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Nordic Salmon:

Value added processing in Nordic aquaculture

– Workshop on secondary processing of farmed fish in the Nordic –

Final report on workshop in Olfus Cluster, Iceland October 19th, 2022

Supported by Nordic Council of Ministers - Working Group for Fisheries (AG-Fisk)



**Nordic
Co-operation**

Sæmundur Elíasson, Matís & University of Akureyri

Unn Laksá, Sjókovin

Audun Iversen, Nofima

Christian Rohde, Baader

Gunnar Þórðarson, Matís

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<i>Authors</i>	Sæmundur Elíasson, Unn Laksá, Audun Iversen, Christian Rohde, Gunnar Þórðarson		
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<i>Executive Summary:</i>	<p>The workshop on value added processing of farmed fish in the Nordic explored options and assessed the feasibility of value added production in the region. It brought together 45 participants from various sectors, including salmon farms, sales and marketing, technical and processing equipment developers, research groups, and transport and freight companies. The project was supported by AG-Fisk and managed by a team of industry experts from Iceland, Norway, the Faroe Islands, and Denmark/Germany. The planning group then compiled a final report using a SWOT analysis to present the workshop's main conclusions. Presentations from the workshop are accessible in the report appendix.</p> <p>The SWOT analysis concluded that the main positive factors for the Nordic salmon industry include favourable farming conditions that can provide steady delivery and the ability to build a strong brand in terms of origin and identity. A major strength identified for secondary processing in the Nordic is the strong demand for high-quality, sustainably-produced salmon. Other strengths included the strict farming regulations to minimize environmental impact and improve animal welfare, as well as the potential for vertical integration to improve transparency and control over the entire production process. Specifically, for Iceland the access to renewable energy is a major strength. Automation and technology access, with the use of water-jet robots to remove pinbones and automatic sorting, grading, and trimming providing opportunities for objective quality control and increased efficiency. Superchilling techniques were also identified as a potential advantage, allowing for longer shelf-life and a firmer product with less gaping. There were also opportunities for increased utilization of side products from salmon processing, as well as the potential for branded, value added products and better market segmentation.</p> <p>The main negative factors included logistic and shelf-life limitations, unfavourable tariffs on trade, and high production costs compared to competitors. Major challenges identified specifically for Iceland are to maintain a steady, year-round supply of salmon and the distance to major retail chains. Logistics and transportation costs were also identified as important barriers for companies operating in Iceland and The Faroe Islands.</p>		
<i>English keywords:</i>	<i>Salmon, Value added production, Secondary processing, Nordic aquaculture, SWOT</i>		

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1. INTRODUCTION

Over 1,7 million tonnes of farmed salmon are produced annually in Norway, the Faroe Islands and Iceland, with Norway being the largest producer. Majority of the production is exported as whole fish, gutted and chilled to various markets around the world. Only a small fraction of the production is produced further in the Nordic region. Secondary processing of salmon could significantly add value to communities in the Nordic region, create jobs in rural areas and support the economy of the Nordic salmon production countries.

The workshop titled “Value added processing in Nordic aquaculture – Workshop on secondary processing of farmed fish in the Nordic” was organised to explore options and the feasibility of value added production of salmon in the Nordic. Participants included representatives from salmon farms, sales and marketing professionals, technical and processing equipment developers, research groups, and transport and freight companies.

The project was supported by AG-Fisk and managed by a team of five individuals with expertise in the relevant topics and connections in the industry; Sæmundur Elíasson (Matís & University of Akureyri, Iceland), Unn Laksá (Sjókovin, Faroe Islands), Audun Iversen (Nofima, Norway), Christian Rohde (Baader, Germany) and Gunnar Þórðarson (Matís, Iceland).

The project workshop was established to bring together a network of industry specialists to assess to what extent secondary production of salmon is a feasible option in the Nordic countries. The meeting, held October 19th at Olfus Cluster in Thorlakshofn (a fisheries community in Southern Iceland), was attended by 45 participants. The final report prepared by the planning group primarily draws upon discussions and the workshop presentations, which are accessible in the appendix.



Figure 1: Participants at the workshop in Thorlakshofn

1.1 Workshop agenda

Figure 2 shows the workshop agenda and speakers.

Nordic salmon

Wednesday 19th of October 2022
Held at the Town Hall in Thorlakshofn



08:30 Opening the workshop: Short introduction to the SWOT analysis

1. Sæmundur Eliásson, Matis

08:45 Address:

1. Elliði Vignisson, mayor of Ölfus municipality.

09:00 – 10:30 Session 1: Competitiveness in secondary processing in the Nordic

1. Halldór Thorkelsson, Marel. „How waterjets increase automation and value generation in the salmon industry“
2. Frank Yri, Seaborn/Iceborn. „Value added production in Norway /Iceland“
3. Per Alfred Holte, Maritech. „Know your fish – How can automated, objective quality control enable new competitive advantages?“

10:30 Coffee

11:00 – 13:00 Session 2: Marketing and logistics for value added products

1. Ögmundur Hrafn Magnússon, Ministry for Foreign Affairs. „Tariffs and trade in value added products from EEA to the EU“.
2. Sigurður Pétursson, Novo Food. „Consumer decision making and carbon footprint“
3. Audun Iversen, Nofima. „How can processing contribute to reduced footprint from the salmon industry?“
4. Jón Havbo Atlason, Hiddenfjord. „Reducing the environmental impact of salmon production“

13:00 – 13:30 Lunch

13:30 – 14:30 Session 3: Side-streams production

1. Matti Isohätälä, Hätälä. „Side product handling and manufacturing processes“
2. Dennis Lohmann, Baader. „Co-product Valorization: Towards Industrial Implementation of Innovative Food Processing Concepts for 100% Utilization“

14:30 Short coffee break

14:45 Discussions and Round up

16:00 Closure

17:00 Refreshments at Lax-inn Mýrargötu 26, 101 Reykjavík.

