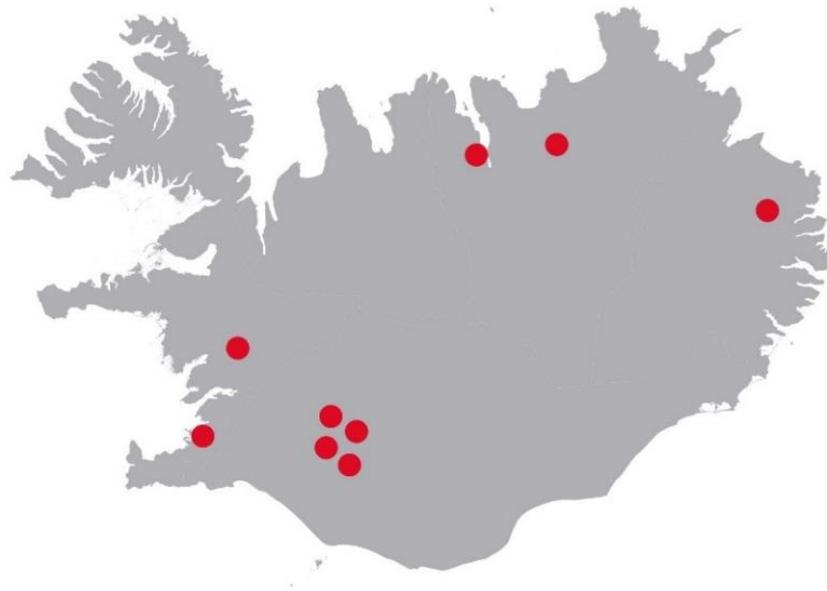


Figure 13 Locations of greenhouse clusters in Iceland

Vegetable production in greenhouses

Geothermal energy for heating and electricity produced by hydroelectric power stations for illumination are the basis of vegetable production in greenhouses in Iceland. A few vegetables are grown in greenhouses all year round, including tomatoes, cucumbers, bell pepper and lettuce. Additionally, a few vegetables are grown more irregularly: spinach, Chinese cabbage, kale and herbs. Even the greenhouse production of strawberries has been successful, but the produce has had a hard time competing with the prices of imported strawberries. Several greenhouses are operated through dark winters by using electrical illumination. Products are marketed on the domestic markets. Most of the greenhouses are located in clusters where geothermal energy is available. See locations in Figure 13.

The greenhouse production of cucumbers, tomatoes and bell pepper was 3 500 tons in 2016. Several other vegetables, e.g. lettuce, Chinese cabbage and herbs, were produced in smaller quantities. The total value of greenhouse and out-door vegetable production in Iceland was 3 800 million ISK 2016. The value of greenhouse products is a considerable part of this, estimated to be about 1 500 million ISK. The number of employees in vegetable production was 237 (year 2008) and for related services 107 employees were involved (outdoor production included).

It is important for consumers to have access to fresh, high quality vegetables from their own region, supporting sustainability and recommended vegetable intake. Availability of local produce of vegetables to local communities could be improved in some cases, and local products could be better marketed as such. The vegan lifestyle is increasing, making the supply of domestic vegetables even more important.

Market and logistics

The greenhouse vegetable production in Iceland meets only a part of the domestic demand and no products are exported. The market share for domestic tomatoes and cucumbers is the highest (70-90%) but lowest for lettuce and bell pepper (about 10%). The import of vegetables is therefore considerable.

Most of the greenhouses are located in South-Iceland within 200 km from the capital area. In this region vegetables can be harvested and brought by trucks to the market within one day. The short transport distance and time help to keep the high quality of the products. The production of organic vegetables is limited in Iceland, the demand for these products is met by import.



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Challenges and opportunities

The producers in Iceland have to compete with imported vegetables, which often are cheaper due to economic large-scale production. Supermarkets demand low price vegetables. However, consumers recognise domestic products as fresh and high quality. To be able to produce vegetables in greenhouses all year round, farmers have to pay for electricity for illumination through the dark winter months. The price of electricity is therefore a key factor. On the other hand the 24 hours daylight during mid-summer is very important for the production. Generally, it is difficult for the small size greenhouse businesses to survive.

The import of vegetables to Iceland has increased over the last decade. Vegetable growers have responded by increasing the size of greenhouses and this has resulted in fewer greenhouse farms. Electrical illumination has been increased and the greenhouses made more technically advanced reducing the staff cost.

New vegetables have been tested successfully in greenhouses in Iceland. There should be possibilities to add more vegetables to the list of greenhouse products. The same applies to berries which have short shelf life. However, market studies should always be carried out before investing in new production. Organic vegetable production is still very limited in Iceland. This is an opportunity to increase organic production replacing imported products. Also, greenhouses can be made more

technically advanced. The all year round production of vegetables could be increased, provided that the price for electricity is acceptable. Domestic vegetable production can aim for sustainability and low carbon footprint. This would be highly valued by consumers, including tourists. The hotel and tourist markets are becoming more important. In the future, export might become possible based on large greenhouse complexes enjoying suitable geothermal and electricity sources.²¹

²¹ Guðjón Þorkelsson *et al.*, (2012). Efling grænmetisræktar á Íslandi (Strengthening of vegetable growing in Iceland). Matis Report 16–12. ISSN 1670–7192. (In Icelandic). Statistics Iceland (Hagstofa Íslands). www.statice.is

4 Food production in Northern Norway

With a total mainland area of 324 000 km² and 5,2 million inhabitants, Norway is one of the least densely populated countries in Europe. The built-up area, including road, amounts to only about 2%. A further 3% is a cultivated agricultural land and estimated arable land is about the double of that cultivated today.²² Norway has a 2 500 km coastline and 90 000 km² of sea within the baseline, corresponding to approximately one-third of the total land area²³. Throughout its history, fishery has been a major industry, together with agriculture. In the last decades the development of the aquaculture industry has made Norway the biggest producer of Atlantic salmon in the world. The country's geographical characteristics, a long coastline, and climatic factors have made the country well suited for both fisheries and aquaculture. The production from agriculture is rather small, compared to countries further south, but is important for national food supply, the food industry and rural development. In addition, the Saami population in Norway holds reindeer and provides high valued food.

Northern Norway consist of the three northernmost counties Nordland, Troms and Finnmark, see Figure 14.



Figure 14 Study area in Norway

²² Strand GH and Bekkhus R (2008) Marklagstatistikk, Dyrka og dyrkbart areal. Ressursoversikt fra Skog og landskap 03/2008.

²³ Eurofish. Overview of the Norwegian fisheries and aquaculture sector. Retrieved from <http://www.eurofish.dk/norway>

Agricultural production

The total primary agricultural production in Norway is based on production from about 41 200 farms with a mean size of 23,9 hectare arable land (2016). The number of farms is decreasing, while the production volumes are relatively constant. About 3/4 of the agricultural income are from animal production (dairy, meat, egg and wool) and 1/4 from plant production (cereals, vegetables, potatoes, berries). The reason for the domination of animal production is because large parts of the arable land are located in areas where climate and landscape are mainly suited for production of animal feed. Cereal production is concentrated to the most productive arable land, mainly in the Southeastern part (Østlandet), Western-coast (Jæren) and in Mid-Norway (Trøndelag).

The agricultural production in Northern Norway is the northernmost active agriculture in the world today and mainly grass-based animal husbandry with ruminants. It is characterized by short growing season and 24 hour day length in mid-summer. Dairy cattle and sheep are the main production, but there are also pig, layer hen and goat farms within the region. The majority of goat farms in Norway are in Troms County (about 60 farms). Northern Norway also includes horticultural production, mainly potatoes, but also some vegetables and berries. In addition, a few farmers grow cereals (mainly barley) in the north.

The food processing industry in Norway is dominated by large cooperatives owned by the farmers, like TINE (dairy) and Nortura (meat). In addition, there are typically some other large companies and many small, local enterprises. The number of small companies in the agricultural sector has been increasing rapidly the last decades due to increasing demands for locally produced special food products. This market segmentation is evident also in Northern Norway, where the large cooperatives are the main actors, while the rest are mainly small (farms) and medium sized companies (SMEs).

Fisheries and aquaculture

In Northern Norway, there are approximately 4 500 people directly employed in fishing and another 3–7 000 working in the fish processing industry throughout the year. In aquaculture 2 000 are employed in the main industry and 5 500 in supporting industries. Despite declining employment in the industry as a whole, production is higher than ever before. According to the United Nations Food and Agriculture Organization (FAO), the productivity of Norwegian fishers and aquaculture workers are 77 times higher than the world average.²⁴

The fisheries' catch varies considerably from year to year. In 2015, about 94 thousand tons was landed in the north, which constitutes 42% of the total landings in Norway²⁵. In economic terms, the cod catch has the highest value, followed by mackerel, herring and saithe. The production of farmed fish has grown sharply since it began in the 1970s, and amounted to about 517 thousand tons in first hand sales in 2015 (from Northern Norway). Salmon dominates the fish farming industry, while in recent years the trout has been stable.

The economic significance of the farming industry, for Norway as a whole, by far exceeds the traditional fisheries. The total export value of fishery products was approximately NOK 95 billion in 2017. Aquaculture accounted for almost three-fourths of the total export value (72%).²⁶

²⁴ Agenda Nord-Norge. (2017). KB Spesial: Sjømat i Nord. Retrieved from <http://kbnn.no/artikkel/sjomat-i-nord#S1>

²⁵ SSB. (2016). 08868: Fangst, etter fiskefartøyet sin landingskommune og hovedgruppe av fangstarter [Metadata]. Retrieved from <https://www.ssb.no/statbank/table/08868?rxid=9f2fb50e-fd24-48b0-908f-76f1c88e4915>

²⁶ Norges Sjømatråd. (2018). Sjømatnasjonen Norge. Retrieved from <https://sjomatnasjonen.seafood.no/>

Only a small amount of the Norwegian seafood goes to domestic consumption. It is estimated that 95% of Norwegian seafood is consumed abroad. In 2017, Norwegian seafood was exported to 140 markets around the globe. The largest export markets were Polen, Denmark and Netherlands. However, Germany is the most important market in terms of consumption.

4.1 Farmed Salmon from Northern Norway

Industry description

385 licenses to be used in 404 approved localities

Primary and secondary:
Production of fresh and frozen whole salmon, and filets

39 companies, but dominated by 4 large companies. Estimated 50% of the salmon industry is owned by people in the south or by foreign interests.

Tertiary: Smoked, sugar/salted and consumer packed fresh and frozen products. Approx. 35 small companies, turnover and employees are difficult to estimate

Key figures

511 000 tons in first hand sales, Northern Norway in 2016
Living weight

1 154 000 tons exported from Norway in 2017, with a value of 65 billion NOK.
Whole fish equivalent

64 NOK/kg is the average export price in 2017 of all salmon products exported from Norway

The total Norwegian household consumption is approximately 12 000 tons/year
Product weight

Key strengths

Cost-effective production
Cheap electricity
Good access to fresh water

Developed technology
Availability of educated and experienced workers
EEA provides labor from Eastern Europe

Europe within driving distance
Airports nearby
(can provide fresh salmon)

Market leader

Local value/value creation

2 200 employees in the main industry.

5 500 employed in supporting industries, mostly suppliers of technical equipment, support and services.

It is estimated that for each NOK that is created in the salmon industry itself, 0,45 NOK are created in supporting industries (feed production excluded).

Customer segments/markets

Exported to 140 countries. A willingness to pay for fresh airborne products.

Important for the sushi-consumption.

EU (76%) - France largest markets.

Product qualities from medium to high-end segments.

Logistics

Freight of fresh whole fish and filets by road to Europe and air to the rest of the world (85%).

Frozen by boat (cheaper, but slower).

Main challenges

Limitation on possibilities for expansion.
Lice and escape challenges.
Tariffs a barrier to increased production of processed products for export.
The industries reputation is strained.

Main Opportunities

Exploiting the high global demand for seafood.
Developing high value niche "Arctic products" for export and tourist markets.
Exploit opportunities within the residual biomass.

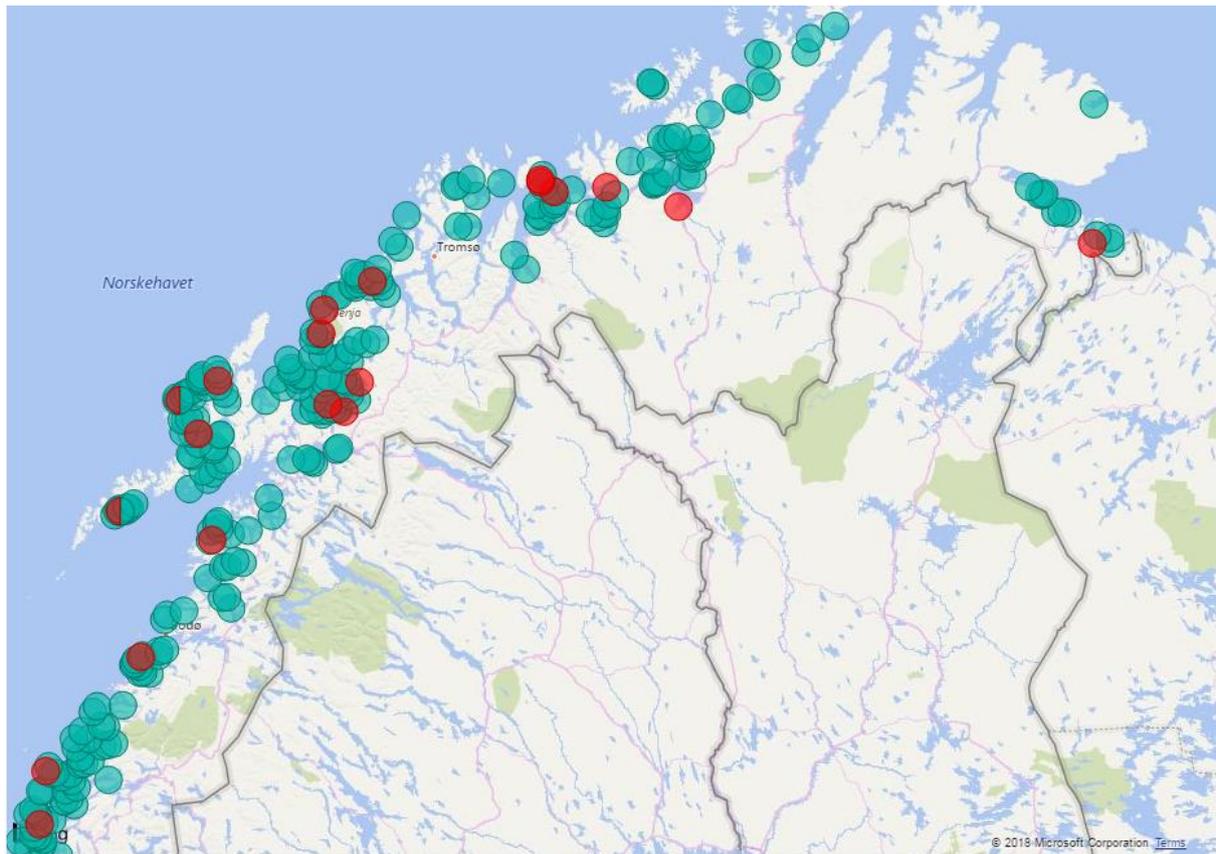


Figure 15 Salmon production in the north (Production cages in sea (green) and slaughterhouses (red))

Description of the salmon industry

Norway is by far the world's largest producer of Atlantic salmon, producing more than 1 million tons a year. This amounts to 54% of the global production of salmon. About 50% of the production is in Northern Norway. The volume is expected to increase more in the north than in areas further south, as there is more area available and the cold climate give less challenges with diseases and sea lice.

The EU is Norway's most important and largest market, with USA and Japan in second and third place. 85% of the salmon is exported fresh, by truck to Europe or airborne to more distant markets. As the volume for export has increased Norwegian salmon has gained market shares in several markets.

There are about 100 aquaculture companies in Norway, owned by 80 actors, of which 39 are operating in Northern Norway. The industry is dominated by four large, internationally listed companies. The four big companies, Marine Harvest, Lerøy, SalMar and Grieg Seafood, all owns large structures in the north. Only a small part of the ownership and main offices are located in the north. Even medium sized companies in the North often have owners located in the southern parts of the country, but nearly half of the value created from the salmon industry in the northern region are crated based on northern ownership interests. In the municipalities hosting salmon slaughter houses (and hatcheries) value creation from the industry is particularly high. The salmon industry however also contributes with employment and income to the, often small, rural, municipalities only hosting salmon production in the sea, as well as those producing feed and other services to the industry.



Sushi from Norwegian salmon, ©Nofima

In 2015 approximately 6 700 persons worked in the aquaculture industry and 2 163 of these were working in Northern Norway. Nationally about 15 000 was employed in supporting industries, mainly in a rapidly growing supplier industry. Of these 5 500 were located in the northern region. Aquaculture therefore contributes with an additionally two workplaces for each created within the industry itself.

The export registered from Northern Norway (export from companies registered in the south is often registered in the south even though produced in the north) was 15 billion NOK in 2016. This amounts to approximately 60% of the total export from the region, and 6,3% of all export from mainland Norway.

Norway has high labor costs, but the industry has experienced an increased efficiency the last decade. Norwegian salmon is therefore competitive in the international market. Increased animal welfare, disease control, vaccine development and reduced use of medication (antibiotics especially) and lower feed factor are important elements on the production side. Also factors like cheap electricity, access to clean and abundant water, access to labor both educated and production labor (often from EEC) and efficient logistics to the EU market are important success factors. Another factor contributing to this success is that salmon originally was a luxury, high value product. The Norwegian seafood export council has done a massive work in generic promotion of Norwegian salmon, and in establishing salmon as a sushi fish.

Even though the production of salmon has doubled in the last two decades, both government and industry aim to at least double the current production, and most of the growth will take place in the north. There are however several challenges related to continued growth. These include increased opposition against expansion in local communities where the production is taking place, due to lack of

economic ripple effects and pollution, and conflicts with other uses of the sea (fisheries, recreation and tourism), as well as concern about negative impacts on wild salmon stocks and other species.

A main constraint for increased processing into higher valued products are high tariffs on processed products to main markets. Longer distance to the European market for the producers in Northern Norway do not seem to be an obstacle for supporting the market with fresh fish, even though harsh weather condition and poor roads is a challenge, especially in the winter time.²⁷ For the national market there is potential in developing high value niche "Arctic products" for the domestic and tourist segments.



Salmon slaughter house and salmon packed for transport by trucks to the EU @Nofima

²⁷ Sources:

Report to the Storting (Stortingsmelding) no. 22 (2012–2013). Verdens fremste sjømatnasjon. Ministry of Fisheries and Coastal Affairs, Oslo.

Hersoug, B. & J.P. Johnsen (eds.) (2012). Kampen om plass på kysten. Interesser og utviklingstrekk i kystsonen-planleggingen. Oslo: Universitetsforlaget.

Isaksen, J.R., O. Andreassen & R. Robertsen. (2012). Kommunenes holdning til økt oppdrettsvirksomhet. (The municipalities' attitudes towards increased aquaculture). Report 18/2012, Nofima, Tromsø.

Sandersen, H.T. & I. Kvalvik (2015) Access to aquaculture sites: A wiced problem I Norwegian aquaculture development. Maritime studies journal 14:27. <http://www.maritimestudiesjournal.com/content/14/1/27>

Nyrud, T., R. Robertsen, E. Henriksen & T. Sebulonsen (2018). Ringvirkningsanalyse Troms – Leverandøranalyse. Report 2/2018, Nofima, Tromsø.

Robertsen, R. & T. Nyrud (2018) Ringvirkninger av havbruksnæringen i Troms. Report 1/2018, Nofima, Tromsø.

Konjungturbarometer for Nord-Norge: www.kbnn.no

Directorate of fisheries, www.fiskeridir.no

4.2 Cod from Northern Norway

Industry description

3 300 active vessels

GEOGRAPHY OF:

FIRST HAND MARKET

97 whitefish

producers/purchasers:

- ✓ 20 in Finnmark
- ✓ 21 in Troms
- ✓ 56 in Nordland

Tertiary:

Approximately 50 companies producing local consumer products in North Norway

Key figures

354 000 tons landed in Northern Norway, 2016
Living weight

216 000 tons exported from Norway in 2017, with a value of 9 billion NOK.
Product weight

42 is the average export price in 2017 of all cod products exported from Norway

The total Norwegian household consumption is approximately 12 000 tons/year
Product weight

Key strengths

Access to raw materials:

Manages a sea area 6–7 times larger than the mainland

Cheap electricity and water

Developed technology

High productivity per employee

EAA provides labor from Eastern Europe and access to main markets

Proximity to Europe (can provide fresh fish)

Good reputation

Extensive data collection and good management

Local value/value creation

4 500 fishermen working fulltime
3–7 000 people working within the processing industry depending on season.

65% of the value creation within fisheries goes to the fisher
The remaining 35% ends as operating profit to owners

The gradual increase in productivity lead to increased salaries

Customer segments/markets

Approximately 77% of the Norwegian cod exports goes to the EU. The largest EU export markets are Portugal, Denmark, Great Britain and Italy.

15% of cod exports goes to China
4% are exported to Brazil and the US

Logistics

63% of fish products caught in the north are transported by sea, 30% by road and 7% by road in combination with other means

Main challenges

Instability in supply

Need for skilled, seasonal workers

Low prices for cod products, e.g. due to low quality or reduced demand

Reduced market access, e.g. due to unfavorable trade agreements

Main Opportunities

Focus on higher quality products, for example the "Skrei" brand.

Developing high value niche "Arctic products" for export and tourist markets.

Stabilize supply, e.g. through live storage of cod.

Access to new markets.

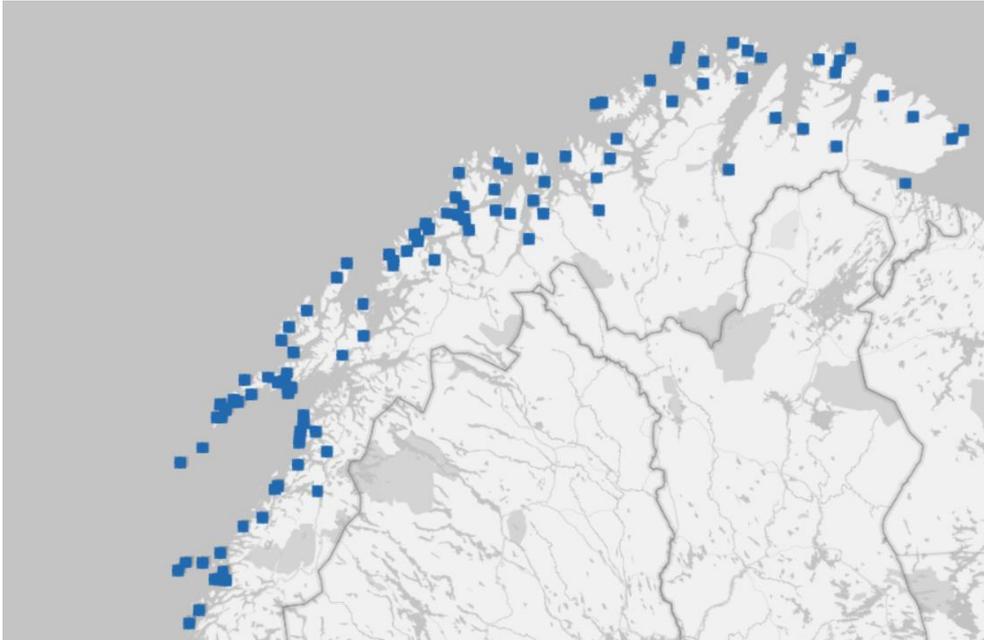


Figure 16 Landing stations in Northern Norway

Description of the cod industry

Fishery has throughout history been of major importance to Northern Norway. The long coastline, together with climate factors has made the region well suited for this purpose. The most important stocks exploited by Norwegian fishers have historically been cod. Accounting for one third of the catch value from all Norwegian vessels in 2014.²⁸ An overweight of cod landings are landed in the three northernmost counties, due to the Northeast Atlantic cod stock being more numerous here than in the North Sea. More than 80% of the total cod catches, just below 400 thousand tons, are landed in Lofoten or further north. Tromsø has the most facilities to support and supply the off-shore vessels operating in the north and thus most cod is landed here. We also find Øksnes, Berg, Måsøy and Båtsfjord on the list of municipalities with large cod landings.

The center of gravity in the Norwegian processing industry naturally lies in the north. The Northern Norwegian industry is made up of 95 large whitefish purchasers and producers in 2016.²⁹ Out of these 95 companies, 20 companies are located in Finnmark, 19 in Troms and 56 in Nordland. Moreover, to some degree we find concentration of companies within specific branches in certain districts.

The number of people registered with a main occupation as a fisher in the north was approximately 4 500 in 2015.³⁰ According to Statistics Norway, the number of employees in the northern Norwegian fisheries industry was around 3 500 in 2015. However, since SSB is measuring in the fourth quarter, and the North Norway fisheries industry has the main seasons in the first quarter, this represents a significant under-reporting. Nofima has calculated employment in the first and second quarters of 2016 to around 7 000 people.³¹

²⁸ Isaksen, J.R. & A. Iversen (2015). Norwegian value chains for cod and herring.

²⁹ Nyrud, T. & B.I. Bendiksen (2017). Driftsundersøkelsen i fiskeindustrien – Driftsåret 2014. Report 1/2017, Nofima, Tromsø. Retrieved from <https://brage.bibsys.no/xmlui/bitstream/handle/11250/2430052/Rapport%2B01-2017.pdf?sequence=1>

³⁰ SSB. (2016). 07811: Fiskarar, etter fiske som leveveg [Metadata]. Retrieved from <https://www.ssb.no/statbank/table/07811?rxid=e0481fb5-fff8-45c6-91fb-a4237d61de6b>

³¹ Agenda Nord-Norge. (2017). KB Spesial: Sjømat i Nord. Retrieved from <http://kbnn.no/artikkel/sjomat-i-nord#S1>

Since the turn of the century, a larger share of the value creation in the fishery sector are accrued to the owners of the capital. For employees in the fishing fleet, the share of value creation fell from about 80 to about 65% from 1994 to 2015. About 35% now ends as operating profit to owners. Even though a lower share of the value creation goes to wages, the wages have increased due to higher productivity per employee.



Production line in processing company for white fish ©Nofima

The Norwegian consumption of the total cod catches are minimal in comparison to what is exported to the EU and other markets. About 5 000 tons of cod products was sold to retail stores and HoReCa (hotel, restaurant, catering) in Norway in 2016.³² In comparison, approximately 215 000 tons were exported from Norway to other markets the following year. Half of the total Norwegian export, about 108 000 tons, or just below 4 billion NOK, are registered as being of North Norwegian origin.³³

Norway's close proximity to the European Union has been crucial for its broader economic development. EU is the receiver of 77% of the total cod volume exported from Norway in 2016. The main export markets are Portugal, Denmark, Great Britain and Italy. China, Brazil and the United States are other important export markets. It is important to note that both Denmark and China have a large share of re-export, thus the importance of these countries, as actual markets are difficult to estimate.

About 63% of the total transport of fishery products was transported by sea, 30% by road and the remaining 7% by road in combination with other means, mainly train.³⁴ The products transported by sea were mainly frozen products, but also saltfish, stockfish and byproducts. The fresh products are in most cases transported by car. There is a potential for airfreight of fresh products from Northern

³² Flesland Markedsinformasjoner AS (2017). Fisk- og skaldyrmarkedet 2017/2018. Retrieved from <https://si.seafood.no/sas/PDF/FiskogskaldyrTotalmarkedet20172018.pdf>

³³ Norwegian Seafood Council. (2017). [Trade statistics]. Unpublished raw data.

³⁴ Transportutvikling AS. (2015). Fra Kyst til Marked: Sjømartransporter i Nord-Norge i 2014. Retrieved from <https://www.nfk.no/tjenester/samferdsel/samferdselsplanlegging/dokumenter/rapport-fra-kyst-til-marked-sjomattransporter-i-nord-norge-i-2014.835340.aspx>

Norway destined for long distance destinations (Asia and America), but currently most fresh fish is transported by road to the airports in Oslo, Helsingfors, Stockholm etc.³⁵



Harbour in the Lofoten region ©Nofima

The challenges in the fishery sector are closely intertwined with the opportunities. One of Norway's largest challenges has to do with unstable supply of cod throughout the year and from year-to-year. The instability is caused by the seasonality of cod in Norway and large changes in quotas from year-to-year. Stabilizing this supply is therefore mentioned as an important opportunity, which for example can be achieved through live storage of cod. The second challenge is low cod prices. To increase cod prices the product needs to be sought after by the customers. This could be achieved through increased marketing, delivering differentiated, quality products, and/or by accessing new markets or segments. Related to this is market access and high tariffs on processed products and the general question of market access to important markets. Brexit is one example, where the outcome of the EU-UK and Norway-UK negotiations will determine the future for one of Norway's largest market for cod. In addition Norway is currently negotiations trade agreements with several countries, working to get improved access to new markets.

³⁵ Transportutvikling AS. (2016). Mulighetsstudie: Flyfrakt over lufthavner i Nordland fylke. Retrieved from https://www.nfk.no/_f/p34/i1993d213-d48f-4706-a289-dbc29c290a66/rapport-16013-flyfrakt-nordland_5des2016.pdf

4.3 King Crab from Northern Norway

Industry description

673 vessels in regulated area, 180 in free fishing zone. Mainly one or two men vessels.

Primary and secondary
19 buyers with 31 landing facilities. All located in the county of Finnmark, as this is the area where the crab lives.

Tertiary:
No companies do any processing of King Crab as of today.

Key figures

2 600 tons landed in 2016
Living weight

First hand value of
317 million NOK

2 200 tons exported/year from the north, with a value of 530 million NOK.
Product weight

King crab are exported for an average of 227 NOK/kg. Live crab have a price of 223 NOK/kg and frozen clusters of 251 NOK/kg.