Sponsored by AG Fisk

Figure 2: The workshop agenda and speakers

2. BACKGROUND

The salmon industries in the Nordic countries have many similarities when it comes to value added production. In Norway, the Faroe Islands and Iceland, the farming sector has been strong and has a substantial potential for growth in the future. One common challenge in terms of competitive advantage in value added production, compared to countries in Eastern Europe, is the significantly higher wage level in the Nordic region. Poland, for example, is a major player in the secondary processing of salmon. Compared to the Nordic countries it has a better connection with the retail market, with large areas of Europe within a 24-hour drive of its factories. To address this challenge, all the Nordic countries have access to automated high-tech processing solutions, as well as a well-trained and knowledgeable workforce. However, what differentiates these three Nordic countries in value added production is their varied logistics to the market, particularly for fresh products. Despite having a favourable geographical location for farming salmon, each country has distinct trade routes.

Norwegians can transport fresh salmon by truck to the European market, even from the North of Norway, and deliver it within two or three days to central and southern Europe. They can also transport fresh salmon by truck to airports in Oslo, Helsinki or Copenhagen within a day and fly it to overseas markets, Asia, America and the Mid-East. Close to 20% of Norway's fresh salmon is air-freighted to overseas markets. While transport by truck only adds 5% to the carbon footprint of a farmed salmon, air freight doubles the carbon footprint per kilo edible salmon. Increasing the share of processed salmon or freezing the salmon and transport it by boat to overseas markets, drastically reduce the footprint¹. Even just sub-chilling the salmon, removing the need for ice in salmon boxes, may reduce the carbon footprint for air-freight of salmon by 17%².

The Faroe Islands only have one small airport with limited regular flight routes and destinations, making it difficult for Faroese companies to fly fresh salmon products to markets. As a result, Faroese companies have adopted different transportation strategies. The largest salmon producer in the Faroe Islands, Bakkafrost, recently established a cargo airline with its own Boeing 757 jet and flies directly to the United States (US) to deliver its fresh salmon to consumers. In contrast, the second largest producer, Hiddenfjord, has chosen not to use air freight at all in order to reduce their carbon emissions. In October 2020, they stopped using air freight and now transport all their salmon via sea cargo, also to the US market, which takes nine days. This change has reduced their carbon footprint from transport by 94%. From the Faroe Islands, there are ferries to Denmark and Scotland, that also ship out fresh salmon. Eimskip sails from Torshavn once a week through Iceland to Halifax in Nova Scotia and Portland in Maine, with a trip time of around eight to nine days including a stop in Reykjavík's main shipping port.

Iceland has a large international airport in Keflavik that flies to approximately 80 cities in Europe and the US. Almost all passenger planes have a cargo space that can be used to export fresh fish. Icelandair Cargo also operates a fleet of cargo planes that can carry up to 55 tons of fish each and fly daily to Europe and the US. There are no direct flights to Asia from Keflavik yet, so salmon must be stacked up in airports in continental Europe before being flown to Asia. There are three major shipping companies that sail from Icelandic ports to Europe and the US. Smyril Line operates four vessels, including a ferry sailing out from East Iceland to Denmark and three Ro-Ro ships sailing from the south of Iceland.

¹ <https://nofima.com/publication/1863000/>

² <https://nofima.com/publication/2068559/>

Samskip operates vessels sailing to ports in Europe and ships fresh fish two days a week. Eimskip sails to Europe and has three vessels sailing from Reykjavík to Halifax and Portland in the US. When the salmon arrives in Portland, it takes around 24 hours for a 1,000-mile transit delivery within the US and Canada. These differences in logistics create very different competitive positions for these countries when it comes to marketing value added salmon products.

Growing interest in fisheries and aquaculture production has led to improved market access for marine products in key markets within the EU. Last year, Iceland exported salmon products to the EU for over 150 million euros, and this export is rapidly increasing, from four million euros in 2015. In 2021, the total export of aquaculture products from Iceland was almost 40 thousand tonnes, mostly salmon. Currently, the terms of trade for fisheries products from Iceland and Norway to the EU are governed by a patchwork of different legal arrangements and Tariff Rate Quota (TRQ) systems. For Norway, higher tariffs on processed products makes processed products less competitive. For Iceland, this can be a complicated and cumbersome process, but negotiation for simpler approaches are currently underway and expected to conclude in 2024. The TRQ system for Iceland when exporting seafood consists of seven permanent quotas, four temporary quotas and GATT/autonomous quotas. The temporary quotas are low volume and provide very limited benefits to fisheries and aquaculture. Fresh and frozen whole salmon and fillets have a 2% tariff, while salted salmon has a 15% tariff and smoked salmon has a 13% tariff. Fresh or chilled fish fins, heads, tails, maws and other edible fish offal have 10% duty. The Faroe Islands have no tariffs on salmon for the EU inner market, except for smoked and salted at 11% and heads, tails, and maws at 13%. Unlike the EEU contract on agricultural products, the one on fisheries and aquaculture does not include regular updates. This means that some market competitors have better access to the EU market than EES members.

Figure 3 shows the development in salmon exports from Iceland in the last decade, with volumes coming largely from open sea-cage farming. There are plans to expand the aquaculture sector in Iceland, both for sea-cage farming and land-based farming. In 2019, over 95% of exports were whole gutted salmon and about 5% as salmon fillets³. The proportion of whole gutted salmon has increased since then, so currently, the quantity of processed salmon exported from Iceland is minimal.