The total Norwegian consumption is estimated at 300 tons in 2015
Product weight

Key strengths

Proximity to recourse
Easy and safe catch

Limited supply of high value product in high demand.

International airports nearby (for some producers) for live export.

Developed technology

Research community with relevant competence

Local value/value creation

Provides economic flexibility and less seasonal fluctuation for companies and workers in the whitefish industry.

Have brought new activity and local value in small and rural communities in arctic Norway.

Customer segments/markets

Live crab is mainly exported to South Korea. Some actors sell smaller volumes to high-end market worldwide.

Frozen clusters are mainly sold to EU and Japan

Logistics

The major volume of live crab goes by plane to Seoul directly from Lakselv, or via truck from Helsinki or Oslo.

Frozen crab goes mainly by boat to Japan or truck to EU.

Main challenges

Very limited resource
High competition for raw material to the industry
Seasonal variation of quality

Main Opportunities

Increased export of live crab.
Developing processed high value products for home market.
Product innovation based on damaged, small and female crabs.

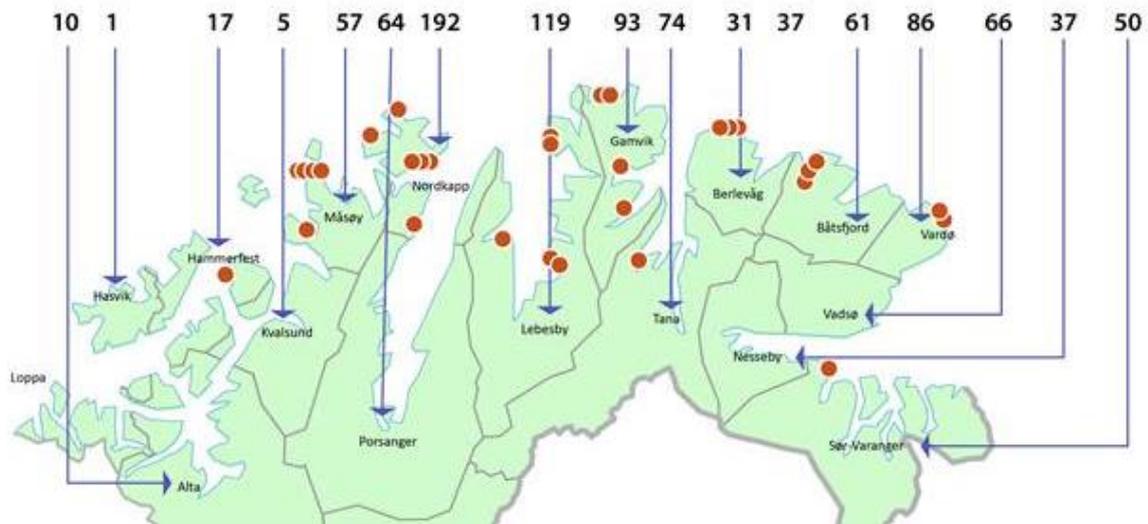


Figure 17 King crab landing stations and vessels according to home harbour (in numbers)

Description of the king crab industry

The King Crab is an invasive species in Norwegian waters. In the late 90's when the crab first made a serious impact on Norwegian fisheries, it was considered a nuisance for the fishermen, destroying nets and bottom fauna. A commercial fishery was opened in 2002 and today more than 600 vessel takes part in the fishery, providing a much welcome additional income to fishermen in coastal communities in Finnmark. The fisheries is a coastal pot fishery, that can be executed all year round with relatively small boats. The volumes are rather small, compared to other fisheries and king crab fisheries in other countries, with an annual catch around 2 000 tons. The value of the crab is however very high, the first hand value amounting to 317 million NOK and export value of 530 million NOK in 2016.

In 2011 one exporter started to test export of live crabs to South Korea, and in cooperation with Norwegian research institutes mortality and animal welfare have been established at acceptable levels. The crab is packed in styrofoam boxes with special CO2 emitters and cooling packs to put the crab into a coma. The major exporter of live crab has an arrangement with direct flights out of Lakselv airport, a merely 170 km drive from their factory. Others drive the crab by truck to Oslo or Helsinki, where some is put into "Crab hotels", a sort of resting tanks, before shipped on out into the world. A level of 36 hours is set after packing to unpacking without compromising mortality and animal welfare. Today the export volume of live crabs exceeds that of frozen clusters (a set of 4 legs and a claw parted from one side of the crab), with a corresponding higher value generated from this limited resource.



Live king crab at the Noryangjin Fish Market in Seoul, South Korea ©Nofima

The live crab is mainly exported to South Korea, with smaller volumes sold to other countries. Frozen clusters are mainly exported to Japan, EU and USA. Export volumes to Japan are strongly fluctuating from year to year due to impact of Russian fisheries and regulations. Japanese import statistics also show that they import Norwegian crab via EU countries like Netherlands and Denmark. Prices for many of the smaller volume markets are significantly higher than the volume markets. This indicates opportunities for differentiation of smaller volumes. More complicated and costly logistics and transport however incur. In addition, processing and product development of damaged, small and female crabs could provide opportunities for employment and value adding, targeting both national and international markets.



King crab fishing ©Nofima

The King Crab industry has brought new activity and economic development to many small rural communities in Finnmark. The whitefish is a highly seasonal fishery, leaving boats, factories and personnel without work a major part of the year. The crab makes the factories able to run on a more stable basis, providing a much welcome income and activity for both land industry and fishermen.³⁶

³⁶ Sources:
Norges Råfisklag and Norwegian Seafood Council 2017
Lorentzen, G., G. Voldnes, R. D. Whitaker, I. Kvalvik, B. Vang, R. Gjerp Solstad, M. R. Thomassen & S. I. Siikavuopio (2017). Current status of red king crab (*Paralithodes camtchaticus*) and snow crab (*Chionoecetes opilio*) industry in Norway. Reviews in Fisheries Science & Aquaculture, 1–13, Published online: 16 Jun 2017

4.4 Meat: cattle, sheep and pigs from Northern Norway

Industry description

Primary:

1 312 producers with cattle
1 608 producers with sheep and
115 producers with pigs.

Secondary:

1 large sized national cooperative, *Nortura* with 3 slaughterhouses and 1 terminal
1 medium sized company, *Horn* and a few small sized slaughter houses.

Tertiary:

Nortura

In addition, 10 other processing companies with a turnover between 20 and 180 million. 60 smaller meat-processers, many connected to their farm.

Key figures

186 462 sheep slaughtered/year
28 061 cattle slaughtered/year
103 600 pigs slaughtered/year

Production value:

2,15 billion NOK (5% of the total national value).

Prices to farmers*

Sheep/lamb meat: 40,78 NOK/kg

Cattle meat: 52,14 NOK/kg

Pig meat: 26,50 NOK/kg

**Prices exclusive subsidies*

Key strengths

Abundant high-quality grazing areas

Animal welfare and disease control

Low use of antibiotics

Renewable energy supplies

Abundant water supply

Developed technology

Sustainable land use

Local value/value creation

1 000 employees in secondary and tertiary industry.

Supporting industries.

Local communities.

Cultural landscape.

Customer segments/markets

Sold locally, regionally and nationally.

High level of products processing.

Increased production of high price specialized products.

Logistics

Nortura are obliged to collect animals from all farms in Norway.

Animals collected by trucks to the slaughterhouses and further to the different smaller processing plants. Products distributed mainly by trucks.

Main challenges

Predator challenges in some areas.

Fragmented farmland – transport costs from feed harvesting over large areas (cattle and sheep).

Unpredictable meat prices due to rapid shifts in demand and production volumes (pigs).

At the moment higher production than demand.

Small margins for profit for the tertiary industry.

Main Opportunities

Room for increased production in the north.

Increased demand for locally produced food (e.g. for tourism).

Local niche products for selected markets.

Quality products for national distribution.

Increase utilization of the total bioresources (industry waste).

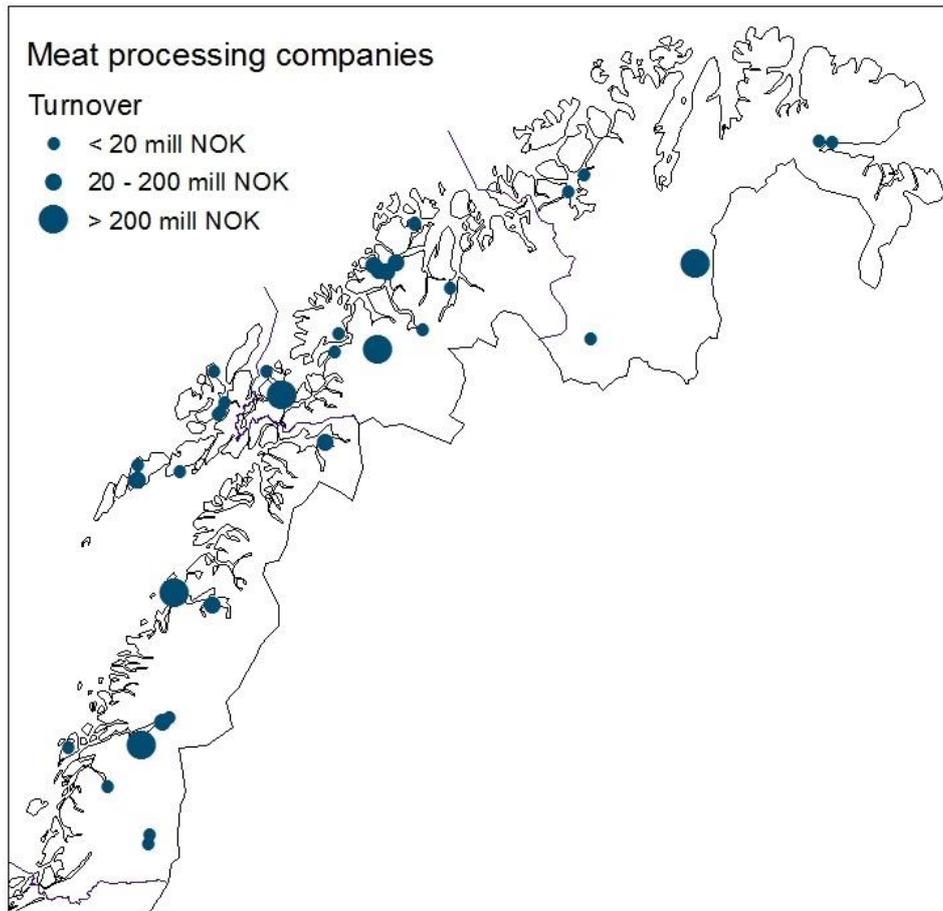


Figure 18 Meat processing companies in the north

Description of the meat industry

The largest agricultural production systems in Northern Norway is based on meat production. Abundant high-quality grazing areas are an important resource for this production, but with a long winter season good grass feed production and sufficient barn capacities are also an important prerequisite for this production. In the primary production, there are 1 312 producers of cattle (mainly dairy farmers), 1 608 sheep producers as well as 115 pig producers (2017). In addition, about 30 dairy goat farmers are producing goat meat. The total primary production is 186 462 sheep, 28 061 cattle and 103 600 pigs slaughtered in 2016.

The main advantages for meat producers in Northern Norway is a high degree of animal welfare and disease control as well as a low use of antibiotics. One of the outcomes of extensive farming with a high degree of outback grazing is sustainable land use. Some areas are experiencing predator challenges, this is especially true for sheep production in the inland areas. Another challenge is that the farmers have a very fragmented farmland, causing high transport costs (both time consuming and fuel consuming) due to feed harvesting over large areas.



Sheep grazing in Troms @Sigridur Dalmansdottir

The secondary production is dominated by one large national cooperative (Nortura) with 3 slaughter houses (one in each county) and one terminal in Northern Norway. In addition there is one medium (Horn) and a few small slaughter houses. Nortura is obligated to retrieve the animals for slaughter in the whole region. This is to secure primary production and farms in the whole region, but also leads to large transportation costs for Nortura.

Nortura is also the largest tertiary producer of processed meat products. In addition, they have an obligation to supply meat to private meat producers. In Northern Norway there are ten medium processing companies with a turnover between 20 and 180 million. And around 60 smaller meat-processers, many connected to their farm either with their own processing facilities or by selling pre-processed meat from Nortura or from one of the medium processing companies.

In 2016 there were approximately 1000 employees in secondary and tertiary industry in Northern Norway. The meat products are sold locally, regionally and nationally. The industry is characterized of high level of products processing. There are possibilities for increased meat production in the north, both by utilizing the total potential in the outfield grazing fields for increased primary production and by increasing the value added by producing local speciality products.³⁷

³⁷

Sources:

Landbruksdirektoratet, statistics: <https://www.landbruksdirektoratet.no/filserver/prodrapp.htm>

Animalia, slaughtering statistics: <http://statistikk.animalia.no/statistikk/>

Statistics Norway, statistics meat production/slaughtering: <https://www.ssb.no/statbank/list/slakt?rxid=2c9310c4-9a42-4bf9-ae33-94ebde71e54a>

Mat og Industri, www.matogindustri.no

Matmerk, increased sales for local food; <https://www.matmerk.no/no/matmerk/aktuelt/lokalmatsalget-vokser-mest>

The business finder; www.proff.no

4.5 Dairy products from Northern Norway

Industry description

Primary:
902 producers with
22 449 dairy cows

87 producers with
11 251 dairy goats.

Secondary/tertiary:
Dominated by 1 large national
cooperative (TINE)

TINE has 6 processing plants and
2 terminals in Northern Norway.
In addition there are approx. 20
small scale producers processing
cheese and other dairy products.
Production of fresh milk, cream,
sour cream, cheeses, butter,
yoghurts and other products.

Key figures

151 million liters of cow milk
7 million liters of goat milk
Produced/year

Production value:
1,43 billion NOK (6% of the
national value)

Local, regional and domestic
market.

Prices to farmers (2017)*
Cow milk: 5,44 NOK/l
Goat milk: 5,44 NOK/l

**Prices exclusive subsidies*

Key strengths

Animal welfare and disease
control

Low use of antibiotics

Renewable energy supplies

Good access to water

Developed technology

Food security

Traceability

Local value/value creation

500-600 employees within the
processing industry.

Supporting industries

Local communities

Cultural landscape

Customer segments/markets

Sold locally, regionally and nationally.

High level of products processing.

Increased production of high price specialized products.

Logistics

TINE is obliged to collect milk from all dairy farms in Norway.

Milk transported to the processing plants by trucks.

Small-scale production mainly at or close to the farms.

Distribution of processed products mainly by trucks

Main challenges

Production regulations (quotas).

Fragmented farmland – transport costs from feed
harvesting over large areas.

High proportion of rented farmland.

More expensive to produce concentrates than to
import.

High investment costs.

Main Opportunities

Increased demand for locally produced food
(e.g. for tourism).

Specialized local niche products for selected markets
(e.g. story telling products).

Product development

Increase quality and profit within the whole value
chain.

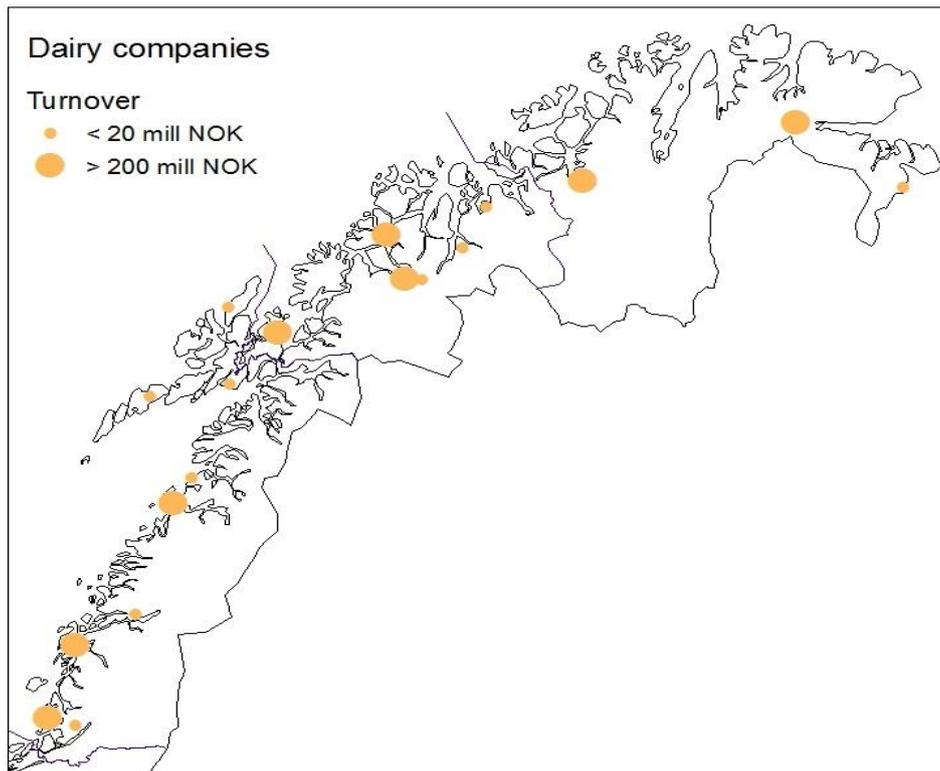


Figure 19 Dairy companies in the north

Description of the dairy industry

Agriculture in Northern Norway is mainly grassland-based production of milk and meat. The region counts about 900 producers with dairy cows and 87 producers with goats³⁸. The milk production is based on 22 449 cows and 11 251 goats, delivering 151 million litres of cow milk and 7 million litres of goat milk in 2016³⁹. The milk is mainly processed by the national cooperative (TINE) which is owned by milk farmers and has 6 processing plants and 2 terminals in Northern Norway. In addition, there are approx. 20 small-scale producers processing cheese and other dairy products, mainly at or close to the farms. About 10% of national cow milk and 35% of goat milk is produced in Northern Norway.

In addition to production of fresh milk, the products are cream, sour cream, cheeses, butter, yoghurts and other products including the traditional Norwegian goat cheese "brunost". Norway is self-sufficient in production of dairy products and export is limited to small amount of cheeses, such as Jarlsberg, which is produced in south-east Norway.

A quota system, with classical regulated dairy regime, was introduced in Norway 1983⁴⁰. The regime contributes as a measure against overproduction of milk and is not economically viable without the Norwegian system of import tariffs and production subsidies.

About 500–600 employees work within the processing industry, which makes Tine an important contributor to the local labour market. Tine regulates the dairy market in Northern Norway, and is as such obliged to collect milk from all dairy farms. The milk is transported to the (TINE) processing plants

³⁸ Landbruksdirektoratet, statistics: <https://www.landbruksdirektoratet.no/filserver/prodrapp.htm>

³⁹ Tine year rapport 2016.

⁴⁰ Almås R. & J. Brobakk (2012). Norwegian dairy industry: A case of super-regulated co-operativism. *Research in rural sociology and development*, 18:169-189

by trucks. Transportation is challenging within the region since the farms are fragmented with long distances between them. The number of farms has been reduced during the last years, with almost 45% reduction in number of farms in Northern Norway from 2006 to 2016.



Cheese and production @Innovasjon Norge



Foto: www.nordnorge.com

@Visitnordnorge.com

The remaining farms are enlarging and innovating in order to increase their efficiency so production volumes are much less reduced. Improved dairy cow performances with increased yield per cow is the reason for keeping the milk production at a similar level. Ecological milk production is slightly increasing within the region. The milk products are sold on the local, regional and domestic market.

Products are based on raw material from animals under a strict control of animal welfare and disease with a minimal use of antibiotic. Further, production within the region is mainly based on renewable energy supplies from electricity with good access to water, providing food security and traceability. An increasing part of the production is of high price specialised products. Future opportunities for the dairy production in Northern Norway most likely lies in further product development. Especially in specialized local niche products for local and selected markets which may increase quality and profit within the whole value chain. The demand of the market is changing and this will be effecting the future dairy production.

4.6 Horticulture in/from Northern Norway

Industry description

Primary:

Potatoes: 406 farms, 464 ha

Vegetables: 61 growers, 43 ha

Strawberry: 38 growers, 14 ha

Other berries: 31 growers, 10 ha

Secondary/tertiary:

Washing, packing and

distribution mainly through

Gartnerhallen (cooperative),

Tromspotet and Bama but

several small companies also

involved (farms).

Processed products produced by a few companies, e.g. Art Nor.

Key figures

8 400 tons potatoes

Produced/year

100 million NOK is the estimated value of secondary and tertiary.

Local, regional and domestic market

Prices to farmers*

Potatoes: 5 NOK/kg

**Prices exclusive subsidies*

Key strengths

Pest and disease control

Low use of pesticides

Water access

Developed technology

Distinctive long-day light growing conditions

Specific quality attributes

Local value/value creation

200 employees, in addition to seasonal workers.

Supporting industries

Local communities

Seasonal work

Direct purchase of goods from producer

Customer segments/markets

Sold locally, regionally and nationally.

Hotel, restaurant and catering (HoReCa).

Logistics

Partly concentrated production, often close to processing companies or bigger cities/markets. Parts of the distribution is directly from producer to consumer (on farms or markets, e.g. Farmers market).

Main challenges

Difficult for local producers to get access to supermarket shelves.

Labor access and predictability of production.

For specialized production: high knowledge demand and investments in equipment.

Unpredictable annual climatic conditions

Effect of future climate changes

Main Opportunities

Room for increased production in the north – climate improving technologies the last years (e.g. tunnels)

Increased demand for local food (tourism)

Local niche products for selected markets

New trends in food consumptions towards increased horticultural products

Prolonged growing season due to global warming

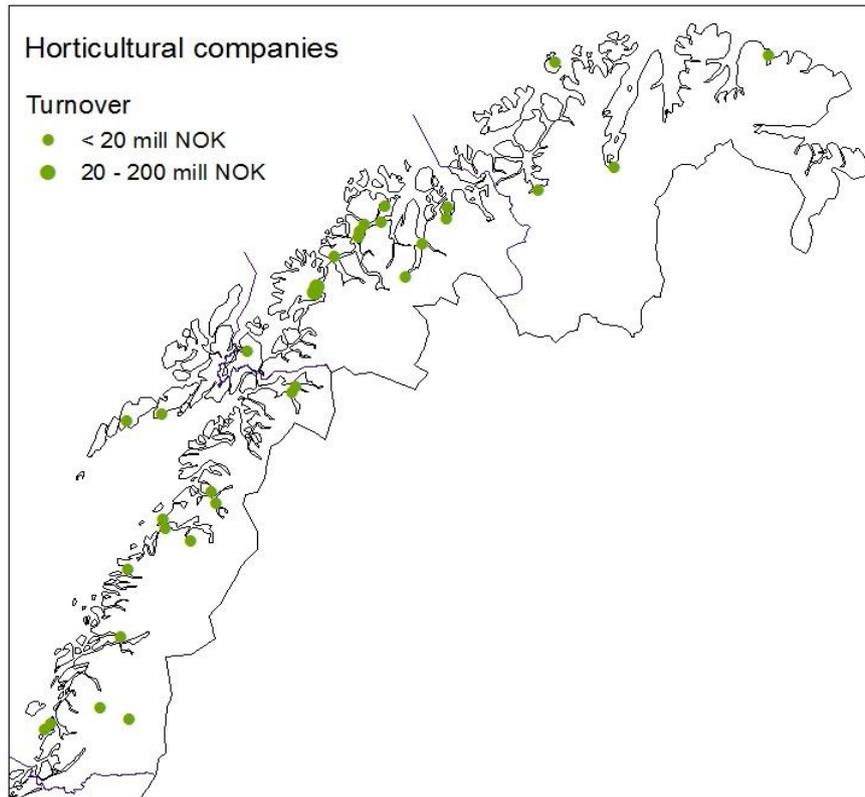


Figure 20 Horticultural companies in the north

Description of the horticultural industry

Horticultural production is low in Northern Norway. The main horticultural production is potatoes that is grown on about 460 hectare⁴¹, mainly in Troms County. Vegetables and berries are grown on about 65 hectare with about equal distribution in Troms and Nordland counties.

Table 1 Potato yield (1000 tons) in Northern Norway 2016⁴²

	2016
Nordland	2,6
Troms	5,7
Finnmark	0,1
Northern Norway	8,4

In 2016, about 200 employees were involved in the horticultural production in Northern Norway. These numbers do not include seasonal workers that are important workforce in the harvestings season for several of the productions. Estimated value of the local secondary/tertiary industry is around 100 000 000 NOK⁴³. The products are sold locally, regionally and nationally. Hotel, restaurant and catering (HoReCa) are important markets for local and regional distribution.

⁴¹ Landbruksdirektoratet, statistics: <https://www.landbruksdirektoratet.no/filserver/prodrapp.htm>

⁴² Statistics Norway, statistics potato production: <https://www.ssb.no/jord-skog-jakt-og-fiskeri/statistikker/jordbruksavling>

⁴³ The business finder; www.proff.no



Turnip from Northern Norway ©Ulrike Naumann, NIBIO

Key strengths for horticultural production in Northern Norway are the natural growing conditions with cool summers and long days. These conditions imply little problems with pests and diseases and thus low use of pesticides and herbicides. At the same time there are indications of specific quality attributes of horticultural products produced under these growing conditions⁴⁴.

Production is partly concentrated, as many of the producers tend to be located close to processing companies or bigger towns/markets. For example, many of the largest potato producers are located in the region around Tromsø, one of the main distributors, and many of the horticultural farms are located close to the towns, selling through Farmers Market and directly from the farms.

The horticultural production is low in Northern Norway and should have a much higher potential. Among the challenges for growth in the sector are the supermarkets demands for large-scale delivery agreements making it difficult for local producers to get access to supermarket shelves. Access to labor in the labor-intensive production periods are another challenge, which is further complicated by annual climatic conditions making it unpredictable to time these periods beforehand. Horticultural productions are, in addition, highly specialized with a high knowledge demand and requirements for costly investments in equipment. Some predicted effects of future climatic changes also contribute to

⁴⁴ Johansen, T. J., A. L., Hykkerud, E. Uleberg & J. Mølmann (2018). Arktisk kvalitet – En beskrivelse av nordlige natur- og klimaforhold og virkning på egenskaper hos nordnorske matprodukter. NIBIO Rapport nr. 40.

some uncertainties concerning the conditions for horticultural production, e.g. flooding and increased autumn precipitation.



Currants production in Troms ©Finn Måge, NIBIO

On the other hand there are also some clear opportunities for future development. There is definitely room for increased production in the north. Especially since there has been great development on climate improving technologies the last years (e.g. tunnels) making it easier to adjust the production to the annual climatic conditions. The demand for locally produced food is increasing. This increase includes higher demands for local niche products as well as higher demands from the tourism industry for local produced food. New trends in food consumptions also directs increased demands towards higher proportions of horticultural products in people's diets. Future climate changes also offers possibilities for northern production through prolonged growing seasons due to global warming improving the growing conditions for horticultural crops in Northern Norway.

4.7 Reindeer from Northern Norway

Industry description

Primary and secondary:
950 reindeer owners
7 stationary slaughter plants, 1 mobile slaughter company

10–15 processing companies, where the 5 largest have 95% of the market share

Tertiary:
Companies, and persons offering tourist related services (reindeer sightseeing, sled touring, etc.)

Key figures

82 000 reindeers *Slaughtered/year*

1 500 tons produced/year
500 mill NOK in value/year
Product weight

Meat mainly for domestic market.

Offal and bi-products for export

Price to reindeer herders app. 75 NOK/kg.

Prices in store from 650 NOK/kg for fillets to 200 NOK/kg for cut off meat

Key strengths

Public demand is much higher than product supply. Makes it a luxury product.

Low feed cost

Low use of antibiotics

Cheap electricity

10 000 years of history

Local value/value creation

350 employees in slaughter and processing companies

The sami culture is built on reindeer herding. A strong relation to people in the north of Norway.

Companies, and persons offering tourist related services (reindeer sightseeing, sled touring, etc)

Customer segments/markets

Today mainly sold in Norway, in restaurants and retail.

High potential for export to "luxury markets"

Logistics

Due to relatively low volume, both fresh and frozen products are transported with trucks.

Products distributed mainly by trucks.

Main challenges

Area and food supply for the living animals. Production is already close to maximum capacity, although it is still possible to optimize the herd structures a bit.

Still huge potential for value growth!

Supply/transport of animals for slaughter

Main Opportunities

Improvement of products. Finding new customers who are willing to pay higher prices.



Figure 21 Reindeer slaughterhouses in Norway

Reindeer related industry

The "reindeer industry" in Norway is closely connected to the sami-culture and heritage. Only persons of sami descent can be owner of reindeers, a right protected by the law. Last year 3 233 persons were registered as owner of reindeer in Norway. However, slaughtering and processing of the animal products is open for everyone that is qualified. The majority of reindeers are found in Finnmark (75%), while Troms and Nordland have approximately 6% and Trøndelag has 14%. The reindeers are semi-domesticated, which means they roam freely in nature where they consume grass during summer and lichen during winter.



Reindeer in fence before marking and slaughtering ©Rune Rødbotten

Although reindeer meat have been consumed for several thousand years in Norway, the volume is still very limited. If divided equally between each Norwegian it will just reach for 2 dinners per year. Approximately 80 000 animals are slaughtered each year, which gives roughly 1 800 tons of meat and 1 500 tons by-products. Feed supply (and predators) limits the total number of animals. Through evolution, the reindeer have been adapted to life in arctic climate. Therefore the total number of animals cannot be increased much compared to herd size of today, which is roughly 220 000 animals in spring. A desired product combined with limited supply could have resulted in very high retail prices. However, reindeer meat is sold at approximately twice the price of beef. Estimated market value for meat and by-products is roughly 500 million NOK. Among the by-products fur and skin represents the highest commercial value. Almost all meat is consumed in Norway while the by-products are mainly sold abroad. Food trade regulations limits the options for selling meat outside Norway, which probably also influence the retail price in the domestic market.