Figure 3: Salmon export from Iceland 2014-2021 (Source: Statistics Iceland)

³ <https://www.stjornarradid.is/library/02-Rit--skyrslur-og-skrar/Sta%C3%B0a%20og%20horfur%20%C3%ADslenskum%20sj%C3%A1var%C3%BAtvegi%20og%20fiskeldi.pdf>, page 97.

Figure 4 shows the development in salmon exports from the Faroe Islands, from 1993 to 2021.

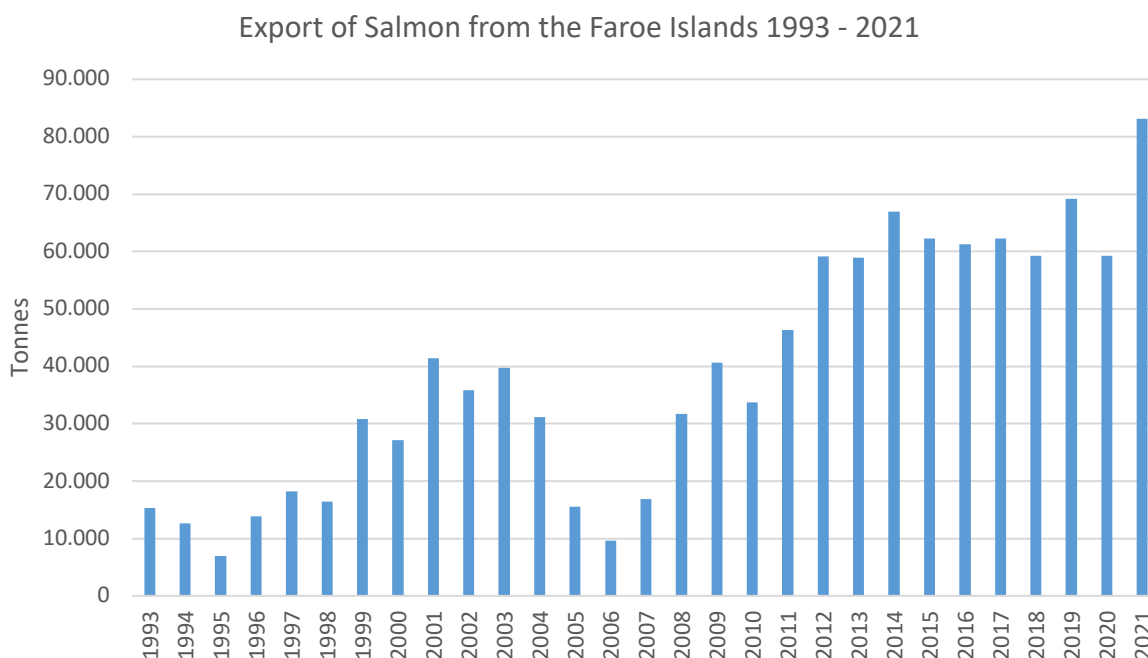


Figure 4: Salmon export from Faroe Islands 1993 – 2021 (Source: Statistics Faroe Islands)

Figure 5 shows the development in salmon exports from Norway, from 1981 to 2022. The total production of salmon in Norway was around 1,6 million tonnes in 2022. Close to 95 % of the Norwegian production is exported. Most of the production is still exported as HOG (Head-on, gutted), but the share of processed salmon has been slowly increasing, and reached 24 % in 2021. In absolute terms, the input of salmon for processing in Norway reached almost 400.000 tonnes, making salmon the most important species for processing in Norway. Most of the processed salmon is exported as whole fillets, though, with VAP-products constituting a smaller part.

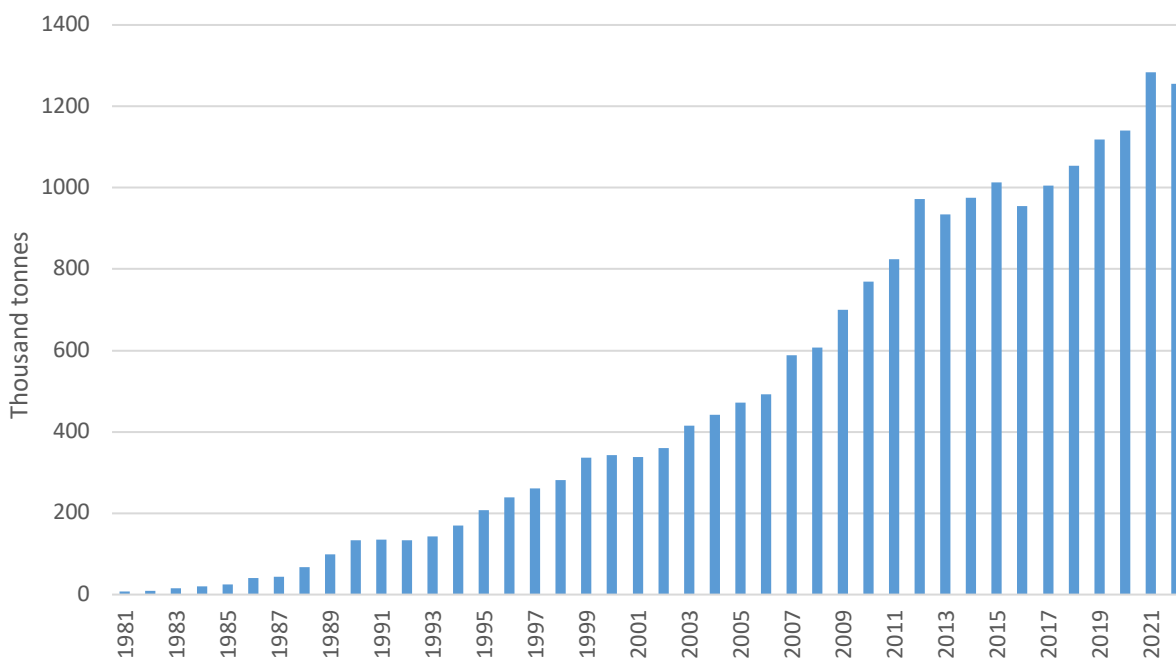


Figure 5: Salmon export (product weight) from Norway 1981 – 2022 (Source: Statistics Norway)

3. SWOT ANALYSIS

During the workshop, participants contributed to a SWOT analysis to explore the options and feasibility of value added processing in the Nordic. Key questions for the participants were:

- “Is large-scale value added processing of salmon feasible in the Nordic countries?”
- “Is competitiveness for further processing achievable through the use of high-tech machinery in the processing?”