©Rune Rødbotten



©Opplysningskontoret for kjøtt

There are 4 medium sized and 3 small slaughter plants for reindeer in Norway. In total, these plants have roughly 350 employees. In addition to the slaughter plants there are 15 companies that process carcasses into meat products. In total these companies have more than 1 000 employees, but most of them process other types of meat also.

In addition to direct food production, there are several tourist related companies utilizing reindeer (in all aspects). This includes watching living reindeers in their natural environment, sledge tours pulled by reindeer and of course restaurants serving dishes prepared with reindeer meat.⁴⁵

⁴⁵ Source: LANDBRUKSDIREKTORATET Årsrapport 2017.
file:///H:/Documents/Arktisk%20mat/Landbruksdirektoratets%20%C3%A5rsrapport%202017.pdf

5 Food production in the Russian North

Food production activities at high latitudes face natural obstacles and require more expenditures, than just importing food to the northern settlements. Nevertheless, some regions of Russian North produce a considerable amount of food and plan an impressive development of agriculture and fisheries activities.

The Arctic zone of Russia occupies a significant part of the country's territory. This zone officially includes Murmansk Region, Chukchi autonomous area, Nenets and Yamalo-Nenets Autonomous areas (also called okrugs) and separate territories of the Republic of Komi, Yakutia, Krasnoyarsk and Arkhangelsk regions, Republic of Karelia. Some regions like Khanty-Mansi Autonomous Area are not included in the Arctic zone, but are similar in natural conditions. Together they form a territory called "Far North and equated territories".

These territories with rare exceptions specialize on extraction of resources (oil, gas, precious and rare earth metals, gems). Most of them are characterized by harsh natural and climatic conditions: long and severe winter, permafrost, swamps. Factors complicating the development of agriculture also include small number of rural population and a focal character of land-use. At the same time, there are branches that can develop only in this zone. For example, there are 328 million hectares of reindeer pastures. The number of reindeer in Russia is over 1,5 million heads. Large areas of swamps and low-yield forests make it possible to organize large-scale harvesting of mushrooms, berries, nuts and medicinal plants. Due to the harsh conditions of the area, people who work there have traditionally been entitled by the Russian government to higher wages than workers of other regions. It is a factor for competitiveness for every industry.

The Russian Arctic is usually divided into 2 parts: European and Asian (the border passes along the Ural Mountains). The European Arctic is more developed because the widespread settlement of these lands started earlier (11th century). Asian part was inhabited with indigenous peoples of the North that conducted their own agricultural activities. Permanent Russian population and population centers appeared here only in the beginning of 20th century. That is why these territories have less developed infrastructure than European ones. On the one hand, this hinders the development of agriculture, but on the other hand is one of the main reasons why it is necessary to ensure food security in this region.

Thus, the agriculture and fisheries of the Russian North can be subdivided into 2 types:

1. Regions where classical agriculture and fisheries has a "platform" character (regions of the European North). This type includes such regions as the Republic of Komi, Karelia, Arkhangelsk region. Traditional agriculture of the Russian population existed here historically, as the main, independent type of activity.
2. Regions of new economic development (resource-extraction). This type includes such regions as Nenets and Yamalo-Nenets Autonomous areas, Khanty-Mansi Autonomous Area, Krasnoyarsk region, Yakutia, Chukchi autonomous area. There existed traditional agricultural activities of the indigenous population (reindeer herding, hunting and fishing), but there was almost no farming in its classical, crop-livestock form. It appeared as a supporting industry to provide new oil and gas cities of the North with their own food products.

Food production in Yamalo-Nenets Autonomous area

Yamalo-Nenetsky Autonomous Okrug (YaNAO) is Russia's most important source of natural gas, with more than 90% of Russia's natural gas being produced there. The region also accounts for approximately 5% of Russia's oil production. Its administrative center is the town of Salekhard, and its largest city is Noyabrsk. YaNAO has an area 750 300 km² and is subdivided into a 7 districts. More than a half of its area is located above the Arctic Circle. Its population was counted to be 538 000 people in the beginning of 2018 and it is constantly growing due to labour migration. Of the YaNAO population 8% is indigenous peoples of the North and about 1/3 of them live on the tundra. Agriculture in this region is a source of preserving their traditional way of life, ethnic and ecological traditions.



Figure 22 Study area in Russia

Food production of the Yamalo-Nenets Autonomous Okrug is primarily oriented towards traditional industries (reindeer husbandry, fishing, hunting, berries, nuts and mushrooms gathering), which are the main economic activities for a significant part of the indigenous population. YaNAO is believed to house 50% of the Russian reindeer population and about 35% of the world's total⁴⁶.

The level of food security is rather high, but the region relies heavily on import. Self-sufficiency is high only in fish (88%). In meat, milk and vegetables it is less than 10% from consumption.

Today, the state support of YaNAO agriculture and fisheries is carried out in fourteen directions. Every year nearly 5 billion rubles are directed to the development of this industry, of which 1,5 billion rubles is the state support of traditional branches. Districts pay subsidies to farms to support reindeer husbandry, livestock production, fur farming. They also cover a part of the costs of loan interest expenses and support the beginning farmers.

The region is important to Russia's largest company Gazprom, whose main production fields are located there. Novatek – the country's second largest gas producer – also has activities in the region. If companies withdraw land from cultivation, they pay compensation to indigenous peoples of the North. Novatek also funded the building of fish hatchery.

⁴⁶ Animals crowd in world No 1 reindeer region, The Independent Barents Observer URL: <https://thebarentsobserver.com/en/ecology/2016/07/animals-crowd-worlds-reindeer-region-no-1>

The main possibilities and challenges for the development of the YaNAO food sector are connected with the development of gas-extracting industry. On the one hand, the growth of this industry attracts new population and the demand for food is growing. Moreover, huge corporations that operate in the region finance infrastructure development and some agricultural activities, like fish hatching. On the other hand, this industry is steadily taking up the lands where indigenous peoples of the North used to conduct their agricultural activities. One more possibility is connected with a development of Arctic tourism. It causes a growing interest to traditional agricultural activities like reindeer herding and local food products made of reindeer meat and northern berries.

5.1 Reindeer from the Russian North

Industry description

Primary:
34 organizations of different forms: individual entrepreneurs, JSCs, LLCs and national communities of indigenous peoples of the North, as well as small forms.

Secondary:
5 slaughter-processing complexes

Tertiary:
Companies, offering touristic services (tours to reindeer herders)

Key figures

2 650 tons produced/2017
Slaughter weight

1 150 tons processed/2017
Product weight

Prices:
160 rubles per kilo (sold to processors)
210 rubles per kilo (free sale)

500 tons exported/2017

Key strengths

The largest stock of reindeer in Russia

The only Russian region that is allowed to export reindeer meat abroad

Public support

Local value/value creation

11–14 thousand indigenous people (different accounts)

App. 1 000 employees at state farms

Traditional type of activity for local communities

Employment for indigenous population

Attraction for tourists

Customer segments/markets

Local consumption

Export of meat (500 tons) and reindeer skins to Finland, of meat to Germany (32 tons from 2018)

Logistics

Individual entrepreneurs and national communities sell reindeers to slaughter complexes. These companies send meat to the market by roads or rivers. They also process it producing jerky, salami, canned reindeer meat etc.

Main challenges

Overgrazing

Recent anthrax attack

Withdrawal of land by oil and gas companies

Main Opportunities

Development of deep processing

Cooperation with China

Growth of exports

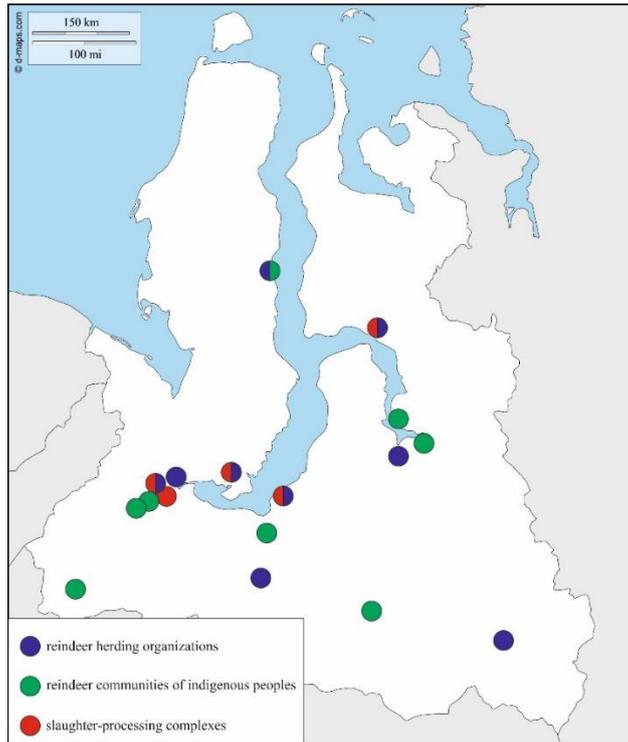


Figure 23 Reindeer organizations, communities and complexes

Description of the industry

According to the authorities in the Yamal-Nenets Autonomous Okrug, there are now more than 700 000 reindeer on the regional tundra. That is an increase of about 200 000 animals in 15 years. According to figures from the Russian Statistical Service, there were 504 000 reindeer in the region in year 2 000.



Reindeer herding in YaNAO, photo by anisimov-photo.com⁴⁷

⁴⁷ <http://anisimov-photo.com/photo.php?gr=17&subgr=32photo.php?gr=17&subgr=32&page=3>

This branch is very important to the local economy. The Nenets culture is built on reindeer herding. According to various accounts there are from 11 to 14 thousand people living in tundra while engaged in reindeer husbandry. For a long time it was perceived as one of traditional industries. Now, there is an on-going transition to large-scale production. The development of a traditional reindeer husbandry is now also taking into account economic and social efficiency. The government started providing subsidies for 1 kilo of meat to inspire private reindeer herders not only to raise livestock numbers, but to develop processing of reindeer meat and offals. It is one of the ways to solve the problem of overgrazing. Yamal reindeer herding is an example of a steady development of the traditional industry. It is able to claim for the role of a pedigree reproducer for reindeer breeding in Russia.

Most of reindeer production capacity is located in Yamal district (located on Yamal peninsula). There is a high-tech slaughter and processing complex that has been successfully operating since 2002 ("Yamal deer"). It has a capacity of 20 000 heads per season. The complex has equipment certified for European standards and it produces reindeer meat and semi-finished products (more than 60 kinds). It was the first one in Russia to get a permission to export reindeer meat to European countries. Over the past 10 years, the volume of reindeer meat exports to the EU has grown 10 times. Deliveries were made to Germany, Sweden and Finland.



Products from reindeer meat. Photo by Vyacheslav Egorov © URA.RU⁴⁸

The introduction of modern technologies will make it possible to bring processing to the almost wasteless level (up to 95%). For this, the Yamal district plans to build a facility for processing enzyme-endocrine raw materials for the production of medicines (pantogematogen, dry blood, etc.). The obtained raw materials will be used in pharmacology for the production of medicines. It is planned to organize cooperation between Chinese and Russian companies specializing in this industry. That is why the future of the industry is closely linked to cooperation with China⁴⁹.

⁴⁸ <https://ura.news/news/1052257217>

⁴⁹ Production of deer meat in Yamalo-Nenets Autonomous Okrug — Sfera.fm, food market news URL: <http://sfera.fm/news/18492>; Yamal has concluded agreements on the supply of delicacies to Finland and Germany, online newspaper Znak URL: https://www.znak.com/2018-01-19/yamal_zaklyuchil_soglasheniya_o_postavkah_delikatesov_v_finlyandiyu_i_germaniyu; Production of deer meat in Yamalo-Nenets Autonomous Okrug — Sfera.fm, food market news URL: <http://sfera.fm/news/18492>; List of recommended prices for agricultural goods, Department of agriculture of Yamalo-Nenets Autonomous Okrug URL: <http://yamalagro.ru/wp-content/uploads/2013/08/%D0%BE%D1%82-06.03.2017-%E2%84%96-46-%D0%9E%D0%94.pdf>; YaNAO increased the export of deer meat to EU countries 10 times in 10 years, RIA news URL: <https://ria.ru/economy/20170317/1490287544.html>

5.2 Fish products from the Russian North

Industry description

82 actors

Primary:

16 fishing companies
+ small-scale forms, including
national communities of
indigenous peoples of the North

Secondary:

All large fishing companies have
equipment for the primary
processing of fish

Tertiary:

4 deep-processing plants (2 big
and 2 small)
1 fish hatchery

Key figures

10 400 tons caught/2017

12 000 processed/2017

900 tons of canned
produced/2017

Prices:

12–290 rubles per kilo (chilled)

14–300 rubles per kilo (frozen)

Top species: pike, ide, burbot

Key strengths

25 commercially valuable species
of fish.

No aqua-farming. Wild catch
means no antibiotics.

Local brand “Yamal product”
Public support

Local value/value creation

App. 2.500 employees in the fishing
sector in total

Traditional type of activity for local
communities

Employment for indigenous population

Customer segments/markets

Local market and Russian market

Logistics

Fish is firstly processed and frozen at the land based factories of
fish-catchers and after that it is ether sold to consumers or
transported to deep-processing plants

Main challenges

Ban on catch of some commercially valuable
species (muksun, white salmon)

Risk of oil spill

Main Opportunities

Development of aquaculture

Export of fish products to China (in plans)

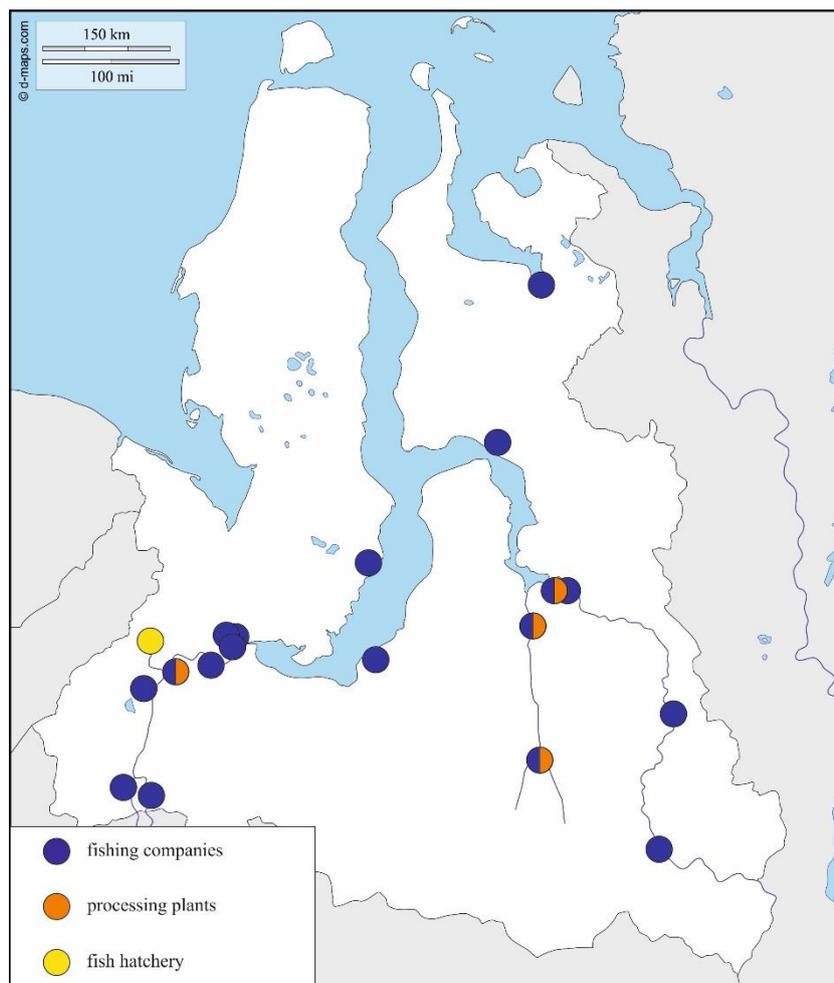


Figure 24 Fish companies, plants and hatcheries

Description of the industry

The fish industry is one of the most important agricultural branches in the YaNAO. It is a complete technological cycle: from fish catch to processing and marketing of products. The total fishery fund of the region exceed 64 thousand km². In the Ob basin, is located the world's largest herd of whitefish, which accounts for 70% of the total Russian stock. The basis of the fish fauna is formed by white salmon (nelma), muksun, chir (*Coregonus nasus*), peled⁵⁰. In 2016 it was prohibited to catch white salmon and muksun until their population stabilize for which many fishing companies have refocused on cod and haddock. Re-specialization was almost painless because maximum concentration of fish catchers is near Ob river mouth.