The workshop presentations and individual SWOT analysis from presenters are accessible in the report appendix. The planning group then compiled the main results of the workshop into this report on the feasibility of secondary production in the Nordic, using a SWOT analysis and providing recommendations to achieve the main objective. A SWOT analysis is a method to evaluate the competitive position and develop strategic planning. This is done by assessing internal and external factors as well as current and future potential. The main components of the SWOT analysis are:

- **Strengths:** characteristics of the business or project that give it an advantage over others
- **Weaknesses:** characteristics that place the project at a disadvantage relative to others
- **Opportunities:** external chances to improve performance in the project environment
- **Threats:** external elements in the environment that could cause problems for the project

The SWOT table in Figure 6 provides an overview of the main points discussed during the workshop, followed by more detailed discussions of each point (an expanded version of the SWOT table is presented in Figure 12).

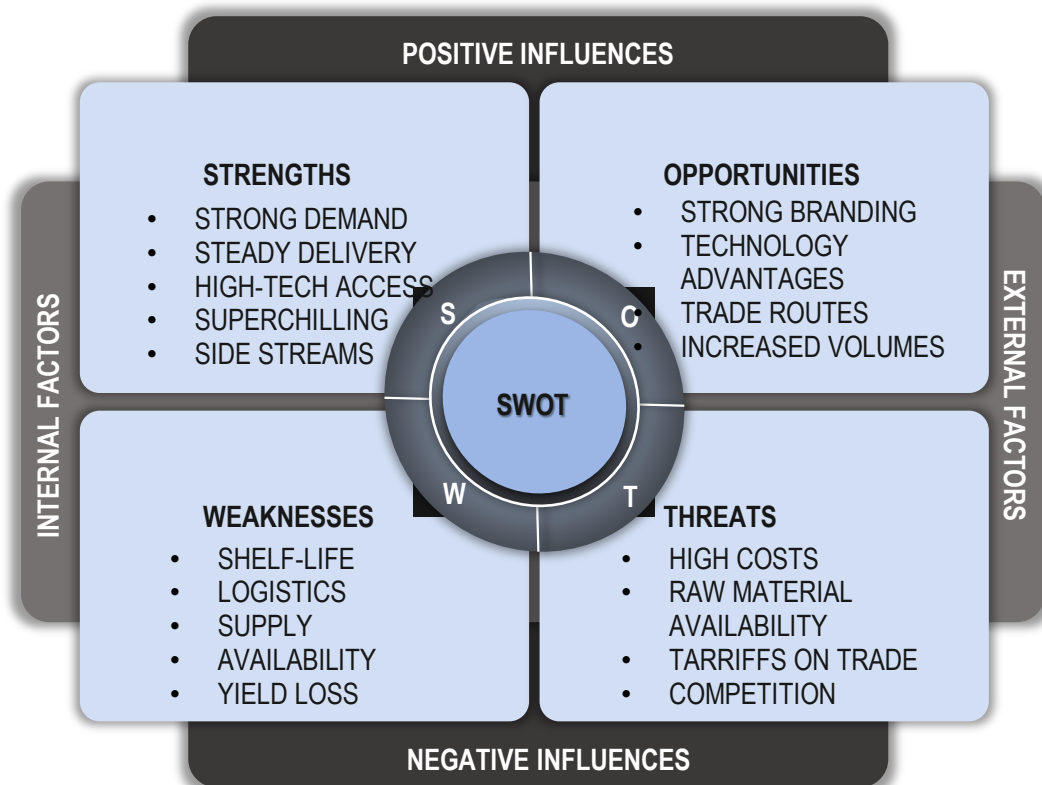


Figure 6: SWOT table, main points from the workshop

3.1 Strengths (Internal factors)

The main strengths of value added processing in the Nordics were identified as:

3.1.1. *Strong demand and steady delivery*

Major strengths of value added processing include a **strong demand** for Nordic salmon backed by **origin, identity, low carbon footprint**, and a **healthy product** reputation. Norway and the Faroe Island provide a **steady delivery**, this applies less to Iceland currently, although its production is expected to increase rapidly in coming years.

To be successful, companies must be regular, **year-round suppliers** with a certain volume to offer, be considered reliable and trustworthy with a proven track record, and in some cases, may need to join forces with other companies in farming, harvesting, and sales to build a joint venture brand with shared certifications and harvesting rules. Vertically integrated companies, which have control over the entire value chain, have a greater ability to monitor the process from farming to sale and have better information about the entire process. In many cases, the product passes through many hands and quality control is not very transparent, so being vertically integrated can provide an advantage in terms of processing and handling information.

Examples of successful brands include IceFjord, a premium Icelandic salmon brand owned by Arnarlax that has already gained success in California and is produced using Sub-Chill technology. Also Seaborn's "Premium Salmon," which is sold under the brand Iceborn in Europe as natural salmon from the Icelandic fjords and is promoted as value added salmon, **supplied 52 weeks a year** to gain loyalty and stable prices. Challenges for these brands include maintaining a steady supply, production issues, weather-related cancellations, and logistical challenges with limitations.

3.1.2. *High-Tech production and processing availability*

Producing fresh fillets or portions for export can reduce logistics costs and carbon footprint compared to exporting whole gutted salmon. **Water-jet robots** are already capable of removing the pinbones from salmon fillets similar to the whitefish industry. By cutting salmon fillets into portion sizes prior to rigor mortis, a longer shelf life can be achieved. Processing after rigor mortis, the pinbones can be pulled out before either trim or portion fillets can be produced according to customer preference, resulting in high-value products but with a shorter shelf life. There have been attempts to remove pinbones pre-rigor but pulling out the pinbones pre-rigor was unsuccessful due to the strong bond between the bones and muscle.

Marel has recently been marketing the technological advancements in the processing of salmon products, highlighting the possibilities for full processing companies to offer their customers by investing in a water cutting machine and sorting products after water cutting, such as fresher products reaching the market earlier. Investing in a water-cutting machine can also offer greater flexibility in product selection and the opportunity to increase the value of fillets by portioning into different categories and maximizing the value of the most valuable parts of the fillet.

Bremnes Seashore AS was one of the first companies to use an automatic water-jet cutting machine to remove bones from fillets in the further processing of salmon, improving the quality of their products and maximizing the utilization of the fillets while reducing labour costs.

Automated production can enable objective quality control, providing competitive advantages through automatic sorting, grading, and trimming. Automated quality control solutions like the Maritech Eye can detect defects, colour, fat content, parasites and sort the products accordingly. Using big data can prevent claims reduction by monitoring the slaughtering process and handling, leading to market and client segmentation opportunities and ensuring better quality products in the long run. "This gives the ability to pre-select fillets based on specifications to reduce manual intervention, such as removing blemishes once the fillets have been sliced. Additionally, sorting by quality and providing objective information allows for the efficient and effective allocation of raw material and products." ⁴



Figure 7: A typical trimmed fillet cut by a water-jet machine

Flying fresh products over longer distances and filleting and cutting into portion sizes will reduce carbon footprint compared to flying whole gutted salmon. Using freezing techniques to produce high-value products in a frozen state can also allow for lower cost shipping in containers and a significant reduction in carbon footprint.

3.1.3. Superchilling availability

Superchilling keeps salmon fresh and unfrozen in a sub-zero state, providing a longer shelf life and a firmer product with less gaping. Secondary processing of salmon and the use of the **superchilling method** in logistics can **reduce carbon footprint** ⁵. Investment costs for superchilled processing are low, while savings on packaging and transportation costs (in airfreight) will reduce costs significantly, with improved quality as an additional positive effect. It may take time to convince the market that superchilling is not freezing and that the method improves quality, is environmentally friendly, and extends shelf life. Consumer education about the acceptance of superchilled salmon and the distinction from frozen salmon will be important for the success of this method in the future.

⁴ Gary Paterson, Head of Operations, at Mowi UK.

⁵ <https://nofima.com/publication/2068559/>

3.1.4. Side stream utilisation

Side streams from secondary processing provide additional income beyond the main product, the fillets. There has been significant emphasis on research into side products, promising valuable production in the future. Secondary processing close to the site of slaughtering can reduce the carbon footprint of the final product. Rather than shipping (or flying) whole salmon to foreign markets, the prime parts can be shipped while the lesser parts can be frozen and side streams (heads, frames, and cut-offs) can be processed and shipped out as a final product or raw material for valuable processing. This approach can save on transportation costs and reduce the environmental impact of the product.

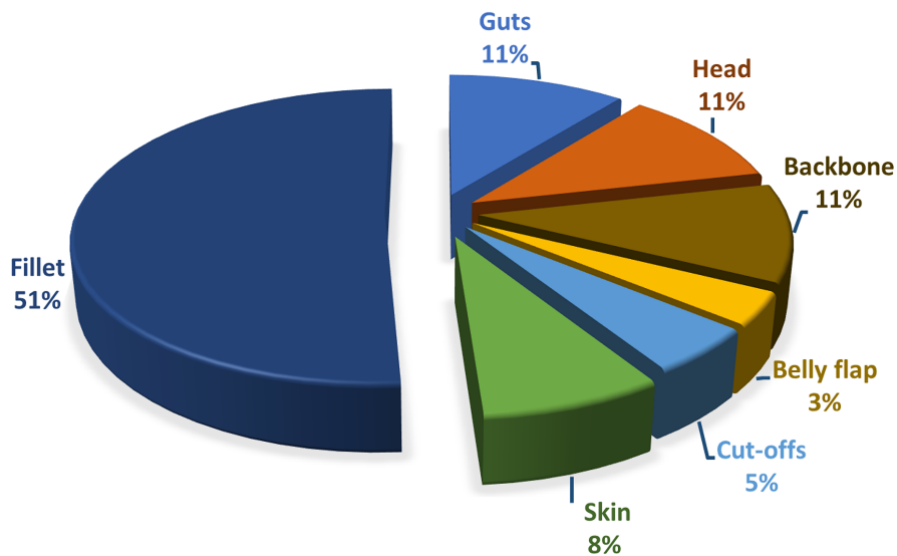


Figure 8: Products from secondary processing at Oddi hf., Iceland

There are significant opportunities for improved utilization of the side products that result from the processing of value added production of salmon. However, producers have generally focused on the most valuable part of the fish, the fillets, and considered other products such as heads, bones, backbones, skins, viscera, and trimmings as less valuable. These side products make up approximately 40-42% of the whole fish, but this can vary depending on factors such as size and trim of the fillets. Despite this, there has been little emphasis on using by-products for human consumption, resulting in low prices for these product categories, especially compared to fillets. However, producers are now seeking to make better use of salmon by-products to create increased value.