⁵⁰ Agro-industrial complex of YaNAO, Department of agriculture of Yamalo-Nenets Autonomous Okrug URL: <http://yamalagro.ru/%D0%B0%D0%B3%D1%80%D0%BE%D0%BF%D1%80%D0%BE%D0%BC-%D1%8F%D0%BC%D0%B0%D0%BB%D0%B0/>



Yamal fishers, photo by anisimov-photo.com⁵¹

A significant part of the caught fish is processed by two enterprises: OOO Salekhard fish cannery (western part of region) and LLC Pur-fish (eastern part of region). Enterprises have modern equipment and their production capacity allows to process 5000 tons of fish per year. Yamalproduct (brand of Salekhard fish cannery) is expanding the range of fish delicacies production and a network of its own branded stores in Yamal, Moscow, Tyumen and Ekaterinburg. 2 smaller processing companies are located around Taz bay and provide fish products only for local market.

There is one fish hatchery on the river Sob that flows into Ob. "Sobsk hatchery" allows to unite efforts of region and companies to replenish aquatic biological resources. In 2017, it released more than 3 million pieces of young muksun, more than 3,5 million pieces of *Coregonus nasus*, and about 17 million of young peled. Among the largest customers this year were the companies "NOVATEK", "Gazprom", "Rosneft"⁵².

⁵¹ <http://fr.anisimov-photo.com/photo.php?gr=17&subgr=89photo.php?gr=17&subgr=89&show=all>

⁵² Information Card of YaNAO region, Ministry of Foreign Affairs URL: http://www.mid.ru/vnesneekonomiceskie-svazi-sub-ektov-rossijskoj-federacii/-/asset_publisher/ykggrK2nCl8c/content/id/128534

Fishery in YaNAO, Interfax URL: <http://www.interfax-russia.ru/Ural/print.asp?id=909364&type=news>

The programme for the development of fish industry in YaNAO, Internet newspaper "Kommersant" URL: <https://www.kommersant.ru/doc/3547674>

List of recommended prices for agricultural goods, Department of agriculture of Yamalo-Nenets Autonomous Okrug URL: <http://yamalagro.ru/wp-content/uploads/2013/08/%D0%BE%D1%82-06.03.2017-%E2%84%96-46-%D0%9E%D0%94.pdf>

5.3 Berries, mushrooms and nuts from the Russian North

Industry description

Primary:
9 enterprises — harvesting wild plants

Secondary:
7 modular processing units in villages (frozen or dried berries and mushrooms)

Tertiary:
1 company — deep processing (jams, juices, syrups etc.)

Key figures

200 tons berries gathered/2017

Mushrooms: no data

Nuts: no data

Berries sold to processors:
180–300 rubles/kg

Key strengths

Wild plants — no pesticides and herbicides,

Environment-friendly products.

Public support

Local value/value creation

Traditional type of activity for local communities

Employment for indigenous population

Additional source of income for the population

Customer segments/markets

Local market and markets of neighboring regions.

Logistics

1 stage: Gather berries and bring them to reception sites

2 stage: Transported (by roads or by boats) to processing units

3 stage: Dried/frozen or fresh berries are brought to the company of deep processing

Main challenges

Dependence of yield from climatic conditions

Poor statistics => lack of control

Main Opportunities

Development of deep processing

Creation of their own “northern” brand for products from local berries (Taste the Arctic)

Entry into service of a modular processing unit on a base of a ship to gather berries from hard-to-reach areas.

Cooperation with China

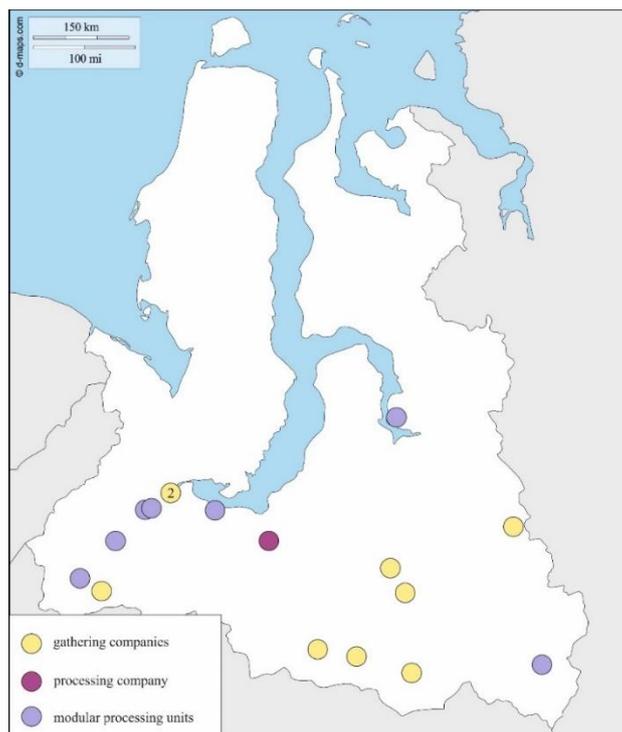


Figure 25 Berries, mushroom and nuts gathering and processing companies/units

Description of the industry

Considering the rich natural potential of the Autonomous Okrug, one of the promising activities is harvesting and processing of wild plants. Nowadays 9 enterprises are engaged in harvesting. People also gather berries and then sell them at receiving points at a cost 180–300 rubles per kilo. A cloudberry is the most expensive one. In 2017 on the territory of the region was gathered almost 200 tons of berries. No statistics on mushrooms and pine nuts. Deep processing of wild plants is carried out by LLC PF "Nyda-resource". The assortment represents more than 50 types of products.



Photo by Tyumenskaya Pravda newspaper⁵³



by Vyacheslav Egorov © URA.RU⁵⁴

⁵³ <http://tyum-pravda.ru/biznes-main/33519-tsarstvo-yagod-i-gribov>

⁵⁴ <https://ura.news/news/1052299162>

To develop this industry, the government provided 7 villages with modular processing units that are made on the basis of sea containers. Every unit is equipped with: a facility for cleaning berries, floor scales, a shock freezer with a productivity of 30 kg per cycle, a packing machine and a 25 m³ refrigerating chamber with a storage temperature of -18°C.



Modular processing unit in Pelvozh, report of Vesti Yamal, 06/07/2015⁵⁵

This activity is accounted to be a very promising one, but there is almost no statistical data.

⁵⁵ <https://www.youtube.com/watch?v=d1tq1GYmiWE>

6 Food production in Arctic Canada

Although Aboriginal communities in the Canadian Arctic continue to rely on subsistence harvesting to meet their livelihood needs, they also have shown a commercial interest in the production of food commodities. Since the settlement of comprehensive land claims, Aboriginal leaders have pursued economic development in food related industries as a means to improve the socioeconomic circumstances of northern communities. The territorial and federal governments have also supported entrepreneurship in Aboriginal communities as a means to create self-employment and regional development. New industries are being developed to better capitalize on commercial food production opportunities that can lead to local economic development and alleviate condition of food insecurity in northern Canada.



Figure 26 Study area in Canada

Northern food production involves farmed and wild stocks. Aquaculture products include char from Icy Waters in the Yukon and poultry\egg production occurs in the Northwest Territories by Arctic Egg. Wild marine stocks are harvested by nine northern producers located in the Northwest Territories, Nunavut, Nunavik and Labrador (see Table 2 and Figure 27).

Table 2 Overall production of food and food related products in Arctic Canada

Species Average annual production	Volume Tons	Revenue Million \$	Market/Destination
Charr (2010–2014)	55	0,27	USA, EU via Greenland and Domestic
Greenland Halibut (2010–2015)	13 951	70,83	USA, EU via Greenland and Domestic
Shrimp (2010–2015)	11 568	38,79	USA, EU via Greenland and Domestic
Freshwater Fish (2010–2015)	422	0,64	Via Freshwater Fish Marketing Company
Seal meat (2004–2010)	83	0,29	South Korea, Taiwan and China
Seal oils (2004–2010)	2 861	3,85	South Korea, China, Norway, US and Italy

Species Average annual production	Volume Number	Revenue Million \$	Market/Destination
Seal pelts (2004–2010)	245	14,39	Norway, Greenland, Finland, Germany, China and Denmark
Muskox (2001–2008)	47	NA	Domestic
Caribou (2005–2006)	NA	20	Domestic
Caribou Harvest (2001)	850	17	Domestic and Commercial
Polar Egg: Number of chicken (2012)	0,11 mill	NA	Domestic
Polar Egg: Number of eggs (2012)	35 mill	NA	Domestic



Figure 27 Locations of key arctic food producers

A number of constraints complicates the interest in commercial sale of wild foods in northern Canada. Legislation at various levels of the government either prohibits or severely restricts the commercial sale of wild foods, particularly for export markets. The requirement to meet conservation measures and respect government-processing standards have restricted the commercial development of these foods for export, which in turn, has limited development opportunities.

Notwithstanding the challenges, there are considerable opportunities for commercial food production, both for export and for meeting local food needs. Food industries are producing large volumes of food commodities that are culturally compatible with indigenous\local food preferences and also have high export value. For example, in 2017, Canada’s Arctic regions exported in excess of 75 163 383 kg of fish and other marine products to international markets. This export had an estimated value of \$797 960 562 CAD⁵⁶. The production and distribution of these products involves a value chain of over 315 domestic and international actors, including producers, processors, transportation services, and wholesalers.

Table 3 Common challenges in the commercialization of Arctic wild food products in Canada

Challenges	Causes	Impacts	Sources
Regulations	Conservation; food inspection; federal safety standards; land claims provisions. Legislation at various levels of government either prohibits or severely restricts the commercial sale of wild foods.	Restricts the availability and accessibility of country foods Directly affecting harvesting. Selling foods is restricted Unable to comply with rules and standard to be maintained for marketing products	BQWMB 2016 ⁵⁷ Gombay 2005 ⁵⁸
Cultural barriers	Beliefs is foods to be shared as received freely A collective goods not to be belonged to someone. Inuit belief: What comes freely must be given freely	Selling of local foods are a taboo and goes gains the communal rules of sharing.	Chan et al. 2006; Gombay 2010; Nuttall et al. 1991 ⁵⁹
Institutional barriers	Financial constraints	Partnerships or contracting resources to outsiders	https://www.ictinc.ca/blog/11-challenges-for-indigenous-businesses
Climate change	Species availability and sustainability.	Increased costs of harvesting (fuels and equipment) Deceased accesses to hunting of other species located in same habitats)	Macdonald et al. 2015; Beaumier MC and Ford JD. 2010 ⁶⁰
Supply uncertainty	Population changes and new products may change or threaten native species.	Corporations may be unwilling to invest risking losses	Mason et al. 2007 ⁶¹
Skilled labour	Limited labour	Shortage of qulaified workers and additional labour costs.	Mason et al. 2007
High production costs	Longer transportations/timing to reach hunting grounds	Food might be available but not accessible because of cost, success is limited	
Lack of infrastructures	Unreliable roads, airports or airstrips, electricity, land sites.	Marketing costs are higher	https://www.ictinc.ca/blog/11-challenges-for-indigenous-businesses

⁵⁶ <http://webgis.usask.ca/ArcticFood/>

⁵⁷ BQCMB (Beverly and Qamanirjuaq Caribou Management Board). 2016. The Beverly and Qamanirjuaq Barren Ground Caribou. 2016. 2015 – 2016 Annual Report. 54 pages.

⁵⁸ Gombay, N. 2005. The Commoditization of Country Foods in Nunavik: A Comparative Assessment of its Development, Applications, and Significance. *Arctic*, 58(2): 115– 128.

⁵⁹ Chan, H.M., Fediuk, K., Hamilton, S., Rostas, L., Caughey, A., Kuhnlein, H., Egeland, G., and Loring, E. 2006. Food security in Nunavut, Canada: Barriers and recommendations. *International Journal of Circumpolar Health*, 65(5), 416-431.

⁶⁰ McDonald, S. 2015. The business of Arctic char fishing in Nunavut. URL: <https://www.country-guide.ca/2015/04/21/the-business-of-arctic-char-fishing-in-nunavut/46508/>

⁶¹ Mason, M., A., Dana, L-P. and Anderson, R. 2007. The Inuit commercial caribou harvest and related agri-food industries in Nunavut. *Int. J. Entrepreneurship and Small Business*, 4(6), pp.785–806.

6.1 Fishery products from Arctic Canada

The major commercial fisheries in the Canadian Arctic are Greenland halibut, shrimp (*Pandalus borealis* or northern shrimp), *Pandalus montagui* (striped shrimp), and Arctic char. In the Northwest Territories (NWT), the major species harvested are lake whitefish, lake trout, northern pike, and inconnu. The average annual contribution from freshwater fish (especially from Northwest Territories) has been 422 tons which has generated a revenue of 0,64 million dollars for the year 2010–2015. Offshore, Canadian Greenland halibut a product from the Nunavut area - primarily enters the EU through the EU Border Inspection Posts in either Sisimiut or Nuuk, Greenland. Container ships transport fish products (Greenland halibut and northern shrimp) from Greenland to Aalborg, Denmark. Northern shrimp from Nunavut are landed in Greenland to facilitate transportation to other international ports. The Pangnirtung production of halibut and other fish is shipped to markets mainly in Europe and Asia via cargo plane. An inshore turbot fishery operates in Pangnirtung mainly in the winter, but sometimes during the summer, which provides an important source of local employment and supplies high quality fish products to international consumers.