3.2 Weaknesses (Internal factors)

The main weaknesses of value added processing in the Nordics were identified as:

3.2.1. Shelf-life and Logistics

Processors in Poland purchase whole gutted salmon from the Nordics, shipping it by container or truck to their processing facilities. From Norway, the logistics time is about one to three days, but about a week from Iceland, by ship to Rotterdam and a truck from there to the production site. By the time the salmon arrives, it has reached the proper maturity for removing the pinbones from fillets, and the product is processed into a variety of retail products. The final market, supermarkets, etc., can be reached within 24 hours of delivery all over Europe. Logistics for retail products will always be a challenge for the Nordic countries due to the **limited shelf-life** of fresh salmon products. It is difficult for Nordic processors to maintain a competitive advantage over rivals with more challenging logistics and higher delivery costs.

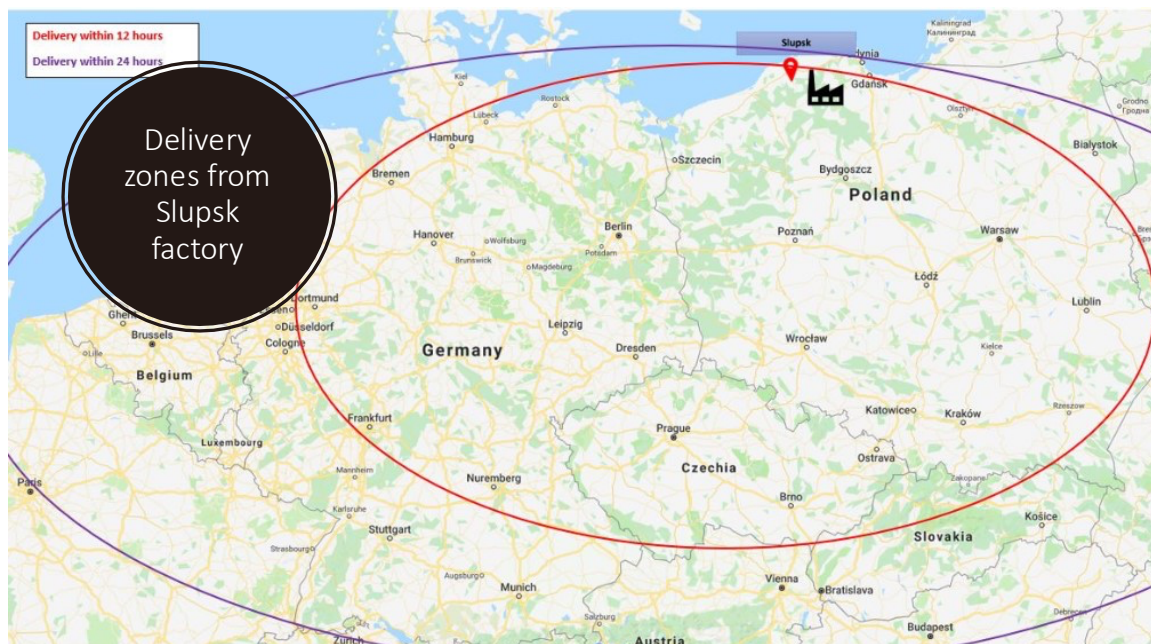


Figure 9: Delivery zones from a factory in Poland

Retail packaging, such as VAP, must include a packing date to accurately inform customers of the shelf-life of the product. For salmon from the Nordic, the difference in transportation times to the final market can give the impression that the shelf-life is shorter, even if the product was slaughtered on the same day. This can be confusing for customers and can be challenging for retailers to manage, especially when the final market is far from the source.

3.2.2. Supply shortage

In Iceland, the **supply of salmon** is currently limited, but production is increasing. To build a strong brand and successfully sell high-quality, branded products in the market, a 52-week supply is necessary. This can be a challenge for individual salmon farmers who may experience interruptions in the slaughtering process. Partnering with other farmers and exporters can help to secure a consistent year-round supply and allow for collaboration in production and sales efforts.

3.2.3. Processing – yield loss and high-tech requirements

In **post-rigor** processing, it is possible to remove the pinbones from salmon fillets with minimal **yield loss**. However, in **pre-rigor** processing, it is not possible to individually remove the pinbones and the only option is to cut out the entire pinbone section, resulting in higher yield loss. The yield loss for pinbone removal (pinbone pulling) of post-rigor fillets is around 1.0-1.5%, while the yield loss for waterjet cutting of pinbones is approximately 3.5%. A bone-free fillet will result in a yield loss of 4.5-5.0%. From a technical perspective, producing larger salmon would be beneficial for improving fillet utilization and portioning. When considering an **investment in high-tech processing**, the scale of operations should be taken into consideration.

3.3 Opportunities (External factors)

The main opportunities of value added processing in the Nordics were identified as:

3.3.1. Branding opportunities

The importance of farmers' attitudes towards environmental and animal welfare matters are issues in building a **strong brand**. Adhering to strict farming regulations set by authorities and even going beyond them with internal standards, using renewable energy, reducing diseases and drug use, minimizing negative environmental impacts such as carbon footprint and genetic contamination of wild salmon and using ships for transport instead of airplanes to reduce CO₂ emissions or employing the superchilling method for chilling, can all contribute to building a brand.

Value added production allows for the potential to obtain a premium price by added additional quality and value to the product. This can be achieved through branding, which is a long-term effort that requires dedication and discipline. Value added production involves making a sellable commodity with added qualities that make it more convenient, attractive, or appealing to the consumer. By marketing the value added product, a clear message is sent to the market that it is worth more than the raw material or similar products from competitors. This can be especially beneficial for small producers and family businesses as a means of differentiating their products and commanding higher prices. There may be asymmetry in information when it comes to the freshness of fish products, as fish farm workers may have more knowledge than the buyer. However, companies that dominate the entire value chain from farming to consumers may have more control and symmetry in information.