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Greenland Halibut

Greenland halibut or turbot (*reinhardtius hippoglossoides*) is a deep-water flatfish found in the cold northern waters of the Atlantic Ocean. In the northwest Atlantic, they are especially abundant in the deep coastal bays or fjords of West Greenland and east Baffin Island as well as off the continental shelf of Baffin Island.

Greenland halibut fisheries constitute the vast majority of the Nunavut catch. The average 6-year (2010–2015) landing has been 10 176 tons, which is worth \$50 million/year. The total landed value of Greenland halibut was 11 150 tons, which was worth \$78 million dollars in 2015. The average annual production of Greenland halibut was 13 951 tons (2010–2015) which provided a revenue 71 million.

Shrimp

Northern shrimp (*Pandalus borealis* and *Pandalus montagui*) are the most important species of wild shrimp in the world and can be found in the Northwest Atlantic from Baffin Bay to the Gulf of Maine. The average annual landed volumes of Northern Shrimp has been 11 568 tons (landed values 39 million/year) between 2010–2015.

The offshore fisheries for northern shrimp have existed since the 1980s, primarily in the Hudson Strait and Ungava Bay. The Baffin Fisheries Coalition and the Pangnirtung Fisheries Ltd. holds most of the licenses for northern shrimp in Nunavut. However, the quota has been redistributed between Baffin Fisheries (70%) and Qikiqtaaluk Corporation (30%)⁶².

Northern shrimp fisheries are very important for the Nunavut economy: yielding approximately \$3 million in 2005. However, fishing northern shrimp in SFA 1 and 2 often involves considerable costs, causing the fishery, in some years to be uneconomical. Due to frequent financial losses, shrimp allocation often go unmet. These high costs, as well as the low market price of the shrimp, has led to much of the quota being left in the water and the allocations going.

Arctic char

Arctic char are distributed throughout the Canadian Arctic and occur in both non-anadromous (lake-resident or land-locked) and anadromous (searun) forms. The commercial harvest of Arctic char has a long history in northern Canada and is harvested both for commercial and subsistence uses by local communities using weirs and nets.

The average annual production of Arctic Char from Nunavut was 55 tons during 2010–2015 and the total revenue has been 0,27 million dollars. Commercial fishing in Nunavut began in the mid-1940s. Today the processing plants are important to the people of Nunavut because they stimulate business growth and promote economic diversification⁶³.

⁶² CBC New. 2016. Food processing course aims to make traditional food market-ready. URL: <http://www.cbc.ca/news/canada/north/inuvik-traditional-food-processing-course-1.3470166>

⁶³ NDC ((Nunavut Development Corporation). 2016. 2015-2016 Annual Report of the Nunavut Development Corporation. URL: [http://www.assembly.nu.ca/sites/default/files/TD%20193-4\(3\)%20EN%202015-2016%20Annual%20Report%20of%20the%20Nunavut%20Development%20Corporation.pdf](http://www.assembly.nu.ca/sites/default/files/TD%20193-4(3)%20EN%202015-2016%20Annual%20Report%20of%20the%20Nunavut%20Development%20Corporation.pdf)



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Three established processing plants (Kivalliq Arctic Foods Ltd. in Rankin Inlet, Pangnirtung Fisheries Ltd. in Pangnirtung, and Kitikmeot Foods Ltd. in Cambridge Bay) process char into products that are consumed by a significant and expanding local market as well as across Canada and internationally. Char products include char fillet, whole dressed char, smoked char, char steak, and Arctic char jerky. The products are shipped to customers (e.g. Kivalliq Arctic Foods) locally through stores available in communities and also to high-end restaurants across the USA and Canada. The heightened sales are partly attributed to CleanFish, a San Francisco-based company that links sustainable fisheries with some prestigious U.S. restaurants and retailers.

According to Todd Johnson of Kivalliq Arctic Foods, the value of this fishery is immense. Mostly importantly, this fishery provides employment for the local fishermen during a normally slower time of the year. The average landings of Arctic char from the Nunavut Region ranges between 66 tons per year that provides a sale value of \$ 3,2 million/year (2010–2014). The local leaders of Nunavut have treated the commercial Arctic char fisheries as one of the territory's best opportunities for economic growth with strong export potentials⁶⁴.

Global warming may be a potential threat to char fisheries. Studies indicate that their range might be contracted from high temperature with global warming.⁶⁵

⁶⁴ Senate Committee Canada. 2009. Nunavut Marine Fisheries: Quotas and Harbours. Report of the Standing Senate Committee on Fisheries and Oceans. URL: <https://sencanada.ca/content/sen/Committee/402/fish/rep/rep04jun09-e.pdf> (Accessed June 2017)

⁶⁵ Reist, J.D., Wrona, F.J., Prowse, T.D., Power, M., Dempson, J.B., Beamish, R.J., King, J.R., Carmichael, T.J., and Sawatzky, C.D. 2006. General effects of climate change on Arctic fish and fish populations. *Ambio* 35(7):370–380, doi:10.1579/0044-7447(2006)35[370:GEOCCO]2.0.CO;2.



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6.2 Seal pelts, meats and oils from Arctic Canada

Canada's commercial seal hunt involves 7 000 sealers and a 2008 landed value of \$6,9 million CAD. There are six different species of seals that are harvested: Harp seal, Grey Seal, Hooded Seal, Ringed Seal, Harbor Seal and Bearded Seal. Among them, harp seals have been a major contributor to commercial sealing and a small numbers of grey seals have also been harvested.

Three types of commercial use of seals. They are as follows:

Pelts: Seal pelts are used in making coats, vests, hats, ties, boots, mittens, trim, and seal leather items. Sealskin garments are both warm and waterproof and are considered the perfect clothing for harsh northern regions due to price and practical reasons.

Meats: Raw and prepared forms for both human and animal consumption. Also a source of traditional foods of Arctic communities such as Nunavut.

Oils: Source of omega 3 health products that are sold in Canada and abroad.

Historically, Canada has been the largest exporter of seal products. Between 2005 and 2014, Canada exported more than \$67 million worth of seal products to 48 countries. Uncertainty in global markets has long existed for the seal market. These uncertainties includes market access restrictions in the European Union (EU) and other destinations that have negatively impacted the seal economy. However, there is an indigenous exemption of WTO (World Trade Organization). Seals have therefore contributed to export markets that include pets, oils, and meats.

Table 4 Existing supply of seal products in Canada

Types of Products	Name of the Company	Areas They Can Sell Products
Meats and oil	Carino Processing Ltd	Canada and can export to Hong Kong, but not Mainland China.
Pelts, meat, and oil	PhocaLux International Inc.	Canada
Seal flippers, seal carcus, seal meat vacuum sealed, seal stew as well as seal jewelry	Kindens Fresh is Best Ltd	Canada

Source: http://www.sealharvest.ca/?page_id=3235

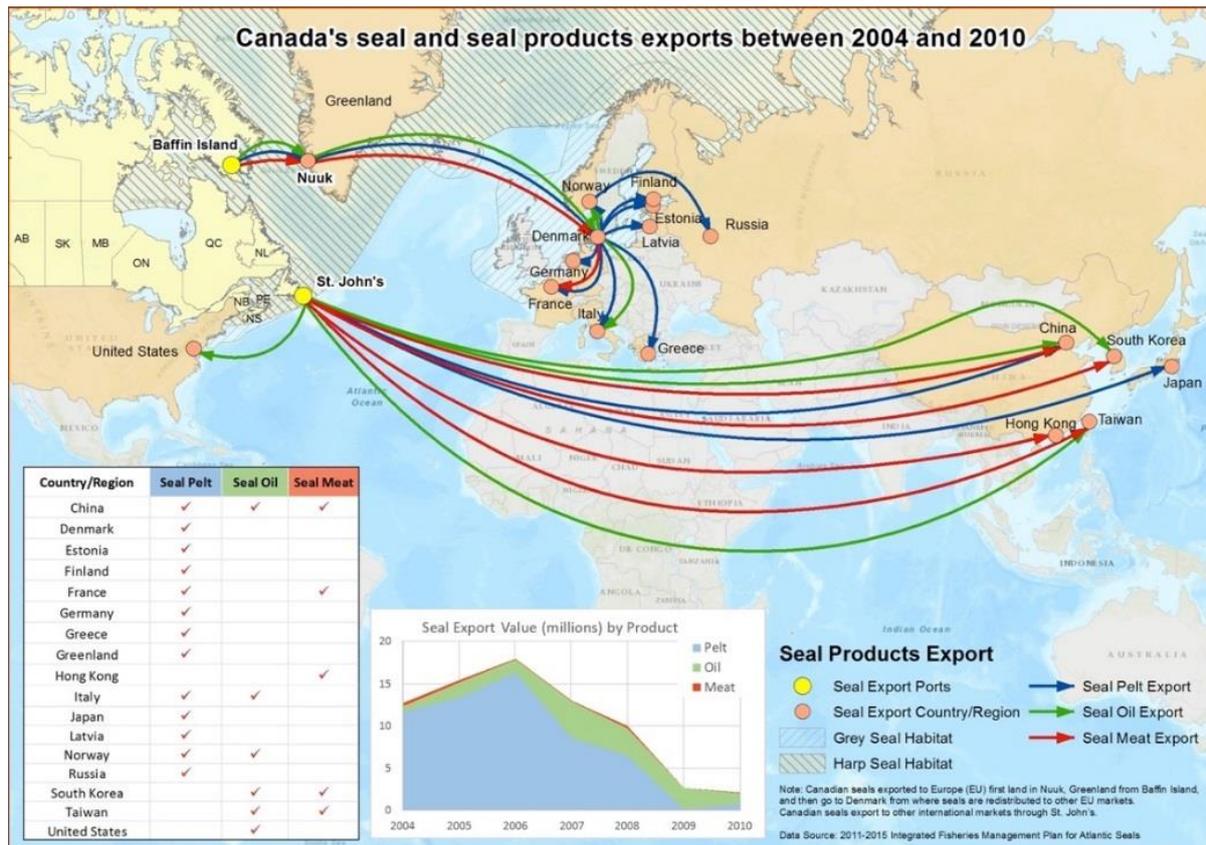


Figure 28 Seal and seal products exports (2014–2010)

Although potential exists for market growth⁶⁶, animal rights groups are active opponents of seal harvesting and claim there is no significant market value in hunting seal. Some reports do indicate the seal industry is saturated with sales in pelts, and the sale of sea oil has been in decline. Additionally, a growing number of countries have closed their doors to seal products. Belgium, Croatia, Slovenia, and the Netherlands currently have national-level bans on seal products, as does the United States and Mexico. Hungary, Germany, Austria, Switzerland, the Czech Republic, and Italy have also taken steps towards implementing national bans. Despite the challenges, DFO sees hope in the increased use of seals products and has been lobbying the EU community greater market access. In response to the

⁶⁶ DFO (Department of Fisheries and Ocean. 2011. Agreement on Edible Seal Products an Achievement for Newfoundland and Labrador Sealing Industry. URL: <http://www.releases.gov.nl.ca/releases/2011/fishaq/0113n05.htm>

bans in Belgium and the Netherlands, Canada requested formal consultations at the World Trade Organization.

6.3 Muskox products from Arctic Canada

Muskox are noted for their unique habitat selection in colder regions of the world with a strong adaptive feature (a thick two-layered fur coating that keeps them warm against colder weather conditions of Arctic) and fairly concentrated distribution across the Arctic. In areas like Nunavut, muskox are an important source of meat where they are harvested as a subsistence food source. Along with seal and other foods, muskox are part of the diet of Inuit and other aboriginal peoples.

Some muskox are harvested for commercial purposes, and is made available in retail outlets and restaurant⁶⁷. The Western Arctic area near Sachs Harbor and Holman is known for large-scale commercial harvests. Usable parts from muskox include meat, hides, wool (Qiviut) and horns. Communities have exported these items to markets in southern Canada.

In addition to hunting for subsistence and marketing purposes, guided sport hunting and outfitting based tourism connected to muskox also provide a source of income for some Northern communities. The communities of Holman, Sachs Harbor, Paulatuk, and Tuktoyaktuk offer outfitted sport hunts. Muskox are considered a unique and valuable trophy. Sport hunters pay as much as \$5 000 to hunt them⁶⁸.

Hunting muskox has contributed to local employment. In the NWT, the Inuvialuit Regional Corporation helps Sachs Harbour residents hold a community muskox hunt on Banks Island. Muskox population on the island fluctuates between 80 000 and 120 000⁶⁹. At present, the community harvests a few hundred muskoxen (roughly 4% of the total estimated population). In 2008, the hunt brought in \$70 000 worth of wages into Sachs Harbour and employed more than 20 community members. In 2006, 300 tags were allocated by the Nunavut Development Corporation (NDC) for hunters that accounted for 30–35 jobs. To harvest muskox, local hunter and trapper organizations (HTOs) have a partnership with Kitikmeot Foods.

Aerial surveys of muskox were carried out to estimate the muskox population in the summer and fall of 2013 and 2014. This survey estimated that around 10 000 muskoxen constitute the population of the Nunavut Settlement Region. Local Inuit knowledge suggests that muskox numbers are declining on Victoria Island, which ultimately resulted in the closure of commercial harvesting in 2013. In contrast, populations of muskox were believed by local harvesters, to be on the rise in the regions surrounding Kugluktuk and on King William Island. At present, the total allowable harvest for Victoria Island is 400 animals, or 4% of the population per year.

Other than processing the meat of muskox, Kitikmeot Foods Ltd. processes the valuable qiviut (the wool of the muskox), which is the animals' soft under-wool. The wool is used to make clothing, and the horns are used for carvings. The knitted qiviut mittens have a high market demand and are sold in

⁶⁷ WMAC (Wildlife Management Advisory Council). ND. Muskox as a Resource. URL: http://www.wmacns.ca/pdfs/118_Muskox%20Fact%20Sheet%20Number%207.pdf (Last Accessed June 2017)

⁶⁸ NDC (Nunavut Development Corporation). 2013. Nunavut Muskox. URL: <http://www.nunavutmuskox.ca/> (January 2017)

⁶⁹ McKeon, L. 2009. Commercial Fishing. News North. URL <http://www.nnsi.com/business/pdfs/commercial-fishing.pdf> (Last Accessed May 2017)

Yellowknife. Mittens sold in retail outlets easily sell for \$100–\$250 a pair, while sweaters go for several hundred dollars more. In southern Canada qiviut sweaters may sell for \$900 CAD while knitted scarfs can cost more than \$400 CAD.

At present, muskox meats are available only to Nunavummiut (Inuit of Nunavut) in a variety of cuts through Kivalliq Arctic Foods. Muskox meat is a gourmet delicacy that offers a natural alternative to beef⁷⁰. As muskox roam free in Northern Canada, the meat contains only organic nutrients. One average sized bull can produce about 135 kg of meat. Muskox meat has fewer calories than beef and pork and it is liked by the Aboriginal community due to its many health benefits. Like Kivalliq Arctic Foods, the Kitikmeot Foods in Cambridge Bay, a subsidiary of the Nunavut Development Corporation, conducts a federally inspected harvest and processes the meat at its registered facility. Although delicious for organic nature and highly desired by local communities as wild meats, muskox is presently unable to be shipped outside of the Territory.



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Muskox meats are generally expensive compared to other meats, costing as much as \$40/kg⁷¹. There are other reasons, too, for the higher price of the meat. In Nunavut, with temperatures ranging from -27°C to -37°C, hunters must transport their harvest back to a processing plant located at Cambridge Bay before the meat freezes or begins to lose its quality. Also, there is the cost of shipping small amounts from the north to southern markets.

6.4 Caribou products from Arctic Canada

Caribou is utilized predominantly for subsistence purposes. In Nunavut harvesting occurs under the supervision of the Nunavut Development Corporation, the responsible authority under the Land Claim Agreements 1999. In 2005–2006, Canada has exported around two tons of meat to distant markets

⁷⁰ NDC (Nunavut Development Corporation). 2013. Nunavut Muskox. URL: <http://www.nunavutmuskox.ca/> (January 2017)

⁷¹ Mintz, C. 2012. Musk ox dish offers sobering food for thought. https://www.thestar.com/life/food_wine/2012/03/01/musk_ox_dish_offers_sobering_food_for_thought_mintz.html

including the USA⁷². Due to dramatic declines in caribou populations across Arctic Canada, caribou hunting occurs on a subsistence basis only but in some cases involves inter-community trade. As of 2013, Kitikmeot Foods Ltd. is the only commercial distributor of caribou meat but no shipments are available outside the territory⁷³. At present, Canada does not have an established market for caribou.

6.5 Community garden and greenhouse products from Arctic Canada

Community gardens and greenhouses are seen as an alternative to imported foods that are often unaffordable, are of compromised quality, or simply unavailable in local retail outlets. There are 36 community gardens and 17 greenhouses across northern Canada. Of these 53 initiatives, 36 are located in the Northwest Territories, 10 in the Yukon, 3 in Nunavut, 2 in Labrador, and 2 in Nunavik. Thirty-four (64%) of these initiatives were in communities with populations under 1000 residents.

The largest projects, in terms of production space, were the Gameti Community Garden in the Northwest Territories (21 600 ft²), the Tr'ondek Hwech'in Teaching and Working Farm in Dawson City, and the Inuvik Community Greenhouse in the Northwest Territories (4 000 ft²).

Greenhouses (10) in the Northwest Territories account for 60 180 ft² of planting space. Community gardens tend to produce various root crops, including potatoes, carrots, turnips, beets, and onions as well as lettuce, sunflowers, berries, chives, and even rice. In addition to vegetable production, community gardens and greenhouses are also stimulating other forms of local food production. For example, the communities of Deline, Wrigley, and Gameti in the Northwest Territories, and Kuujjuaq in Nunavik, have incorporated poultry operations as part of their community gardens, as a source of organic fertilizer and meat production.

⁷² Humphries, J. E. 2007. Reindeer Markets in the Circumpolar North: An Economic Outlook John Eric Humphries. URL: http://www.iser.uaa.alaska.edu/Publications/reindeer_markets_jeh9-13-2007.pdf

⁷³ NDC ((Nunavut Development Corporation). 2016. 2015-2016 Annual Report of the Nunavut Development Corporation. URL: [http://assembly.nu.ca/sites/default/files/TD%20193-4\(3\)%20EN%202015-2016%20Annual%20Report%20of%20the%20Nunavut%20Development%20Corporation.pdf](http://assembly.nu.ca/sites/default/files/TD%20193-4(3)%20EN%202015-2016%20Annual%20Report%20of%20the%20Nunavut%20Development%20Corporation.pdf)

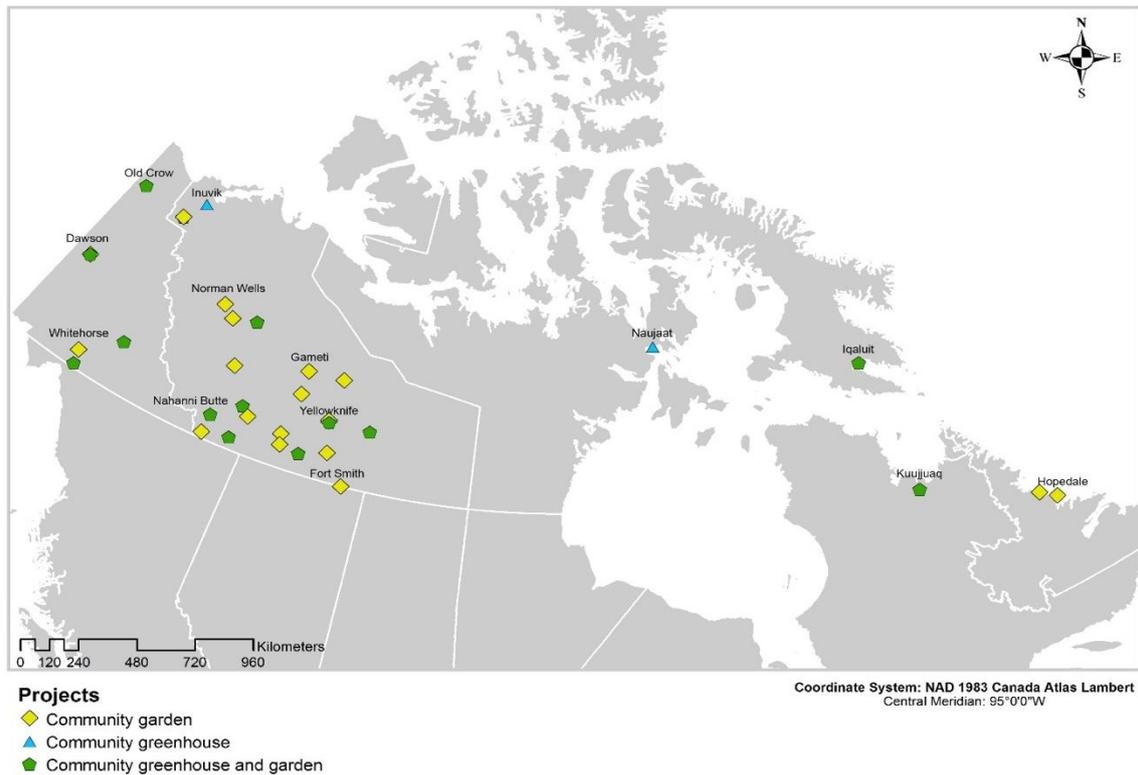


Figure 29 Community greenhouses and gardens

Community gardens and greenhouses provide users with multiple benefits well beyond food production. Community gardens and greenhouses are being used as sites for the delivery of training and education modules on food utilization and storage, food preparation, food safety, nutrition and healthy eating behavior⁷⁴. Communities in the Northwest Territories (Jean Marie River, Fort Simpson, Nahanni Butte, and Samba K'e) and Labrador (Hopedale) also deliver community workshops on home gardening and food preservation techniques. Having access to such programs enhances the wellbeing of participants by decreasing anxiety and feelings of helplessness as well as providing a social environment and a safe communal space⁷⁵. The development of community gardens and greenhouses in northern Canada also provide communities with a method of adapting to rapid climate and socioeconomic change being experienced by Northern communities⁷⁶.

⁷⁴ Inuit Tapirit Kanatami (n.d.a). NiKigijavut Nunatsiavutinni (Our Food in Nunatsiavut) Project. Retrieved August 2016 from <https://www.itk.ca/nuluaq-mapping-project/initiative/nikigijavut-nunatsiavutinni-our-food-in-nunatsiavut-project/>

⁷⁵ Ford, J., Lardeau, M., & Vanderbilt, W. (2012). The characteristics and experience of community food program users in arctic Canada: A case study from Iqaluit, Nunavut. BMC Public Health, 12(1), doi:10.1186/1471-2458-12-464.

⁷⁶ Government of Yukon (2013). Yukon agriculture state of the industry report 2010-2011-2012. Retrieved December 2017 from http://www.emr.gov.yk.ca/agriculture/pdf/20102012_agriculture_stateofindustry_interimreport.pdf

7 Discussion

The long term objective of the project is to contribute to identify new food production opportunities that could lead to sustainable economic development for Arctic communities. Preliminary results show that within the Arctic region there are considerable opportunities for commercial food production, both for export and for meeting local food needs. Food industries are producing large volumes of food commodities that are culturally compatible with indigenous\local food preferences and also have high export value.

There are large variations in actual and potential production and harvesting volumes, both between Arctic nations, species and product groups. The volume variations at a national level can, for instance, be seen in the export statistics for seafood products (Table 5). These differences will have large effect on product development and marketing strategies chosen by the company and country as a whole. An interactive map of Arctic seafood export can be found at <http://webgis.usask.ca/ArcticFood/> illustrating the export and destination of seafood from the different Arctic countries.

Table 5 Export of seafood from the Arctic countries in 2016 (in volume and value)⁷⁷

Country	Volume (in tons)	Revenue (in million)	
Canada (Arctic)	75 163	CAD	797 961
Alaska	1 552 429	USD	2 113 876
Norway	2 232 902	NOK	89 187 310
Denmark	662 427	DKK	21 866 239
Iceland	595 750	ISK	245 967
Russia	1 622 000	USD	3 430 000

Whereas challenges with infrastructure and food security are important issues in both Greenland, northern Canada and Russia, marketing access, lack of available raw material and skilled workforce, and environmental issues are some of the main challenges in Norway and Iceland. All countries can have the advantages of adding value to the products by further processing and product development or identifying the local value by historic background or arctic quality for increasingly growing tourist market. Iceland, Norway and Russia are already identifying special chemical attributes within the raw material produced in the arctic climate, and using this for marketing or as extractions of valuable compounds used within the industry. New opportunities within the Arctic region arise because of global warming, especially within land-based production. As the growing season is being prolonged, it opens up for new and more productive species, especially annual species. An ongoing North-Atlantic collaboration has identified a possible northward expansion of barley cultivation because of temperature increase⁷⁸. With a changing diet preference the market demands more vegetable based products which can increase production of berries and vegetables in the Arctic. Future opportunities also lies in new and better storage methods for seasonal raw material and full utilization of the raw material. Further, the Arctic areas have unused grazing resources.

⁷⁷ Data source: https://www.ic.gc.ca/eic/site/icgc.nsf/eng/h_07052.html

⁷⁸ Martin P, S. Dalmannsdottir, JI í Gerdinum, H. Halland, J. Hermannsson, V. Kavanagh, K. MacKenzie, O. Reykdal, J. Russell, S. Sveinsson, M. Thomse & J. Wishart (2017). Climatic Change. Recent warming across the North Atlantic region may be contributing to an expansion in barley cultivation. *Climatic Change*, 145:3, pp. 351–365.

Food production is of great importance for the economy of Iceland. Fisheries based on large vessels are well established and fish is exported to many countries. A considerable part of the population and economic activities are located in the southern part of the island. The northern part faces the Arctic Ocean and this part of the island is sparsely populated. However, the northern region is well suited for sheep farming and geothermal energy and tourist attractions are found in this region. Infrastructure is less developed than in South Iceland, e.g. regarding roads and transport systems. The population in North Iceland has been shrinking over the last few decades and this could develop to a critical point where residence cannot be maintained. Increased food production in the northern regions might be a key factor to preserve the inhabited regions. New opportunities might include domestic food production in farms and villages to meet required sustainability and reduced carbon footprint. This might interest tourists which are mostly visiting South Iceland at the present time. The tourist industry could become important for the economy of the northern regions.

Agriculture production in Northern Norway is mainly grass-based animal husbandry (dairy cattle, sheep, pig, laying hen and goat), but some farms also include horticultural production (potatoes, vegetables and berries). The national objective is to cover local, regional and national demand, thus the amount exported is quite small. As much as 95% of the fishery and aquaculture products are, on the other hand, being exported to other markets. The most important species in terms of volume are salmon, trout, cod, mackerel, herring and saithe. Despite different market situations of agriculture and aquaculture products, some challenges are general. First, all industries experiences production or harvesting limitations, due to either national regulations (e.g. quotas, health and safety legislations) or natural circumstances (e.g. climate, availability of food sources, resource availability). Second, high labor costs, transport costs and tariffs on high-value food products, affect the profitability of food producing companies, for example contributing to less processing of seafood within the Norwegian borders. Third, similarly to the other countries, there is also a shortage of skilled workforce. Since food harvesting and/or production in most instances are located in districts with low population density, acquiring knowledgeable and flexible employees can be an issue. The main opportunities for increased food production and value adding revolves around niche products and storytelling, better use of leftover biomasses, improving product quality and increasing food tourism and local markets.

Canada's Arctic regions in 2017 exported in excess of 75 163 tons of fish and other marine products to international markets. This export had an estimated value of 797 961 million CAD. The production and distribution of these products involves a value chain of over 315 domestic and international actors, including producers, processors, transportation services, and wholesalers, the value and potential are herefore high. Yet Canada's Arctic foods value chain is challenged by a host of social, economic, logistical, and political obstacles. Industries located along the value chain tend to be fragmented and have little to no coordination or communication. This has perpetuated an overreliance of raw export, bottlenecking of distribution points, and limited innovation in primary and secondary product development.

Similar challenges exist for Greenland where the two dominating challenges are the poor infrastructure and the lack of skilled labour, which makes it difficult to increase the volume of production and costs involved. However, even the though the amount of food produced (other than non-processed fish) remains relatively small, the quality is often high and the storytelling about pure and sustainable production of food with an almost 100% focus on wild food resources holds potential. Even though exports might be challenging, an increase in tourism with a focus on Arctic gastronomy

might increase sales and the value of locally produced quality food - simply by bringing people to the food instead of relying on export.

Agriculture in Northern Russia is mostly based on reindeer husbandry and fishery. Due to low population density and lack of infrastructure production of traditional crops and livestock mostly has a self-sustaining value. Northern agriculture works for the local market to provide population with food and indigenous peoples of the North with workplaces. The most important species of fish include cod, herring and salmon. Freshwater fish production decreased because of a recent ban on catch of some commercially valuable species (muksun, white salmon). Regions of Asian Arctic (e. g. YaNAO) specialize on reindeer production with reindeer meat being sold on local, national and export markets. Regions of European Arctic produce frozen fish and fish products for national market and export. Products from northern berries are produced mostly for local and national market. Similarly to other northern countries, there is a lack of skilled workforce. The reason is that the salary in agriculture is really low, especially in comparison to resource extraction that is dominating in the Russian Arctic. High cost of electricity and poor infrastructure makes it difficult to develop agro-processing. For example, in Nenets autonomous okrug, people use helicopters to bring reindeer meat to load (in the necessary volume) a local meat-processing factory. The main opportunity is connected with development of infrastructure and power generation. It can make local production cheaper and expand the market. The growth of demand on "northern" products (reindeer meat, local berries) will inspire the development of traditional industries (the same effect may be caused by the growth of arctic tourism). Automatization of agricultural production can reduce the need in labour force and provide people with better wages.

The next phase of the project

The knowledge produced in this first phase will be used in the next phase of the project, where we will conduct case studies to identify conditions for success and consider the potential and barriers, and provide advice on how to increase production, processed products and added value of food from the Arctic region. Here the opportunities and challenges will be further analysed to develop knowledge about how to promote Arctic food products in local, national and international markets.