In France, one of the largest salmon markets in the world, approximately 90% of salmon sales at supermarkets are pre-packaged rather than sold at the fresh fish counter. Consumers consider a variety of factors when choosing their salmon, including packaging, best-before date, price, presentation, ease of preparation, sustainable certification, health claims, origin, and environmental impact. Organic salmon may command a premium price of 1.0-1.5 Euros, but the production cost is at least 0.5-1.0 Euros higher. Some producers have been able to achieve a 30% premium for their organic salmon products.

One potential strategy for Nordic salmon farmers is defer from local value added processing to establish secondary production in a low-wage area with good access to the end market, such as

Poland. Norwegian farmers are already successfully operating production facilities in that country. Another option for Icelandic and Faroese farmers is to conduct secondary processing in the US, shipping whole gutted salmon to Portland, processing it, and distributing it along the East Coast or flying it to the West Coast. This could provide a steady supply and allow for the development of an Icelandic/Faroese brand. The experience of Icelandic fresh/whitefish producers, who sell portioned cod fillets and deliver them year-round to the retail market, demonstrates the importance of controlling the entire value chain from fishing to delivery. This gives more opportunities for control over raw materials, the creation of high value products, and the development of new packaging solutions.

3.3.2. Application of High-tech for production

The Nordic countries can adopt and benefit from **new technology** in the salmon industry, which can be used to produce **high-value products**. This can include using side-products for the pet food industry, conducting research and development for medical or cosmetic products, and producing value added products for retail and the food service sector (also called Horeca). By controlling the entire value chain, companies can better utilize new technology and innovate their packaging solutions. Pre-rigor production and packing at the source can also improve efficiency and product quality. The ability to benefit from new technology can be a key advantage for the Nordics in the salmon industry.

3.3.3. Logistics

There are opportunities for Icelandic and Faroese salmon farmers to utilize the Eimskip shipping route to the US. The ship travels weekly from Torshavn via Reykjavík to Northern America, with stops in Halifax, Nova Scotia and Portland, Maine. The trip takes nine days from the Faroe Islands and around seven days from Reykjavík. This shipping route could also potentially be extended to Norway, which would add a couple of days to the trip to the US. As volume increases in the future, there may be the opportunity to skip Halifax and shorten the trip by one day. Using this shipping route can significantly lower the cost of servicing the important US market with fresh salmon, whole gutted or pre-rigor fillets, compared to using air cargo. It can also significantly reduce the carbon footprint, as shipping by sea containers generates around 95% less emissions than using airplanes. By using a 700 TEU ship with a speed of 16 mph, the route could be shortened to 5.6 days. Using a 1200 TEU ship with a speed of 18 mph, the trip could be shortened to 5.3 days. With a 2000 TEU ship travelling at 21 mph, the trip could take as little as 4.5 days, but this will depend on the volume of fresh fish and finding freight back to Europe in the future.

3.3.4. More volume

An increase in volume in the next 5-6 years is expected to create economies of scale in both ocean and land-based production. Salmon production in Iceland is expected to grow from 38,000 tonnes in 2021 to 87,000 tonnes in 2025. This increase in volume will create economies of scale for slaughterhouses and more opportunities for value added production, with a steadier supply.

3.3.5. Freezing

Freezing value added salmon products can provide a great opportunity to **stock up products** in the freezer and ship them by container to markets. This can alleviate the challenges of the logistics of fresh products and their short shelf-life. Freezing is an important aspect of value added processing. By freezing the product with minimal change in colour, which can be a major disadvantage for marketing, and preserving other qualities such as texture and enzymatic activity, it is possible to compete with fresh products. Freezing slows the biological, chemical, and physical deterioration of food, and the degradation of food quality such as colour, texture, enzymatic activity, and lipid oxidation.



Figure 10: Comparing fresh and frozen salmon⁶

3.4 Threats (External factors)

The main threats to value added processing in the Nordics were identified as:

3.4.1. High costs and logistics

Labour costs will always be a challenge for Nordic value added production. High-tech production will support secondary production in the Nordics, but competitors will also be able to invest in automation to keep up with their advantage.

Logistics can be a major obstacle for Nordic value added production to compete with Eastern Europe, which has a well-established retail market with efficient distribution channels. This applies both to **logistics costs** and transport time. It takes around 7-8 days to ship salmon from Iceland to Poland and 4 days from Northern Norway. Factories in Poland are large, with modern facilities and moderate

⁶ <https://fisk.com.sg/fresh-vs-frozen-salmon/>

technology, and can produce a wide range of retail products including fresh, frozen, smoked, and marinated products. However, logistics costs are significantly lower and production labour costs are almost five times lower compared to the Nordics. Fresh products from a secondary processor are typically sold within 4-5 days of being stocked at a retailer, with a shelf life of 8 days. Extending the shelf life of fresh salmon through methods such as superchilling is possible, but consumers may not perceive a long shelf life after packing as a positive attribute. Shipping fresh fish from Iceland and the Faroe Islands presents opportunities, but severe weather conditions during the winter on the North Atlantic Ocean can be a threat and may cause delays in the delivery of goods. This can be a major weakness for the fresh fish business, where timeliness is crucial.

3.4.2. Raw material availability

In retail brand marketing, supply is a key factor. Supermarkets require a **52-week supply** on their shelves. Currently, the supply of the salmon industry in Iceland is to some degree insufficient to meet the demand of such a market, both in terms of volume and steady supply, even with partnerships among farmers and marketers. Norway and the Faroe Island are currently far better in terms of steady supply and volumes but have less growth potential.

3.4.3. Tariffs on trade

Iceland and Norway currently pay tariffs on their exports to the EES markets, with rates ranging from 2% for whole gutted salmon to 13% for smoked salmon and 10% for side streams. The Faroe Islands have a better deal with the EU, with no tariffs on fresh whole gutted salmon, smoked salmon, or fillets, but a 13% tariff on side streams. **Heavy taxation** on salmon farming can lead to less local processing.

3.4.4. Competition

Some competitors have a **competitive advantage** due to their better access to the EU market. They may also have an easier time accessing a labour force and shorter distances to reach the markets. Any potential advantages the competitors adjust to, such as technical implementation, increased automation, branding and investments, can become a treat to the feasibility of local value added production in the Nordic region.

4. CONCLUSIONS

With the diverse group at the Thorlakhshofn workshops it was possible to produce a SWOT analysis at the end of the event. While the Nordic salmon industry has many similarities in terms of value-added production, there are significant differences between Norway, Iceland, and the Faroe Islands. One commonality is that they all have high wages and costs, which reduces their competitiveness compared to low-wage countries like Poland. Additionally, the logistics of getting the final product to retail shelves can be challenging. However, it was noted that the lack of delivery power could be overcome through cooperation among Nordic farmers, producers, and sales companies. The strengths of these producers could be their technological capabilities and use of superchilling to improve quality and shelf-life. Additionally, secondary processing can add value through side stream production. Vertically integrated companies, which control a large part of the value chain, have an advantage in terms of monitoring the process from farming to sale and having better information through the process. In this regard, it is beneficial for companies in the industry to be vertically integrated.

One of the strengths of the salmon value added business is a strong demand, providing an opportunity to build a strong brand for the Nordic product. An important factor for building up a strong branding is the strict regulatory framework and following reasonable legislations can further push the farmers to commit to environmental matters and animal welfare standards. By following strict farming regulations and implementing even stricter internal rules, minimizing negative environmental impacts such as carbon footprint and genetic contamination, and using ships for transport instead of airplanes to reduce CO₂ emissions farmers and producers can enhance their brand.

The main negative factors consist of logistic and shelf-life limitations, unfavourable tariffs on trade, and high production costs compared to competitors. A major challenge identified is the need for a steady, year-round supply of salmon and the difficulties of serving retail chains from a distance. Logistics and transportation costs were also identified as potential barriers, particularly for companies operating Iceland and the Faroes.



Figure 11: Drinks at Lax-Inn after the workshop

<p style="text-align: center;">STRENGTHS</p> <p>STRONG DEMAND: Favourable locations for farming salmon and a strong reputation for origin and identity.</p> <p>STEADY DELIVERY: Strong farming sector, with growth potential, to provide a 52-week delivery.</p> <p>HIGH-TECH ACCESS: Access to high-tech processing solutions and superchilling. Also access to a well trained and knowledgeable workforce.</p> <p>SIDE STREAMS: Side stream utilisation for value added and innovation.</p>	<p style="text-align: center;">OPPORTUNITIES</p> <p>STRONG BRANDING: Product differentiation and increased demand for value added salmon products.</p> <p>TECHNOLOGY ADVANTAGES: Water-jet cutting and opportunities for innovation.</p> <p>TRADE ROUTES: Potential to expand into new markets.</p> <p>INCREASED VOLUMES: Room for more production.</p> <p>FREEZING: Flexibility to stock up on value added products.</p>
<p style="text-align: center;">WEAKNESSES</p> <p>SHELF-LIFE: Limited product shelf-life to reach remote markets.</p> <p>LOGISTICS: Limited access to certain markets due to varied trade routes.</p> <p>SUPPLY: Some regions are not providing volumes for year-round delivery.</p> <p>YIELD LOSS: Potential yield loss from pre-rigor processing.</p>	<p style="text-align: center;">THREATS</p> <p>HIGH COSTS: Competition from countries with lower wages and logistic costs.</p> <p>RAW MATERIAL AVAILABILITY: Insufficient supply threat.</p> <p>TARRIFFS ON TRADE: Heavy taxation can lead to less local processing.</p> <p>COMPETITION: Threat of competitors with better market access, lower costs, increased automation levels.</p>

Figure 12: Summary version of the SWOT table

APPENDIX

All the presentations can be seen at the following link:

<https://matis.is/nordic-salmon-value-adding-process-vinnufundur-um-laxeldi/>

Workshop presentations

Workshop opening	<u>“Short introduction to the SWOT analysis”</u>	Sæmundur Elíasson, Matis
Session 1: Competitiveness in secondary processing in the Nordic	<u>“How waterjets increase automation and value generation”</u>	Halldór Thorkelsson, Marel
Session 1: Competitiveness in secondary processing in the Nordic	<u>“Value added production in Norway /Iceland”</u>	Frank Yri, Seaborn/Iceborn
Session 1: Competitiveness in secondary processing in the Nordic	<u>“Know your fish – How can automated, objective quality control enable new competitive advantages?”</u>	Per Alfred Holte, Maritech
Session 2: Marketing and logistics for value added products	<u>„Tariff and trade on value adding product from EES to EU”</u>	Ögmundur Magnússon, Ministry of foreign affairs
Session 2: Marketing and logistics for value added products	<u>“Consumer decision making and carbon footprint”</u>	Sigurður Pétursson, Novo Food
Session 2: Marketing and logistics for value added products	<u>„Environmental footprint of salmon production in Norway“</u>	Audun Iversen, Nofima
Session 2: Marketing and logistics for value added products	<u>“Reducing the environmental impact of salmon production”</u>	Jón Havbo Atlason, Hiddenfjord
Session 3: Side-streams production	<u>“Side product handling and manufacturing processes”</u>	Matti Isohätälä, Hätälä
Session 3: Side-streams production	<u>„Co-product Valorization: Towards Industrial Implementation of Innovative Food Processing Concepts for 100% Utilization”</u>	Dennis Lohmann, Baader